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Motivation to Study During COVID-19 as a Function of Parent Marital Status

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Abstract: The COVID-19 pandemic brought the learning process into the home and family space, such that parent marital status can affect the student's studies. These circumstances might pose a challenge for students in general and in particular for those coping, in addition to COVID-19, with family difficulties such as their parents' divorce. Hence, it is necessary to examine how family situations affect students' functioning and motivation to study. The current study seeks to address the issue of motivation to study among children of divorced parents versus children of married parents, particularly following the effects of distance learning during COVID-19. This is a pilot study that explores the association between motivation to study in a time of crisis (COVID), which requires a new (digital) study skill, and familial status, family support. In order to relate to this issue, we conducted a study among 148 respondents, school children aged 12-18. Forty-three percent of the respondents were children of divorced parents, while 52.7% were the children of married parents. Through questionnaires, these respondents addressed their parents' marital status and their attitude to distance versus face-to-face learning. The study also addressed the motivation of these teenagers to study and the association between the different learning methods and parent marital status. The research findings indicate that children of divorced parents have lower intrinsic motivation than children of married parents. It was also found that the variable most influencing motivation to study is learning in the face-to-face method, at 17.1%. A decline in motivation in general, and higher extrinsic motivation among children of divorced parents, derive mainly from parent marital status and the complexities stemming from parents' divorce. The unstable psychological state of children of divorced parents, both in general and during COVID-19 in particular, affect the level of motivation to study. The findings of the current study indicate the complexities experienced by students during distance learning, their preferences for a certain study method, whether face-to-face or online, and their motivating factors, whether extrinsic or intrinsic. In addition, the study indicated the significance of family support, with its complexities. The research findings may have considerable consequences for the coping of students from different types of families, in normal times in general and in times of crisis in particular.

Keywords: Covid 19, divorced parents, married parents, motivation, digital study, distance learning, face to face learning, family space, motivation, distance learning, study method, family support

1. Introduction

It is evident from the research literature that parent marital status has a considerable impact on their children. Hence, there are differences between children of divorced parents and children of married parents. It is clear that divorce is a grave crisis for children as this dramatic family event weakens the family system responsible for providing their mental and emotional needs as well as with a sense of support, protection, and security (Levy-Shiff, 2018). Cohen (2016) too claims that divorce is perceived as one of the toughest life events, one that generates crisis and trauma for the parents and their children.

The literature also describes the various effects of e-learning versus face-to-face learning on students. A study that examined the effect of the changing teaching and learning methods on motivation to study following COVID-19, found that students reported less motivation to study than before the pandemic. Moreover, students reported spending less time studying than before and also participated less in lectures and virtual encounters and were less appreciative of online versus face-to-face encounters (Meeter et al., 2020).

COVID-19 brought with it many challenges to the world in general and to the educational system in particular. These include social distancing and the need for proper continuation of school-based learning and development (Ben-Amram and Davidovitch, 2021). In order to meet these needs, educational systems in Israel and elsewhere have shifted to distance learning that includes online lessons and many attempts to facilitate

adequate studies despite the upset circumstances. These changes put the students in an unfamiliar and uncertain state that questions their motivation to study (McCarthy, 2020). The COVID-19 pandemic has brought the learning process into the home and family space, such that the parents' marital status can affect the students' studies. These circumstances might pose a challenge for students in general and in particular for those who experience family hardships such as parent divorce, in addition to COVID-19.

Hence, it is necessary to examine how family situations affect students' functioning and motivation to study. The current study seeks to address the issue of motivation to study among children of divorced parents versus children of married parents, particularly following the effects of distance learning during COVID-19.

2. Literature review

In March 2020 Israel's educational system was closed and all studies moved to the home court for about two years. Studies indicate that closure of educational institutions has complex implications for students and their families (Ben-Amram and Davidovitch, 2021). During COVID-19 the educational system moved to e-learning from home, and the parents' involvement in the study process increased. Students' parents helped provide the mental, administrative-infrastructure, technical, and pedagogic support necessary in order to allow teachers to apply remote learning. This period enhanced the blurred boundaries between the home and the school, the home and teaching, the family and the school, and also enhanced the blurred boundaries between parents and teachers, children and parents (Cho, 2020). The technology demanded a new view of the mutual relations between the school and the family as well as the role of each in the children's development process (Garbe et al., 2020). Parents were compelled to be more involved in their children's learning process.

Studies conducted on online learning spaces even before the pandemic show that parents become students' learning coaches (Waters and Leong, 2014). Teachers reported identifying parents' help as beneficial for virtual students in organizing and managing students' schedule, nurturing relationships and interactions, motivating student involvement, and guiding students when necessary (Borup, 2016).

3. E-Learning during COVID-19

E-Learning, also called digital learning or computer-based learning, is carried out through digital devices intended for assisted learning (Mayer and Clark, 2016). This definition includes three parts that relate to the following aspects: components of the study material, how it is conveyed, and the reasons.

Components of the study material: When dealing with the components of the material presented we shall examine how the contents are conveyed: through spoken or printed words, use of graphics or animation, use of illustrations, diagrams, pictures, or contents conveyed by video.

How the material is conveyed: With regard to how the material is conveyed, we shall relate to the means of conveyance: personal computer, laptop, tablet, smartphone, or virtual reality.

Reason for conveying the material: This issue relates to the purpose of teaching as a change agent of the student's knowledge (Mayer and Clark, 2016). E-learning allows many innovative approaches that support learning, but there is also need for research-based principles in order to enable best utilization of these approaches. In addition, e-learning poses a challenge also for guiding teaching, as it does not cause learning rather learning is generated by the teaching methods within the online medium (Clark, 2011).

Following the outbreak of COVID-19, many different educational institutions were compelled to remain closed temporarily and e-teaching became a necessity. Institutions shifted their pedagogy from face-to-face to online, even when to begin with they had no intention of integrating modern technology (Dhawan, 2020).

Students often experience e-teaching as boring and uninvolved (Dhawan, 2020). Also, two-way interactions, where students respond and are responded to, is important and not always implemented in e-teaching (Dhawan, 2020). The lack of social contact (McCarthy, 2020), as well as technical problems, also constitute main barriers to e-learning (Song et al., 2004; Ben Amram and Davidovitch, 2021). The current circumstances of remote e-learning are unique, unlike any other digital learning situation prior to the virus, as current studies are crisis-based (Pace-Pettit and Barker, 2020). A study that examined e-learning during COVID-19 found that the lack of class socialization caused difficulties with carrying out group tasks in distance learning, as reported

by 42.9% of the students, and about 50.8% of the students thought that full courses could not be efficiently completed via e-learning. Moreover, 78.6% of the students felt that face-to-face connection with the teacher is important for their studies and is absent in the current circumstances of remote learning (Dhawan, 2020). Another study that examined the effect of COVID-19 and of staying at home on motivation to learn found that students reported a decline in motivation compared to before the COVID-19 pandemic. This decline in motivation was associated with a drop in efforts. Students reported that they spent less time studying than in the past and participated less in virtual encounters and lectures. They also expressed less appreciation towards online encounters compared to face-to-face encounters and noted the lack of social interaction as the most significant cause of the decline in motivation (Meeter et al., 2020). The global pace and extent of the current lack of educational stability are huge, and might result in various levels of psychological distress and pain (McCarthy, 2020).

4. Motivation for learning

Motivation is the desire to invest time and effort in a certain activity even when it involves hardships, a high price, or lack of success (Gorev, 2018). Avi Assor, in his article, defines motivation similarly, and adds to this definition that motivation is an internal mental entity whose intensity can be assessed variably. For instance, by verbal reports and conversations or by following behavioral manifestations, such as investing time and efforts in the relevant activity, attendance and punctuality, persistence and effort despite difficulties or failure, responding to challenges and meeting commitments (Assor, 2001). From the learning respect, motivation is a vital component of academic performance and high levels of it are associated with good academic performance (Kusurkar et al., 2013). Students with high motivation to learn tend to invest more efforts in learning, leading to better results (Gottfried, Marcoulidis, Gottfried and Oliver, 2013). This motivation of both teachers and students, is an important component in the academic climate and in setting the personal progress of participants in the educational discourse (Gorev, Weisman and Lauterstein-Fitlik, 2018). Academic motivation can be divided in two: intrinsic motivation and extrinsic motivation. Intrinsic motivation is defined as carrying out an activity for the satisfaction it entails rather than for any other outcome. It relates to the aspiration to meet high standards of excellence, and to one who operates for the purpose of enjoyment or challenge rather than for incentives (Gorev, 2018). This generates interest-based learning, and when learning derives from interest more time and thought is invested in it, knowledge is processed more intensively and remembered over time (Motero, Shternlicht and Goverman, 2011). This state stems from several factors such as: investment due to identifying the inner value of the activity, the activity provides interest, enjoyment, or moral value. Such investment is related to shaping one's personal identity, realizing or forming values and goals, and the need for a challenge, i.e., a sense of ability and control, acquiring skills, and undermining premises. Motivation stemming from these factors is accompanied by positive feelings such as lack of conflict, relative serenity, gratification, expression of a cognitive, motor potential, or a symbolic expression – enjoyment from operating one's thoughts, operating one's muscles, and imagination games (Assor, 2001). Students who rely on autonomous motivation (internal motivation) usually display more flexibility and creativity in how they do things (Gorev, 2018). Moreover, this state also predicts high academic achievements (Veder-Weiss, 2013).

In contrast, extrinsic motivation is associated with activities aimed at reaching a defined result due to an external constraint or requirement. Hence, it leads at times to high academic achievements but involves negative feelings and mental harm (Gorev, 2018). It originates from several factors: the need for belonging and acceptance by society, social evaluation, and social status, efforts made for concern of rejection by familiar others or by oneself, efforts made for fear of punishment or in the hope of material reward, or efforts made as a result of pressure by a figure of authority. Many research findings indicate that motivation stemming from these factors often comes at a high emotional and cognitive price for students. In addition, these motivators are accompanied by negative feelings such as anxiety, anger, shame, guilt, strong internal conflict, and pride (Assor, 2001).

Hence, it is clear that intrinsic motivation is more efficient and effective than extrinsic motivation. When students operate from an internal desire, on one hand they feel satisfaction, mental well-being, and vitality, and on the other less feelings of frustration, anger, or jealousy, and even aggressiveness (Gorev, 2018). Students with high intrinsic motivation have a higher likelihood of participating in activities, being involved, and enjoying the learning process (Ramadhani and Ritonga, 2020).

As mentioned, when the learning method shifts from the classroom to the internet students are often required to enlist higher motivation than in face-to-face learning in order to cope with their studies. This is because the web-based learning environment depends on motivation features such as inquisitiveness and self-regulation. In fact, technology itself is perceived by some people as causing motivation, as it combines qualities recognized as important for nurturing motivation, such as challenge, inquisitiveness, innovation, and fantasy (Ramadhani and Ritonga, 2020). One of the main problems encountered in the online learning environment is related to a decline in students' motivation to learn over time (Karaoglan and Yilmaz, 2019). A significant reason for this is associated with the fact that students often do not know what to do in the online learning process and need external support. This is particularly evident among students who did not develop self-learning skills and need external guidance for e-learning (Karaoglan Yilmaz, Olpak and Yilmaz, 2018). It appears that not all students will do well in the e-learning process and the reasons for this derive from differences in learning, in environmental elements, and in the student's personal characteristics (Ramadhani and Ritonga, 2020). One of the environmental reasons found related to a decline in students' motivation, involvement, and autonomy is their parents' divorce (Nusinovici et al., 2018).

5. Children of divorced parents

The rise in divorce rates is one of the dramatic changes that has occurred in family life in the last fifty years. Parents' divorce has significant consequences not only for the divorcing parents but rather also for their children. These consequences originate from the conditions in which the children develop and are raised and from the family relations with which the children are compelled to deal. Divorce is a grave crisis for children because it weakens the family system that is responsible for providing them with their mental and emotional needs as well as with a sense of support, protection, and security (Levy-Shiff, 2018). Support of this is provided by Dana Cohen (2016), who claims that divorce is perceived as one of the most severe life events and a crisis and traumatic event for the divorcing parents and their children. Moreover, children perceive parents' divorce as one of the two gravest life experiences, second only to the loss of a parent. In addition, the common view in the literature relates to children of divorced parents as victims of life experiences who suffer from social injustice and its grave implications for their development. In addition to the children's feelings, many divorced parents might experience significant and long-term effects of the emotional burden of divorce, which might be manifested as chronic stress (Hald et al., 2020). This pressure might be enhanced among parents who must continue maintaining ties with their former spouses for the sake of the children (Raley and Sweeney, 2020).

Children who experience their parents' divorce might be adversely affected on several dimensions. For instance, in the social domain. Twenty-five percent of children of divorced parents report long-term social problems, versus 10% of children of married parents. Children of divorced parents are relatively less socially accepted and also find it hard to develop an intimate relationship with a partner than children of married parents (Majadla, 2015). The effect of divorce on children can also be seen on the behavioral dimension. As part of the behavioral effects, problems involving inappropriate behavior, aggressiveness, outbursts, and even use of psychoactive substances and delinquency, might emerge (Cohen, 2016). Other behavioral problems found are problems with the police and disciplinary problems at school, such as suspension (Majadla, 2015). Disciplinary problems and suspension from school are associated with another dimension of harm to children following their parents' divorce, which is the academic dimension. Many studies found a negative correlation and effect on studies as a result of parent divorce, both with regard to achievements and with regard to motivation to study (Hald et al., 2020).

Parents' divorce might have a negative impact on academic achievements at school. Lower academic achievements were found among children of divorced parents compared to other children (Majadla, 2015). Similar data were found by Dana Cohen (2016), who claims that, in the cognitive-learning sphere, the child's learning-oriented or environmental attention might be affected by parents' divorce. Sometimes there is even a decline that culminates in dropping out of school. Additional support for this is provided by Rachel Levy-Shiff, who claims that adults with divorced parents have a lower chance of acquiring a higher education, lower academic achievements, and a greater tendency to drop out of school. Levy-Shiff adds that these are associated with lower scores on measures such as occupational prestige and job satisfaction, while financially children of divorced parents have a lower income, less property, and are characterized by financial pressures (Levy-Shiff, 2018).

It appears from the above that students with divorced parents have deficient motivation. A negative association was found between motivation to learn and children of divorced parents, such that it may be hypothesized that lack of motivation is positively correlated with low academic achievements. In addition, the spirit of the times together with COVID-19 and distance learning on the web have generated many challenges for students, including a drop-in motivation to learn (Goldberg, Allen and Smith, 2021). Children of divorced parents seem to be experiencing a double crisis during COVID-19, one that is connected both to their studies and to their family.

During COVID-19, divorced parents naturally have many disagreements concerning supervision of distance learning, where each side places the responsibility on the other, claiming that the other does less for the children (Goldberg, Allen and Smith, 2021). Accordingly, adolescents with low reported levels of parental support, typical of many families with divorced parents, were found to have lower motivation to learn online than face-to-face (Klootwijk et al., 2021). Secondly, when the shaky family support is joined by the many changes that have occurred following COVID-19, children's emotional and psychological strength to deal with the circumstances is limited. It appears that the negative effects of this unusual situation, such as lockdowns, social distancing, and distance learning, are felt less by people with high psychological stamina, while those with low psychological stamina are much more badly affected by the global pandemic (Kocak et al., 2021).

The purpose of the current study is to examine the association between parents' marital status, i.e., divorced or married, and their children's motivation to learn, during distance learning in the COVID-19 era. Family dynamics and the family structure affect every individual in the family unit and negative dynamics have a negative impact on children of divorced parents and their achievements. Hence, a complex family situation such as parents' divorce, together with the COVID-19 period that generated new anxieties and fears, are changes that might also affect academic achievements and motivation to learn among children of divorced parents. It is clear that there is insufficient information in the research literature on the nature of the association between parents' marital status and the impact on motivation among children and that truly understanding this association can help understand how to support students who might sometimes be overlooked.

6. The current research hypotheses are:

H1 – The level of intrinsic motivation for online learning among children of married parents will be higher than among children of divorced parents.

H2 – The level of extrinsic motivation for online learning among children of married parents will be lower than among children of divorced parents.

H3 – Higher motivation to learn face-to-face will be found than to learn online.

7. Method

7.1 Participants

Our participants consisted of 148 junior high and high school students in the 12-18 age range. The sample was divided into children of divorced parents and children of married parents.

7.2 Research tools and research procedure

The questionnaire utilized in the current study included two parts. In the first part the respondents provided sociodemographic details: age, gender, place of residence, place of parents' birth. In addition, the questionnaire included a question distinguishing between children of divorced parents and children of married parents. This distinction between the respondents created a division into two groups of respondents: children of divorced parents and children of married parents.

In the second stage, the respondents completed a questionnaire on motivation for distance learning, which includes questions distinguishing between distance learning and face-to-face learning. Moreover, this questionnaire included questions distinguishing between intrinsic motivation to learn and extrinsic motivation. The questionnaires were administered to the respondents through Google Forms, and sent to them via social networks (WhatsApp, Facebook). The respondents completed the research questionnaires with no time limitations. All their responses were collected by Google Forms and entered in the SPSS program for statistical analysis.

8. Research findings

8.1 Sample characteristics

The research participants consisted of 148 respondents, high school students aged 12-18, during the school year. Table 1 presents the distribution of the continuous demographic variable of age.

Table 1: Distribution of the age variable

Variable	Range	M	SD
Age of respondent	12-18	16.17	1.426

It is evident from this table that the mean age of the respondents is 16.17 and the standard deviation is 1.426. Moreover, the range of the respondents' age is 13-18.

Table 2: Distribution of the parent marital status variable

Variable	Values	N	%
Parent marital status	Divorced parents	70	47.3
	Married parents	78	52.7

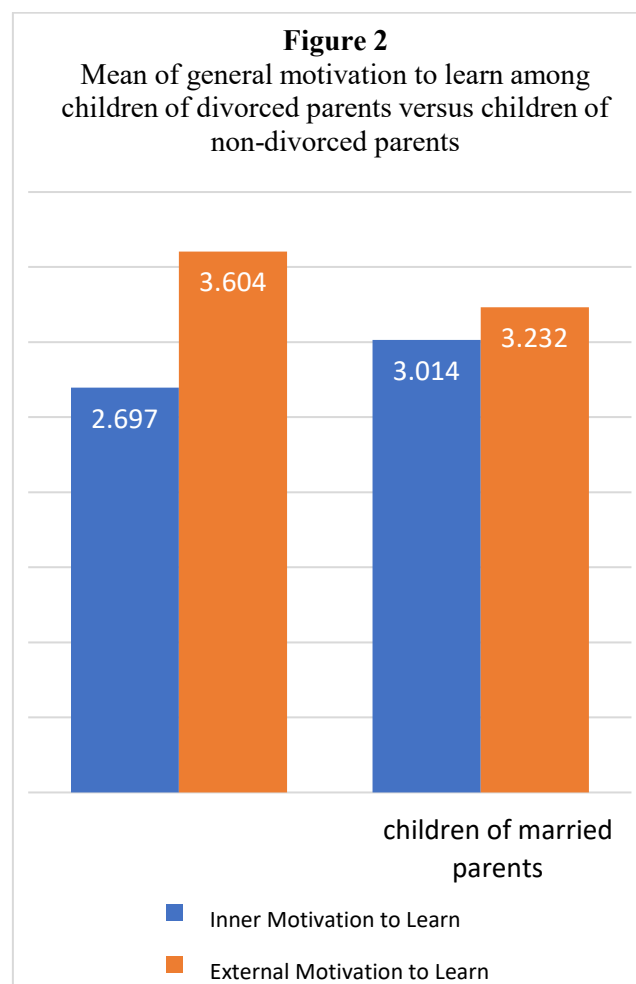
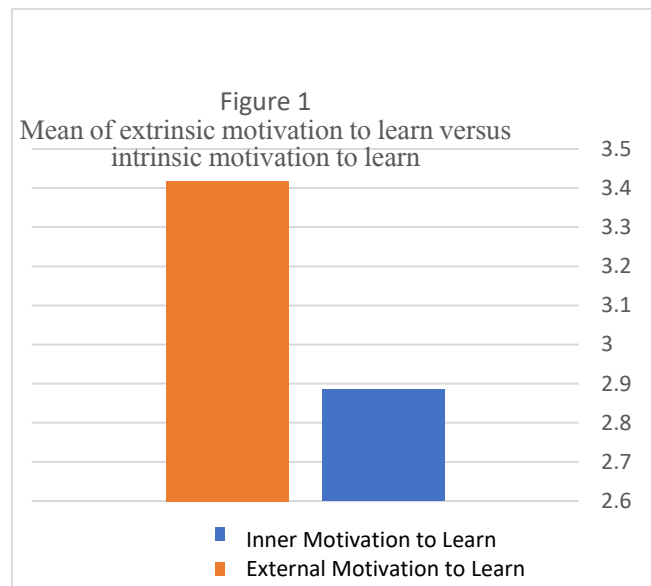
It is evident from this table that the relative prevalence of children of divorced parents (47.3%) in the sample is almost identical to the relative prevalence of children of married parents (52.7%).

Figure 1 shows the differences in the mean of intrinsic motivation to learn among the respondents compared to the mean of their extrinsic motivation to learn.

In order to check for differences in the mean of intrinsic motivation to learn among the respondents compared to the mean of their extrinsic motivation to learn, a t-test for dependent samples was conducted. The mean for extrinsic motivation to learn ($M=3.408$, $SD=0.749$) was found to be significantly greater and at a considerable distance from the mean for intrinsic motivation to learn ($M=2.864$, $SD=0.566$) ($t(147) = 7.603$, $p<0.01$).

Figure 2 shows the differences in the mean of intrinsic motivation to learn among respondents compared to the mean of their extrinsic motivation to learn, among children of divorced versus children of married parents. This figure repeats that found in Figure 1, whereby the mean of extrinsic motivation to learn among the respondents is higher than their intrinsic motivation, as evident among both children of divorced and children of married parents. Moreover, these differences are much more evident among children of divorced parents, such that the differences between extrinsic motivation to learn and intrinsic motivation to learn among children of divorced parents are almost five times higher than among children of married parents.

Further details of these data are available in the forthcoming analysis of the two first research hypotheses.



Children of Divorced
Parents

9. Examination of the hypotheses

Hypothesis 1: The level of intrinsic motivation to learn among children of married parents will be higher than among children of divorced parents.

In order to check for differences in the level of intrinsic motivation to learn among children of divorced parents versus children of married parents, assuming that the level of intrinsic motivation to learn among children of married parents will be higher than the level of intrinsic motivation to learn among children of divorced parents, a t-test for two independent samples was conducted.

Table 3: T-test for independent samples to check for differences in the level of intrinsic motivation among children of divorced parents versus children of married parents

Variable	N	M	SD	T	P
Divorced parents	70	2.697	0.568	3.531	.001
Married parents	78	3.014	0.524		

This analysis found, as hypothesized, that the mean of intrinsic motivation to learn among children of married parents ($M=3.014$, $SD=0.524$) is higher than among children of divorced parents ($M=2.697$, $SD=0.568$) ($t_{(146)}=3.531$, $p<0.01$). This result can be seen in Figure 2 above.

Hypothesis 2: The level of extrinsic motivation to learn among children of married parents will be lower than among children of divorced parents. In order to check for differences in the level of extrinsic motivation to learn among children of divorced parents versus children of married parents, assuming that the level of extrinsic motivation to learn among children of married parents will be lower than among children of divorced parents, a t-test for two independent samples was conducted.

Table 4: T-test for independent samples to check for differences in the level of extrinsic motivation among children of divorced parents versus children of married parents.

Variable	N	M	SD	T	P
Divorced parents	70	3.604	0.692	3.098	.002
Married parents	78	3.232	0.760		

This analysis found, as hypothesized, that the mean of extrinsic motivation to learn among children of married parents ($M=3.232$, $SD=0.760$) is lower than among children of divorced parents ($M=3.604$, $SD=0.692$) ($t_{(146)}=3.098$, $p<0.01$). This result is evident in Figure 2 above.

Hypothesis 3: Higher motivation to learn face-to-face will be found than to learn online.

In order to examine this hypothesis, a stepwise multiple regression analysis was conducted for the independent variables of e-Learning and face-to-face learning, in order to check which of these variables is the most meaningful for forming motivation to learn (the dependent variable). Furthermore, the variable of parent marital status (divorced or married parents) was also entered in this model in order to check its impact on motivation to learn. Table 5 presents this analysis.

Table 5: Stepwise regression for examining the effect of the independent variables on motivation to learn

Steps of the regression model	Variable	β	R	R square	R square change	F
1			0.413	0.171	0.171	30.095
	Face-to-face learning	0.413**				
2			0.473	0.224	0.053	20.092
	Face-to-face learning	0.479**				
	E-Learning	0.239**				
3			0.519	0.270	0.046	17.721
	Face-to-face learning	0.556**				
	E-Learning	0.261**				
	Parent marital status	-0.226**				

* $p<0.05$ ** $p<0.01$

It is evident from this table that the analysis found that the variable with the most contribution to motivation to learn is face-to-face learning. In addition, this variable explained 17.1% of the variable of motivation to learn, such that the more face-to-face the method of learning the greater the motivation to learn. Moreover, it is evident that the explained variance of motivation to learn by e-Learning and parental status is 5.3% and 4.6%, respectively, and that the explained variance by the three independent variables examined is 27%.

In addition, it is evident from the third regression model that face-to-face learning is the variable with the largest unique contribution to predicting motivation to learn of all independent variables explored ($\beta=0.556$, $p<0.01$).

10. Discussion and conclusions

The purpose of the current study was to examine the association between the marital status of divorced and married parents and their children's motivation to learn, in a time of distance learning during COVID-19. For this purpose, we examined two groups: a group of children with divorced parents and a group of children with married parents, who completed self-report questionnaires on their parents' marital status, their views regarding distance learning versus face-to-face learning, their motivation to learn, and a questionnaire on personal information. The hypothesis was that among children of divorced parents' higher extrinsic motivation and lower intrinsic motivation would be found than among children of married parents, and higher motivation to learn would be found among both groups in the face-to-face method. The study is the first to explore the association between motivation to study in a time of crisis (COVID), which requires a new (digital) study skill, and familial status, family support.

New findings in the literature indicate that the COVID-19 pandemic caused people to change their regular life style, as evident mostly outside the home, and instead brought the daily routine into the home, including studies, together with the effect of the negative news in the media and the concern of lockdown and restrictions. The negative effects of an irregular situation such as the COVID-19 pandemic are felt less by people with considerable psychological stamina compared to people with low psychological stamina who are much more negatively affected by the global pandemic than the former (Kocak et al., 2021). The transition to distance learning and the challenges it entails are also concerning, as parents are required to provide their children with support that they themselves lack. This state might adversely affect parent and child burnout (Griffith, 2020). This, of course, in addition to the fact that parent divorce constitutes a grave crisis for the children since it weakens the family system that is supposed to provide the children with their mental and emotional needs and give them a sense of support, protection, and security (Levy-Shiff, 2018).

The first research result indicated that children of married parents have higher intrinsic motivation to learn than children of divorced parents, a fact showing that children of married parents are less inundated by negative feelings and have relatively greater serenity and satisfaction with their life (Assor, 2001). It may be assumed that intrinsic motivation among children reflects their psychological stamina, which allows them to better experience the COVID-19 period with all its changes and pressures from a place of intrinsic motivation, in contrast to children in the other category.

The second research result presents the significant difference in extrinsic motivation to learn, which exists on higher levels among children of divorced parents more than among children of married parents. This research result seems to indicate the motivation sources of children of divorced parents and to illuminate possible difficulties they encounter with learning in general and distance learning in particular. It is well known that extrinsic motivation often stems from fear of punishment or hope for reward, and this type of motivation has severe emotional prices (Assor, 2001). Notably, divorced parents too have challenges that are manifested between the spouses. For instance, during COVID-19 divorced parents were found to have many disagreements concerning supervision of distance learning and each side seems to place the responsibility on the other, arguing that each does less for the children (Goldberg, Allen and Smith, 2021). Moreover, divorced parents with a high level of tension following COVID-19 reported higher levels of parenting difficulties than at any other time, with a higher likelihood of utilizing punishments in response to their children's deficient behavior (Sahithya et al., 2020). In light of the current research findings, it may be assumed that children of divorced parents experience emotional difficulties that make all life areas hard for them. The unstable family unit, which becomes at times a battlefield between the parents, particularly during COVID-19, can also explain why students of divorced parents have more extrinsic than intrinsic motivation to learn. It seems that their

desire to do well at school derives from the goal of placating their parents and showing them that they are functioning well. Alternately, it can also be said that among students with divorced parent's extrinsic motivation stems from fear that the parents will be angry and punish the children for not displaying the proper achievements and adequate behavior on the academic sphere. A previous study found that one of the environmental reasons related to a drop-in motivation for learning, involvement, and the child's autonomy is parents' divorce (Nusinovici et al., 2018). Hence, it may be assumed that the reasons for the decline in motivation in general and for the existence of greater extrinsic motivation among children of divorced parents stems largely from the parents' marital status and the complexities produced by parents' divorce in general and during COVID-19 in particular.

The third research result shows a preference for face-to-face learning over e-learning in the two research groups – children of divorced parents and children of married parents, and that face-to-face learning is directly associated with a rise in motivation. Among students studying face-to-face, motivation to learn and success were found to be higher than in e-learning. Face-to-face learning was also found to explain some 17.1% of the motivation variable, significantly higher than the contribution of e-learning (only some 5.3%). This result is compatible with the premise that e-learning is a significant reason for the decline in motivation to learn, and this is related to the fact that students often do not know what to do in the process of e-learning and need external support. This is particularly conspicuous among students who did not develop self-learning skills and need external guidance for e-learning (Karaoglan Yilmaz, Olpak and Yilmaz, 2018). In the absence of external support and of the development of independent learning methods, many students may feel a lack of success and antagonism towards studying. In addition, a recent study found that adolescents who reported low levels of parental support were found to have lower motivation for e-learning than for face-to-face learning. The academic motivation was positively associated with high levels of intrinsic motivation to learn (Klootwijk et al., 2021).

The findings of the current study seem to be compatible with the findings in the research literature and to add to the association between motivation to learn during COVID-19 and parents' marital status. Also evident is the contribution of the current study, which adds to the research literature and allows an additional angle regarding the association between parents' marital status and their children's extrinsic and intrinsic motivation during COVID-19 and the transition to distance learning. Moreover, the current study seems to illuminate for us the complexity experienced by students during the period of distance learning and their preferences with regard to the learning method – face-to-face or online, as well as the factors that motivate them – extrinsic or intrinsic.

Notably, during COVID-19 many children are affected by pressure, anxiety, and family complexities. This is a new family state, in which all members of the family are at home or, alternately, children of divorced parents sometimes remain alone or with no support. These factors might or can affect the research results in a way that will affect honest and true responses to the self-report questionnaires on occurrences at home between the parents.

The association between motivation to learn and family status during COVID-19 has not yet been investigated significantly, such that our study is a pioneer study that invites additional research that might illuminate family sources of support and their impact on children's motivation when studying from a distance at different ages. These findings raise the need for an intensive discussion by leaders of the educational system on the topic of the added value of the school as an academic-social expanse. In addition, the research findings raise questions concerning the new role of parents within the online school-based learning system and processes.

The research findings indicate a possible direction for students' distress when the home is unstable and therefore there is need for special attention by the various types of educational professionals: teachers, principals. The research findings constitute a foundation for further research on studying in times of crisis, learning in a new era that does not distinguish between the study and home space.

In times of crisis such as COVID, even if parents who are not divorced are not supportive, the children may perceive the home as stable. In a situation when the parents are divorced, we have a crisis situation both within and outside the home: a health situation, a learning situation, a social situation. COVID brought children of divorced parents in Israel back home, to the crisis situation, to the same place.

The research findings aim a beacon at the fact that in the post-COVID era there is a trend of working at home – with all the family situations it encompasses, and in this respect the study constitutes a foundation for further research.

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Digital Skills and Online Collaborative Learning: The Study Report

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Abstract: This paper discusses digital skills and their role in collaborative distance learning. Collaboration is considered to be one of the most effective, yet challenging, methods of teaching and learning. Many learners avoid collaborative tasks, for different reasons. We believe that the level of digital skills may be a key to understanding their attitude. A study was conducted at Nicolaus Copernicus University in Toruń, Poland. The respondents assessed, amongst other items, the level of their own digital skills. Based on this assessment, three groups of students with different skill levels were distinguished. Further analyses showed that students with different level of digital skills vary according to their own experiences in collaborative online learning, but not in terms of views on the phenomenon, technologies used, or computer hardware. Most differences are between the low and high skill groups. However, they are also present between the low and average, and the average and high skill groups. These results contribute to the discussion on the need to individualise the teaching and learning process and highlight the roles of digital competence development for all participants in the learning process.

Keywords: digital skills, metacognitive strategies, collaborative learning, e-learning

1. Introduction

Collaboration is considered to be the highest level of group work, in which participants work together to solve a problem. Collaboration processes are increasingly supported by Information and Communication Technology (Wang, 2010). The use of digital technologies can improve the quality of the learning experiences if they are used as a participatory, communicative tool to support collaboration and co-construction of knowledge (Lai, 2011; Sangeetha and Saileela, 2021). Therefore, collaborative online learning is not an exchange of information or cooperation (in which tasks are divided between participants), but involves working together, such as to solve a problem. This not only requires an intensive exchange of thoughts or discussions, but is also more cognitively demanding, and permits the creation of deeper social bonds (Blau, Shamir-Inbal and Avdiel, 2020). Collaboration reveals students' capabilities of self-education and self-improvement, and also allows them to create a positive climate of openness and mutual support as a result of establishing relationships between team members. Based on studies, the Broadband Commission for Sustainable Development's (2017, p. 108) Working Group on Education confirms that currently students demonstrate significantly higher levels of digital collaboration, and their digital skills seem to facilitate such collaboration. Digital collaboration also includes socio-emotional learning dimensions, such as self-management, social awareness and self-efficacy. In addition, collaborative learning fosters a sense of responsibility for the success of actions taken through a better understanding of constructive feedback (Raffone and Monti, 2019) and improved collaboration, relationship and communication skills in student groups (Estriegana, et al., 2021). It is worth emphasising that in this type of learning, particular attention should be paid to the element of participants' interaction, because it is the foundation for building a sense of participation in the group, and it mobilises and strengthens relationships. Aragon (2003) emphasises the importance of providing reassurance to learners so that they feel comfortable working in a group. Hara, Bonk and Angeli (2000), on the other hand, believe that collaborative learning enables greater interaction and dialogue between learners, which fosters a sense of belonging to a group, team or community, reduces student isolation, failure and dropout rates, and increases enthusiasm or motivation. Numerous studies (Davis 1997; Borden and Perkins 1999; Ge, Yamashiro and Lee 2000) have shown that those students who understand their role in a collaborative learning situation learn better. They feel satisfied about having participated in the interaction experience and achieving learning outcomes. The research also confirms the many benefits of collaborative learning, such as cognition through experience (Bauerle and Park, 2012), enhancement of creativity (Ayob, et al., 2012), and improvement of learning skills (Blanco, et al., 2017), including self-study (Wang, Chen and Gao, 2020). Collaborative learning offers a space where learners can share their knowledge, structure their thinking as part of the sharing process and learn from others (Blanco, et al., 2017).

Due to a number of changes, including technological changes and their pace, collaboration is a subject of wider social interest, and in many countries it constitutes the basis for guidelines for solutions in the sphere of, e.g. education (Bellal and Nader, 2014; Brooks, Dau and Selander, 2021). Ragoonaden and Bordeleau (2000, pp. 361-

372) state that collaborative assignments should be an integral part of an online course and be offered at regular intervals. Learners should be encouraged to participate in collaborative work by assigning them collaborative assignments that allow for effective interactions. An appropriate group composition is important, taking into account personal, professional, cultural and academic predispositions. It is hard to disagree with this. However, one of the challenges of online work is to encourage both students and teachers to use collaborative tasks. It is worth emphasising once again that collaboration has undoubted advantages, such as joint construction of knowledge, development of pro-social attitudes and interpersonal skills or a sense of shared responsibility, as well as negotiation and problem solving, or even understanding others and taking different views into account (Pallof and Pratt, 2005), and it is recognised that such an approach ensures better learning outcomes (Hämäläinen, 2012). Nevertheless, online learners – similarly to offline learners – often avoid collaboration-requiring tasks, such as editing other people's works (Blau, Shamir-Inbal and Avdiel, 2020). It also happens that they take part in a group discussion, but their input is insignificant and often conservative (Hämäläinen, 2012; Lee, Wing and Yang, 2020). It seems that one of the reasons may be the fear that their digital skills are inadequate, and that they themselves will not cope and will be criticised.

Complex digital skills, including metacognitive skills, include aspects such as: 1) planning skills, which are based on setting learning goals, collecting the necessary materials before starting learning, determining the time needed to prepare and own knowledge, 2) monitoring skills - thanks to which the attention is directed during the learning process, asking questions about understanding the content, controlling the pace of learning and solving tasks, etc., and 3) the ability to regulate learning, i.e. changing existing learning strategies (Arends, 1994, p. 208-210). The problem of digital skills and their importance in the modern world, and of teacher or adult education in this regard, is widely discussed in the literature (e.g.: Van Dijk and Deursen 2014; Shopova 2014; Martinez-Cerdá, Torrent-Sellens and González-González, 2018; Blau, Shamir-Inbal and Avdiel, 2020). However, digital skills are rarely examined in the context of collaborative distance learning. There is still a lack of integral and objective analyses in relation to higher education. Many analyses focus only on how to design activities and what tools to use to increase engagement and improve learning outcomes, rather than on learners' characteristics (Hadwin and Winne, 2001; Azevedo and Cromley, 2004; Brooks, Dau and Selander, 2021). Moreover, a number of contradictions are noted. The first one concerns problems with the implementation of research results and conclusions into educational activities, arising, inter alia, from the inability to translate the language of science into the language of practice. Other ones are related to the discrepancy between the need to abandon traditional education methods and the level of digital skills of teachers and students or the conditions of using IT in the practice of higher education. Many publications focus on the use of advanced tools, e.g. virtual reality, programming and collaborative games, without considering technological limitations or difficulties faced by participants in the learning process (Laakso, Korhonen and Hakkainen, 2021). Currently, educators more and more often use digital tools to organise remote cooperation of student groups and to develop the latter's digital skills. However, the implementation of remote education in Polish higher education has not proceeded as quickly and efficiently as was expected (which was especially visible during the early weeks of remote work forced by the COVID-19 pandemic), and there were also several doubts expressed regarding students' proficiency in this regard. The modern academic education system, therefore, faces new challenges in developing and improving collaborative learning and digital skills, considering the requirements of education and work. The issues raised are particularly relevant in the context of a growing demand in the labour market for people who can cooperate and have appropriate digital skills, which results in the need to shape and develop a culture of interpersonal relations, cooperation, and use of individual opportunities ensuring educational and, in the future, professional success. This may be important given the need for greater work efficiency, higher income and employability, as well as in everyday life. In addition, digital skills in collaboration are also assumed to be important, for its contribution to people's empowerment, emancipation and self-fulfilment (Punie, 2007).

To sum up, although there are many studies on online collaboration, there is no research that addresses the problem of digital skills (including their subjective assessment by learners) in the context of collaborative online learning. The topicality of the issues undertaken, the emerging contradictions, and the lack of research in this area justify the choice of the research problem. This article tries to fill the abovementioned gap by analysing the literature on the topic and by showing the results of the authors' own research project. The study focuses on 1) presenting a distribution of digital skills among study respondents, 2) showing how level of digital skills is linked with impressions and reactions to collaboration in online learning tasks, 3) offering recommendations on how students and teachers alike can reap the greatest learning benefits of collaborative learning in online environments.

2. Digital skills as the foundation for effective online learning

It can be assumed that digital skills have played a special role in the process of adaptation to the new conditions of solely remote learning and teaching in higher education. The skills are crucial for independent learning, studying, or developing one's own metacognitive competencies. They relate to the critical use of digital technologies for information, communication, collaboration, and problem-solving in all aspects of life (Shopova, 2014). One's digital skills also facilitate the organisation of learning, and ensure better planning, monitoring, control, and assessment of the effects of one's own learning (Blau, Shamir-Inbal and Avdiel, 2020). If learners are more aware of their own learning strategies, they organise their time to learn at their own pace more effectively. Therefore, digital skills are considered to be one of the eight key competencies for lifelong learning (European Commission, 2018; OECD, 2019). In the literature on the subject, digital competencies are differently defined and analysed on the basis of different theoretical frameworks. Three terms concerning this area appear most frequently: digital literacy, competencies, and skills. They are not the same; the differences between them are described in more detail in the literature on the subject (e.g. Duță and Cano, 2020). In the presented research, the definition of digital skills is based on the document below.

The European Digital Agenda report defines digital skills as a fundamental digital competence that manifests itself through "the skilful and critical use of information society technologies for work, leisure, study and communication" (European Commission, 2012). The European Commission's science and knowledge service (The Digital Competence Framework 2.0, 2019) indicates that a person with this competence should demonstrate such skills as:

1. Using information, which is done by locating and searching for digital data, evaluating the accuracy of the source and its content, and organising information.
2. Communication and collaboration through digital technologies, while being aware of cultural and generational diversity; participation in society through public and private digital services.
3. Creating digital content, integrating information and content with existing knowledge while understanding how copyright and licences are to be applied.
4. Security, protection of devices, content, personal data, and privacy in digital environments; but also protection of physical and mental health, and awareness of how digital technologies serve social welfare and social inclusion.
5. Problem solving: identifying needs and problems, and solving conceptual problems and problem situations in digital environments, as well as metacognitive skills related to, for example, finding one's own digital competence gaps.

The above-mentioned skills constitute a set of intellectual tools that may be important for the sense of self-efficacy, and can thus positively influence the involvement of learners in the learning environment, where they will be able to plan, monitor and regulate their activities (Allan, 2016).

Moreover, metacognitive skills are also important as integral components of digital skills. Learners who can use metacognitive strategies are more aware of and have more control over the learning process (Blau, Shamir-Inbal and Avdiel, 2020). Using them increases the ability to self-evaluate their own work, increases the sense of self-efficacy, and thus enables learners to achieve greater success (Blau, Shamir-Inbal and Avdiel, 2020). Moreover, lack of effective use of cognitive and metacognitive strategies translates into lower achievement of learning outcomes (Kramarski and Gutman, 2006). Interestingly, there is some feedback between digital skills and metacognitive strategies. Specifically, digital skills allow learners to choose a learning strategy that is more suited to their individual needs and abilities, which also results in a better application of metacognitive strategies (Arends, 1994).

3. Digital skills and online collaborative learning – the role of the teacher

Digital skills also support learners in regulating the collaborative learning process, and help them cope with the sense of responsibility for the results obtained (Blau, Shamir-Inbal and Avdiel, 2020). It seems that remote collaborative learning creates conditions for the improvement of digital skills, including the ability to manage one's own learning process and time planning, and thus the monitoring and regulation of this learning process. However, in e-learning, students more often choose individual work; this is due to a lack of need for contact with others, concerns about communication or technical problems, and the fact that they work on the basis of methodological instructions included in the course (Parra, 2016). Such action – i.e. working alone, or even in a group when based on guidance – will often be unproductive (Hämäläinen, 2012). Moreover, research results

indicate that the primary predictor of not dropping out of an online course is the time spent on communication activities. The authors Rienties and Toetenel (2016), after analysing 151 modules and the behaviour of over 110,000 students, noticed that communication plays a key role in academic retention. They suggest – provided that the course learning objectives allow it – that the course assignments include tasks that enable activities such as discussions and the exchange of views. This is especially important given that the quality of learners' communication is related to the quality of learning (Hämäläinen, 2012). Research also shows that simply writing a post or another form of participation in a discussion does not always translate into the quality of cooperation or achievement of goals. It can therefore be assumed that effective collaborative learning is not possible without the active participation of the teacher, through their mentoring or coaching (Blau, Shamir-Inbal and Avdiel, 2020). The teacher must also watch over, for example, an exchange of views or a discussion that occurs in the course, and if necessary, monitor it. Research by Hämäläinen (2012) shows that some students, in order to work effectively in a group, need more support (e.g. detailed instructions, monitoring their activity) in carrying out collaborative tasks.

Hence, the role of the teacher is found to be crucial, in terms of streamlining and supporting the students' learning process. It is important to promote a learning culture, search for reliable sources, respect copyrights, and support learners in improving their own learning strategies (Kwiatkowska, 2018). The appropriate adaptation of teaching materials is also particularly important in promoting active learning (Kwiatkowska, 2018), as is their quality. Therefore, the literature on the subject emphasises the importance of orchestrated learning methods, including collaboration scripts (Hämäläinen, 2012).

Even the most fully described and tested teaching methods may turn out to be insufficient if changes are not made in the attitude of teachers. However, as Hämäläinen (2012) aptly points out, the collaboration process is "a challenging task for teachers" (p. 603). This is due to a lack of support (including institutional support, such as related to the nature of the study programme), reluctance of learners themselves to adopt such activities, or the change in the role that participants of collaborative learning are to play. This last challenge is related to the transformation of the role of the teacher, which many find difficult to accept. From being a person who is a source of knowledge, an authority in their field, the teacher now becomes a moderator responsible for managing the collaborative learning process. The form of communication is also changing: from monological it is becoming dialogical, focused on the exchange of thoughts – not only talking, but also listening. This is often in contradiction to the teacher's individual and social experiences (Sajdak-Burska, 2020), which does not facilitate adaptation to new conditions.

Siemens (2005), the creator and promoter of connectivism, claims that when moving in the digital world, the learner draws from the experiences of other people present in this space. They cannot experience everything themselves, and thus should be able to obtain the knowledge, ideas, and actions of others, through integrating, sharing, enriching themselves and finding recognition among others. In his concept, the author combines the twofold nature of remote learning: independent and community learning. He focuses on the discourse between online community participants who express similar interests and share their opinions and experiences. An analogy can be found here with the theory of situational learning as defined by Lave and Wenger (1991). Siemens (2005) emphasises the importance of self-regulation in enabling learners to achieve their own learning and development goals through, inter alia, using collective knowledge and the ability to create new knowledge. The conclusion is that teachers' control must give way to greater learner autonomy. Members of the learning community must develop mutual trust, support each other, pursue common goals, or take responsibility for their commitment to group learning. To this end, it is necessary to develop effective communication or conflict resolution strategies; and this is not easy, when taking into account, for example, the presentation of many points of view or various perspectives. When dealing with the inflow of information, responsibility for the learning process, including group learning, emphasises the role of self-regulation (Blau, Shamir-Inbal and Avdiel, 2020). The role of the teacher is therefore full of paradox: on the one hand, they are required to support, monitor and motivate; and on the other, to respect the autonomy of the learner.

Garrison and Archer (2007) believe that teachers need to understand that online learning has a unique character, which makes it possible to create a critical learner community, regardless of time and place. In other words, they need to provide new and more efficient learning situations that encourage learners to engage in critical discourse and reflective thinking, and teach them how to learn in this environment, both individually and in collaboration. However, even the greatest advantages of collaborative learning, such as well-chosen teaching methods or a supportive teacher, will not always be able to change students' reluctance regarding active and committed

activities. Despite many years of research on the phenomenon of collaboration, many aspects remain unknown, including what factors make some students reluctant to engage in such tasks. It is hard to disagree with the statement of Lee, Wing and Yang (2020), that “one essential requirement of all students is the capacity to collaborate effectively with peers” (p. 1). However, students themselves do not always collaborate effectively in groups, and they perform their tasks, such as placing discussion posts, only to get a pass for them. Their statements often add little to the topic (Sarja et al., 2018) and do not lead to collaboration, even in tasks designed for such activities (Hämäläinen, 2012). Based on their analysis of the literature on the subject, Lee, Wing and Yang (2020) note that one possible explanation for this is “social loafing”. Relying on someone else to do the work on behalf of the group to which one belongs, in turn, causes the frustration and withdrawal of those committed and cooperative learners. Other reasons include socio-cultural barriers and the lack of adequate skills to complete a collaborative task. In our opinion, the latter factor may be of particular importance. The research described below is an attempt to answer the question of whether the subjective assessment of their own digital skills is related to how learners evaluate and work in collaborative online learning.

4. Material and methods

4.1 Objective of the study

The main objective of the research was to identify whether the perception of one’s own level of digital skills is related to students’ experiences and approach to collaborative distance learning. In connection with the assumed goals, the following research questions were formulated in this study:

First, concerning the state of the variables:

1. What is the distribution of the level of students’ self-assessed digital skills?

Second, regarding the relationship between variables:

1. Does the level of students’ self-assessed digital skills relate to their approach to collaborative online learning, and how?
2. Does the level of students’ self-assessed digital skills relate to the type of technology, the type of videoconferencing system, and computer equipment used in collaborative learning, and to what extent?
3. Does the level of students’ self-assessed digital skills relate to their experience (preferences) in collaborative learning, and to what extent?

4.2 Study Design and Data Collection

The research was conducted online through a closed research system. The research group consisted of students of various faculties and specialisations, studying at Nicolaus Copernicus University in Toruń, Poland. The study was conducted in May and June 2020, after students had completed approximately 2–3 months of exclusive distance learning. The respondents received a link and an invitation to participate in the survey via the university’s e-mail system. People entering the start page of the research were informed about the purpose of the research, as well as about the method of data processing. Moreover, the students were informed that the research was anonymous, voluntary, and they could resign from it at any time. In order to take part in the survey, interested persons had to give their consent to participate. The start page was viewed over 500 times, but only 163 responses were complete and were included in further analysis.

The selection of the respondents for the sample was purposeful, and the basic criterion was participation in remote university classes. The study used the diagnostic survey method. For this purpose, a questionnaire was constructed, consisting of four groups of questions:

1. Sociodemographic data: gender, age.
2. Assessment of students’ own digital online learning skills at the time of the study. Students were offered a definition of digital skills (i.e. free and critical use of digital technologies in educational settings). The respondents could indicate the level of their own skills on a five-point Likert scale (1: very low, to 5: very high). This type of scale is most often used in research because its main advantage is simplicity and usability. It can be concluded that in the case of this study, it will meet the optimization condition and will be sufficient.
3. Applications and tools used in online learning. The respondents could choose any number of the proposed technological solutions. They also had the opportunity to add their own answers.

4. Online collaborative learning: students' own experiences and perception of the phenomenon. Participants were presented with 15 statements about collaborative online learning. Students answered on a five-point Likert scale (1: completely disagree, to 5: completely agree).

The verification of the research tool and the research procedure were performed in a pilot study, which ensured the identification of errors, shortcomings and ambiguities. Based on the information obtained, some items in the survey form were redrafted, changed or deleted.

4.3 Results

The analysis of the test results was performed using the PS Imago Pro Academic 6 program (SPSS for Windows, version 26). The first step was to divide the respondents into three groups depending on their own subjective assessment of their digital skills. The respondents chose answers on a Likert scale, where 1 meant very low competence, and 5 indicated very high. The group was divided as follows:

- Group 1 was composed of a total of 30 people, including four who assessed their skills as very low, and 26 who assessed their skills as low.
- Group 2 consisted of 62 people who assessed their skills as average.
- Group 3 comprised 71 people in total, including 60 with high skills and 11 students who assessed their skills as very high.

Main demographic data about the groups are presented in Table 1. The next step was to look for differences in perceptions and experiences related to collaborative learning via the Internet.

Table 1: Basic data about the groups of respondents

		All groups (N=163)		Gr. 1 Low (N=30)		Gr.2 Average (N=62)		Gr.3 High (N=71)	
		N	%	N	%	N	%	N	%
Gender	M	43	26.4	9	30	15	24.2	19	26.8
	F	120	83.6	21	70	47	75.8	52	73.2
Age group	18–20	49	30.2	9	30.0	17	27.4	20	28.2
	21–30	107	65.6	18	60.0	41	66.2	48	67.6
	31–40	4	2.5	3	10.0	2	3.2	2	2.8
	41–50	2	1.2	-	-	2	3.2	-	-
	Over 50	1	0.5	-	-	-	-	1	1.4

The analysis of the data contained in Table 2 shows that the groups do not differ statistically significantly in the tools they use in collaborative online learning. In all groups, the most popular were social networking sites, Internet messaging, and Google applications (this group includes, for example, text or presentation documents). Interestingly, the Moodle workshop (a solution available as part of the university's e-learning support system, enabling the submission of papers and their subsequent assessment by other participants and the teacher) was used by about one-third of students.

Table 2: Distribution of numerical and percentage indicators by the level of digital skills, indicating the type of technology used in collaborative learning

What are you using for collaborative learning?	All groups (N=163)		Gr. 1 Low (N=30)		Gr.2 Average (N=62)		Gr.3 High (N=71)		χ^2	V_c
	N	%	N	%	N	%	N	%		
Google	75	46.0	13	43.3	27	43.5	35	49.3	0.546	0.058
Wiki	22	13.5	4	13.3	8	12.9	10	14.1	0.040	0.016
Moodle workshop	62	38.0	10	33.3	23	37.1	29	40.8	0.542	0.058
Internet messengers	110	67.5	23	76.7	38	61.3	49	69.0	2.312	0.119
Social networks	126	77.3	20	66.7	50	80.6	56	78.9	2.429	0.122

The respondents most often pointed to the use of the Microsoft Teams videoconferencing system in collaborative learning. Subsequently, Discord and Zoom were indicated (Table 3).

Table 3: Distribution of numerical and percentage indicators by the level of digital skills, indicating the type of videoconference system used collaborative learning

What are you using for collaborative learning?	All groups (N=163)		Gr. 1 Low (N=30)		Gr.2 Average (N=62)		Gr.3 High (N=71)	
	N	%	N	%	N	%	N	%
Discord	5	3.1	-	-	2	3.2	3	4.2
Docer	1	0.6	1	3.3	-	-	-	-
Big Blue Button	-	-	1	3.3	-	-	-	-
Skype	1	0.6	-	-	-	-	1	1.4
Slack	1	0.6	-	-	1	1.6	-	-
Teams	9	5.5	1	3.3	3	4.8	5	7.0
Zoom	3	1.8	1	3.3	-	-	2	2.8

The observed differences were not found to be significant with regard to what technologies are used for collaborative learning (Table 4). It is worth noting that the most respondents specified mobile tools.

Table 4: Distribution of numerical and percentage indicators by the level of digital skills, indicating the type of computer equipment used for self-study

	All groups (N=163)		Gr. 1 Low (N=30)		Gr.2 Average (N=62)		Gr.3 High (N=71)		χ^2	V_c
	N	%	N	%	N	%	N	%		
Smartphone	52	31.9	11	36.7	22	35.5	19	26.8	1.544	0.097
PC	27	16.6	3	10.0	13	21.0	11	15.5	1.937	0.107
Laptop	147	90.2	27	90.0	55	88.7	65	91.5	0.303	0.043
Tablet	3	1.8	1	3.3	-	-	2	2.8	1.907	0.108

The next step was to look for differences in respondents' opinions and experiences regarding collaborative learning. The analysis of the data contained in Table 5 shows that there are several differences between the separate groups, related to the learners' own experiences. People who rate their digital skills as high (group 3) are more active and committed, are not afraid to express their own opinion and participate more fully in collaborative online learning tasks, compared to respondents with both low (group 1) and average (group 2) skills. The described differences also exist between respondents with low and average competences. These differences are not only statistically significant, but account for 12.6% to 27.5% of the variance between the groups.

Moreover, people convinced that their skills are high are less afraid of making mistakes and are more willing to contribute to the group's work. They also find that online collaborative tasks take less time than offline tasks. The described differences exist between the low-skilled group (group 1) and the high-skilled group (group 3). On the other hand, the willingness to share, including via social media, is at the same level in individuals from the groups with average and high competences. It is also statistically significantly higher than that of the low-skilled group. It is also worth noting that people belonging to each group value a clear division of the tasks and a clear definition of what each person is to do.

The analysis of the data concerning opinions on collaborative learning (Table 6) shows that the respondents, regardless of their level of digital skills, have similar views. It is worth noting that they agree that activities requiring collaboration – including those related to, for example, peer review of one's own work – are relatively rare.

Table 5: Views on students' own experiences of online collaborative learning in different groups

Statement		All (N=163)	Gr. 1 Low (N=30)	Gr.2 Average (N=62)	Gr.3 High (N=71)	ANOVA	Post-hoc Tukey test		η^2 %
							p	types	
By implementing educational team tasks using the Internet, I am an active and committed person.	M	3.52	2.57	3.32	4.08	F	26.415	0.002	24.8
	SD	1.14	0.94	1.10	0.92	p	0.000	0.000	
I prefer editing and correcting the work (documents) of other people than commenting and sharing tips.	M	2.75	2.67	2.84	2.72	F	0.361	-	0.4
	SD	1.12	0.94	1.06	1.03	p	0.698	-	
I am more willing to communicate with other people (e.g. via online messaging) than exchange documents.	M	3.57	3.63	3.45	3.65	F	0.690	-	0.9
	SD	1.01	1.22	0.97	0.96	p	0.503	-	
I am happy to share my ideas with others during my studies, also using social media.	M	3.55	2.97	3.68	3.68	F	6.759	0.003	7.8
	SD	0.99	1.25	0.92	0.84	p	0.002	0.002	
When I work online with others on a task, I have the courage to express my opinion/view via the Internet.	M	3.82	3.20	3.74	4.15	F	11.524	0.026	12.6
	SD	0.99	1.19	0.94	0.79	p	0.000	0.000	
If it is clear what I have to do and I know what my contribution to the online task is, I am more ready to work with others.	M	4.21	4.07	4.21	4.28	F	0.948	-	1.2
	SD	0.72	0.91	0.63	0.70	p	0.390	-	
I demonstrate a high level of participation in online collaborative learning.	M	3.27	2.50	3.06	3.77	F	30.293	0.005	27.5
	SD	0.93	0.82	0.90	0.68	p	0.0001	0.000	
If I could remain anonymous, I would be more willing and more likely to express my opinion and evaluate other projects.	M	3.15	3.17	3.29	3.03	F	0.908	-	1.1
	SD	1.12	1.21	1.14	1.07	p	0.405	-	
I hesitate to add my own contribution for fear of being criticised or misleading group members (learning community).	M	2.74	3.20	2.76	2.52	F	3.285	0.031	3.9
	SD	1.24	1.16	1.29	1.18	p	0.040	-	
If I were to perform the same tasks by collaborating with others outside the Internet, I would have to spend more time and energy.	M	3.14	2.63	3.16	3.33	F	4.005	0.015	4.8
	SD	1.15	1.13	1.10	1.15	p	0.020	-	

Table 6: Views on online collaborative learning in different groups

Statement		All (N=163)	Gr. 1 Low (N=30)	Gr.2 Average (N=62)	Gr.3 High (N=71)	Anova	Post-hoc Tukey test		η^2 %
							p	types	
Modern remote technologies enable learning experiences based on collaboration between learners.	M	3.61	3.27	3.63	3.75	F	2.715	-	3.3
	SD	0.96	1.1	0.91	0.92	p	0.069	-	
When I analyse all the tasks I do while learning online, the collaborative ones are by far the most time-consuming.	M	3.50	3.30	3.39	3.69	F	2.069	-	2.5
	SD	1.06	1.21	1.05	0.98	p	0.130	-	
A significant part of all online activities are activities that require interaction with others.	M	2.50	2.17	2.71	2.45	F	2.792	-	3.4
	SD	1.07	0.91	1.22	0.95	p	0.064	-	
Tasks for learners in e-learning that involve peer review of their work in a course are definitely a rarity in online education.	M	3.91	4.03	3.85	3.92	F	0.339	-	0.4
	SD	0.97	0.69	1.02	1.04	p	0.713	-	

Statement		All	Gr. 1 Low	Gr.2 Average	Gr.3 High	Anova	Post-hoc Tukey test	$\eta^2\%$
		(N=163)	(N=30)	(N=62)	(N=71)			
The quality of the work results is higher if the work is the result of cooperation.	M	3.14	2.90	3.26	3.14	F 1.233	- -	1.5
	SD	1.03	0.96	1.02	1.05	p 0.294	- -	

4.4 Discussion

Three elements play a significant role in collaborative online learning: well-prepared teaching materials; a supportive, dialogical teacher; and committed students (cf. Kwiatkowska, 2018). It can be assumed that the quality of the effects achieved will depend on the weakest link in this feedback. Many publications and studies are devoted to teaching materials, aiming to find the most effective solution in achieving educational results (cf. Schlosser and Anderson, 1994; Holmberg, 2007; Moore, 2007 Allen and Sites, 2012). Therefore, it is worth focusing on the other two elements of the process, paying attention to the “human face” of collaborative distance learning (DeBrock, Scangoli and Taghaboni-Dutta, 2020).

In summarising the results of the conducted research, it can be noticed that the assessment of students’ own digital skills as low translates into lower activity of learners, their lower involvement (including reluctance to share their own ideas or to use social media), as well as a greater fear of sharing ideas. Several results seem to be surprising. First of all, regardless of the subjective assessment of their own level of digital skills, students do not differ in what type of technology or type of computer equipment they use. Moreover, what is more interesting, the described differences occur only in relation to the participants' own experiences and not their views on collaborative distance learning. The analysis of the latter shows that the tasks requiring collaboration are still rarely used in the courses. Moreover, students believe that they require more time, but are not entirely convinced that their contribution translates into better learning outcomes. The obtained data is an important indicator in the discussion on the importance of highlighting the benefits of collaborative distance learning and building a positive experience in this regard.

The analysed results are in contradiction with the data from the report of the Statistics Poland (2020), according to which as many as 63.9% of Internet users aged 16 to 24 have more than average digital skills, and only 9% - low. As previously emphasised, general digital skills may not translate into effective online learning, especially in collaboration. The obtained results may also indicate some students’ poor preparation for the conscious use of modern technologies as a tool for intellectual work. Even though young people interact in the digital world every day, this does not necessarily cause an increase in their digital skills. As Josefsson and colleagues (2015) note, learners use, for example, social media in three roles: the Student, the Private, and the Professional Role. Researchers (Josefsson et al., 2015; Allan, 2016) suggest that the role of the university is to educate students on how to use available technologies for learning. At the same time, it should be noted that despite the positive changes in access to the Internet and the high adaptability of learners to constantly changing conditions, research and analyses (Carr, 2013; Spitzer, 2013) indicate not only the apparent coordination of many activities, reduced split attention and a lower capability of solving problems in a short time, but also the lack of the ability to critically use new technologies for learning and entertainment. Therefore, it cannot be assumed that students already have digital skills that allow them to study effectively. In the absence of them, they become only passive recipients of information, which translates into their inactivity or commitment. Of course, one could search for other psychological characteristics, including personality traits responsible for this state of affairs; but such actions, although justified from a scientific point of view, would not be possible in practice. An academic teacher would not be able – even with the appropriate knowledge – to analyse the personality profiles of several dozen or several hundred students, and choose the most appropriate way of working with each student.

Is the key to greater learner involvement, then, researching and developing digital skills in the context of collaborative distance learning? Or is this too simplistic? Richards and Pilcher (2020) raise an important problem in their text: namely, whether study skills are not Tinkerbell – a panacea, solution to all students’ problems, and whether the focus on their development actually results in, for example, achieving better learning outcomes. We can ask a similar question: Does it make sense to focus on digital skills, and will focusing on their development translate into better functioning in a collaborative learning environment? The answer to this question is complex. In our research, we took into account the subjective assessment of skills; we did not study their objective indicator, because in our opinion, it is not technical skills (which are part of digital skills and which are easy to

assess), but metacognitive skills (much more difficult to assess, such as the ability to critically analyse), which can prove crucial. Therefore, we do not propose a simple solution in the form of increasing skills, but advise mindfulness and openness of the student, and their adoption of ideas that may help them adapt to a collaborative distance-learning environment. We believe – although we are aware that this view may be controversial (cf. Richards and Pilcher, 2020) – that the development of digital skills may also take place during remote work. We also agree with the views of Lee, Wing and Yang (2020) on the special role of self-efficacy (cf. Pintrich and de Groot, 1990) and teacher support, especially in the early stages of coursework. Appropriate supervision, monitoring and correction of activities, as well as the permission to relate to one's own experiences, are particularly important in building the internal motivation of learners. They can increase their self-efficacy, to achieve higher self-esteem and greater commitment.

It is worth emphasising, however, that the above activities are not possible without the active participation of the second important element of the puzzle: namely, academic teachers, from whom increased effort is required (Garrison and Anderson 2003; Hämäläinen, 2012). It is necessary not only to prepare educators to conduct online classes aimed at improving digital skills and cooperation among students, especially in their first years of study, but also to notice that a well-prepared e-learning course requires a significant amount of work, exceeding the hours devoted to its offline equivalent. The reluctance of academic teachers to become more involved in the online didactic process may be dictated, for example, by the lack of appropriate gratification and, paradoxically, by their own digital skills. In Poland – and, we suppose, in many other countries – the role of an academic teacher is unique: on the one hand, he/she is a teacher; and on the other, a scientist. Recent changes (including legal ones) have shifted attention to the latter role: thus, in many cases, the evaluation of work is based primarily on scientific achievements (e.g. research grants obtained, and publications written). Moreover, in the Polish reality, an academic teacher is often left without support (especially long-term support) regarding didactics, and they themselves have never received formal training in this field. Hence, they often draw from their own experiences or follow the well-trodden path set by more experienced colleagues. Years of work or scientific proficiency are supposed to result in being a good educator; yet this assumption in many cases turns out to be fallacious. Lack of support in the field of teaching (including, for example, presenting research results and translating them into the language of a given discipline) means that teachers often learn attitudes and values that in online collaborative learning do not guarantee the achievement of learning outcomes, or do not support learners (Sajdak-Burska, 2020) – for instance, a lack of dialogue, or too much distance from learners. The motivation for developing the professional practice of researchers in the use of technology is not only the need to raise their technological competence, but also to implement the concept of teaching and learning (Kirkwood and Price, 2013).

Therefore, it seems that the control of the level of digital skills (the subjective ones) may allow the teacher to adjust the working methods to the participants (e.g. through individualisation of support, appropriate division of students into groups, etc.). However, it cannot be assumed that this will solve all the difficulties in collaborative distance learning.

5. Conclusions

Entire generations of young people interact with digital media with ever greater intensity. We know that these experiences have a bearing on the world they perceive, the values they present, or the opinions they express. In the situation of distance learning in higher education, we are dealing with enormous opportunities, but also dangers. To help this generation learn to use technology wisely, it is of vital importance that the teachers themselves first understand the potential and threats of these solutions, and be able to use them for the proper guidance and individual and social development of young people, also in the sphere of education. The COVID-19 pandemic has changed the use of technology in teaching, also in the field of higher education, and it can be expected that the role of online solutions will be even more significant than before. As highlighted earlier, it cannot be assumed that young people have the relevant digital skills essential to educational success just because they are surrounded by or actively using modern technologies.

One more point worth highlighting is that distance learning, including distance collaborative learning, “done right (...) is surprisingly intimate” (DeBrock, Scangoli and Taghaboni-Dutta, 2020). It enters the homes of students and university teachers, it robs them of their privacy, and makes some of them extremely vulnerable. Perhaps it is important to be aware of this. It seems that it is the development of digital skills and metacognitive skills of all participants in the education process that allows for better coping with potential threats, and makes it possible to realise the advantages and limitations of collaborative online learning. It can therefore be assumed that thanks

to better digital skills, students will be more engaged and cooperative, also because their fear of violating privacy will be reduced.

Naturally, the research presented in this article is not without its limitations. Firstly, it was not skills that were researched, but their subjective assessment. It can be assumed that there are variables that may influence the assessment such as, for example, self-confidence, self-esteem, self-efficacy, susceptibility to social approval or other characteristics (e.g., personality). It would be worth considering them in future projects. The use of tools that ensure greater precision or neutrality also seems important.

It is obvious that the presented own research does not cover all the problems related to the use of digital skills in collaborative learning. Interesting topics for further research could include assessment of the didactic effectiveness of collaborative learning, analysis of the relationship between the level of digital skills and the use of IT tools, development of cooperation models constituting the basis for improving the organisation of these activities and their implementation into practice, or last but not least a study of the nature, development of communication and interaction in collaborative learning.

It would also be worth undertaking further research monitoring the level of teaching of digital skills in cooperation in adult courses and academic education, but above all at a school level, where they are initiated and shaped at a fairly early stage of life. It is worth taking care of preparing teachers to educate and develop the discussed skills also among students.

It should be remembered that there are still few reports on research conducted in this area in Poland. Certainly, the conclusions drawn from the presented research should be taken into account and be gradually verified.

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Future Proposals for E-Learning at Conventional Tertiary Institutions as they Move on Past the COVID Experience

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Abstract: As the COVID-19 pandemic was spreading rapidly throughout the world, the most widespread reaction in many countries to curtail the disease was lockdown. As a result, educational institutions had to find an alternative to face-to-face learning. The most obvious solution was e-learning. Conventional tertiary institutions with little virtual learning experience had to deal with an unprecedented challenge. This study delineates practices that can be suggested for conventional institutions of tertiary education that may be planning to acquire more e-learning experience in the post-COVID era so that they may be better prepared to move on beyond traditional classroom teaching. The qualitative research method was utilized to carry out this study. The data collected for the study comprised mainly two sources: the existing literature that tackles the issue of how tertiary institutions around the world shifted to e-learning during the pandemic, and an analysis by the researchers of COVID-related circulars that were issued by the Saudi Ministry of Education and by Prince Sattam bin Abdulaziz University. The review of related literature and the analysis of the circulars enabled the researchers to produce a number of suggestions aimed at improving the e-learning experience of conventional tertiary institutions. The researchers followed five steps in their literature review: (1) pinpointing search terms and then creating a search strategy and implementing it, (2) sorting the studies gathered, excluding duplicates and studies deemed irrelevant, and decreeing standards for deciding what to keep and what to rule out, (3) evaluating the studies in the light of those standards, (4) obtaining data, and (5) analysing data. This study does not recommend that conventional tertiary institutions become 100% online, but it does suggest that those institutions should make some learning content digitally accessible, build community partnerships, encourage self-study skills among students, help students change their learning style from passive to active, and revisit their e-assessment practices. This paper also stresses the importance of giving further support to teaching staff, sheds light on how institution buildings can reopen smoothly as the restrictions ease, discusses what factors influence the outcomes of e-learning, and tackles the issue of student dropouts during the pandemic. This study concludes by outlining the important notion of adopting blended learning and developing e-learning programs on an international scale.

Keywords: COVID, pandemic, e-learning, distance learning, conventional tertiary institutions

1. Introduction

For the past circa three years, education around the globe has witnessed an unprecedented challenge posed by the COVID pandemic. The most widespread reaction to contain the pandemic across the world was lockdown (Cahapay, 2020). Without a doubt, lockdowns resulted in serious disruptions to a large number of governmental and civic institutions (Jan, 2020). That lockdown included, inter alia, educational institutions of various types and levels (Karalis and Raikou, 2020). The closure of educational institutions was meant to be in response to protocols of social distancing and quarantine and so to curtail the spread of the virus (Longhurst, et al., 2020). Thereby, the obvious alternative to conventional classroom face-t-face (FTF) learning was e-learning (Mulenga and Marbán, 2020). In Saudi Arabia, where this study was conducted, a swift shift to e-learning was seen nationwide, in elementary and high schools as well as in tertiary institutions (Altwaijry, et al., 2021). Owing to the abrupt nature of the lockdown and the shift to e-learning, the Saudi Ministry of Education (MOE) opined it would be vitally important to be flexible, and that is why it allowed a lot of leeway to the individual tertiary institutions in implementing whatever measures those institutions deemed tenable and implementable within their existing capacities.

Now it is incumbent upon conventional tertiary institutions to learn lessons from their COVID experience so they may be better equipped and better prepared move on beyond traditional classroom teaching, and one way to do that is to acquire more e-learning experience (Piller, Zhang and Li, 2020). Cahapay (2020, p.269) states that preparation for the post-COVID era is crucial since educational institutions nowadays are starting to reopen, and so measures must be in place to ensure the safety of students and teachers. Ability to deal with the forthcoming stage of reopening is a key factor in overcoming its obstacles and delivering education without impediments or risks.

Although this paper does not suggest that it is mandatory for all educational institutions to go digital if and when another pandemic hits, this paper does suggest that institutions may be better prepared to move on beyond traditional classroom teaching if they improve their e-learning potential. Therefore, this paper can provide insight to conventional institutions that wish to ameliorate their virtual learning experience (VLE). The issue of e-learning during the lockdown is of great significance to policy makers in the education industry for a number of reasons. For one thing, studies on how conventional institutions can handle the current challenges are still inadequate (Diab and Elgahsh, 2020). For this reason, this study aims to shed light on a few vital suggestions that would help conventional tertiary institutions in their endeavour to combat the e-learning challenges. Also, due to the unpredictability of the pandemic, it is essential to conduct extensive research and help educational institutions be on the guard. The ones who will benefit first and foremost from the findings of this study are the teachers, because they are the ones on the educational front line who interact directly with the students and face the challenges of e-learning first hand. In addition, the findings of this study will be of great value to policy makers in education, since they will be in a more informed position to decide which of the current practices are practical and which need to be reformed or changed.

As educational institutions are getting ready to reopen (Di Domenico, et al., 2020), everyone in the educational arena is bracing up for next few moves to be taken by those institutions. This study attempts to suggest a number of recommendations for reorienting conventional institutions to make them better prepared for the post-COVID era. To achieve this goal of the current study, the researchers have reviewed extensively the existing literature that tackles the issue of how tertiary institutions around the world shifted towards e-learning during the pandemic, and they also analysed COVID-related circulars released by the Saudi Ministry of Education (MOE) as well as those issued internally at Prince Sattam bin Abdulaziz University (PSAU). To warrant the validity and reliability of this study, the researchers applied triangulation methods of the two pivotal phases of collecting data and analysing that data. For one thing, this article provides extensive reviews of up-to-date COVID-related literature. Secondly, official COVID-related documents issued by the Saudi MOE and PSAU were analysed to augment the reliability and validity of the present study. Thirdly, two experts were consulted during this process to ensure inter-rater reliability as far as the parameters for inclusion and exclusion are concerned. This piece of research attempted to address the following question:

RQ: What practices should be suggested for the conventional institutions of tertiary education that wish to acquire more e-learning experience in the post-COVID era so that they may be better prepared to move on beyond traditional classroom teaching?

It is worth noting here that some universities in Saudi Arabia, as elsewhere, were already running e-classes through their electronic learning management systems (LMS) (Aldiab, et al., 2019) alongside the traditional classes in the classrooms. For those universities, the shift from partial online to total online was relatively easy and swift (Teräs, et al., 2020). By contrast, conventional tertiary institutions who had never experienced e-learning at all struggled immeasurably during the lockdown (Nugroho, et al., 2020). This piece of research is confined to the latter type of educational institutions because they were the ones that encountered serious impediments in their endeavour to go digital.

2. Literature review

The abrupt shift from campus learning to online learning during COVID has had some adverse effects on teaching at traditional universities, which has forced them to rethink their current traditional teaching (Clark, 2021). This study aims to suggest practices from hindsight for conventional tertiary institutions so that they may be better prepared to move on beyond traditional classroom teaching. Mukan and Lavrysh (2020, p.109) mention that e-learning has however become more relevant now than ever before as an indispensable tool for education. Harizan, Hilmi and Atan (2016, p.21) stated that virtual learning as a type of formal education had been relegated by universities as well as ministries of education. Gabelaia (2019, p.675) posited that virtual

learning came to be acknowledged as a well-perceived mode of education because it presented an assortment of problems to education that educational institutions would have to grapple with. Nenko, Kybalna and Snisarenko (2020, p.5) stated that some of the problems that virtual learning presented were isolation, lack of or restricted interaction, and shortcomings related to technology. Boelens, Wever and Voet (2017, p.4) shed light on the problem of how to afford an active learning environment. Abbasi, et al. (2020) discussed the problem of attention; they posited that in virtual learning, students were much more likely to get distracted than in a traditional classroom. Agnoletto and Queiroz (2020, p.2) touched upon the issue of digital literacy; they said that some teachers as well as students may fall behind as their computer literacy skills may not be adequate for a full-fledged online teaching/learning experience. Kearns (2012) and Oncu and Cakir (2011) lavishly discussed the issue of assessment reliability in the online learning environment; they mentioned that no clear, universally acknowledged criteria were in place to ensure fair and unbiased assessment of online tests.

Interestingly, the experience of e-learning was actually not strictly a shift from traditional to virtual learning (Lee, 2020). Lee (2020, p.3) posits that the response of a good percentage of teachers was in the form of delivering the same material online that they had hitherto taught in the classroom. Lee believes that this superficial change in the delivery of classes was unlikely to bring about any positive outcomes. It can be argued that e-education is a much more complex matter than simply delivering the course material digitally instead of face to face (Agnoletto and Queiroz, 2020, p.1). It can be argued that this shift from offline teaching to online teaching was so abrupt that no clear policy-making procedures were applied (Zhang, et al., 2020, p.1).

These adverse effects of the sudden shift to online learning are not peculiar to Saudi Arabia. They have affected institutions in every country in the world that opted for lockdown. The recommendations and suggestions that will be outlined in this paper will, therefore, not be confined to Saudi institutions; this universality of the effects of the lockdown makes these recommendations and suggestions of a universal appeal.

Prior to the COVID pandemic, e-learning was not popular among Saudi HE institutions. Putri et al (2020) state that prior to COVID e-learning was not part of the learning culture and so the interaction was not really effective when done virtually. Although e-learning is not a novel concept, education remained traditional in Saudi Arabia prior to COVID, and when used it was only a complement to classroom learning (Alarifi, ALjuwayid and Quraishi, 2021). According to Al Meajel and Sharadgah (2018), 80% of universities have made e-learning available to their teaching staff since 2011, but only 20% of them utilized it. Before the pandemic, only the Arab Open University in Saudi Arabia was offering online learning (Alanazy, 2011), whereas today, "the number of schools that offer online programs in addition to their traditional face-to-face offerings is on a steady rise" (Tyler Sr, 2020). With regard to the perceptions of students and faculty members about e-learning, they were divided between those who think it is not effective (Zaki, 2021) and those who perceive it as effective (Aldossary, 2021).

3. Theoretical framework

In the current study, the Activity Theory and Technology Acceptance Model guided the data analysis and data interpretation to propose and predict acceptable e-learning practices for higher education institutions to improve students' engagement in e-learning. According to Hashim and Jones (2007, p. 16), "Activity Theory is an appropriate theory to use in understanding and solving problems involving e-learning." Whereas, Technology Acceptance Model is used to determine the priorities that need to be done by HE institutions to improve learners' acceptance of e-learning mode.

4. Method

This study was carried out in the academic year 2020/2021, during a precarious period when COVID was still looming but thought to be gradually fading away. This article makes use of the qualitative research method in order to put forward a number of suggestions for refurbishing the practices at conventional institutions of higher education for the purpose of making them better prepared and equipped for e-learning as they move on past the COVID experience. The researchers applied the deductive approach in the data analysis; this means that they proposed some provisional themes and concepts and then endeavoured to find proof for those themes and concepts. Prior to starting this research, the researchers elicited an ethics approval from the

PSAU Deanship of Scientific Research. The research underwent two major phases: review of the related literature and analysis of related circulars from the Saudi MOE and PSAU.

4.1 Review of the existing literature

The researchers carried out an extensive review of the most up-to-date literature related to e-learning during the COVID lockdown. For this part of the research to work, the researchers followed five steps: (1) establishing what search terms to use in the search for literature; (2) sorting the literature, keeping the most relevant studies and excluding the duplicates and the irrelevant ones, and along the way creating clear parameters for inclusion and exclusion; (3) evaluating the selected documents with regards to the inclusion/exclusion parameters; (4) gathering data; and (5) data analysis.

Step 1: Establishing what search terms to use in the search for literature

First and foremost, the researchers wanted to adopt a clear, unequivocal search strategy via which they could decide what articles to include in the present study. Three of the most popular databases on the Web were used; those were Google Scholar, Web of Science and Scopus. The advanced search option was used, in which the following filter options were applied: search for studies that contained all the words; contained the exact phrase; contained the search phrases in any part of the article; and no specific period publication dates, due to the scarcity of resources on COVID. Key words of this research were used in the search, such as “tertiary institutions” AND “e-learning” AND “COVID”. In each search, all three key words above were used, in addition to one more phrase in each individual search. Those additional phrases included “e-learning material,” “online self-study,” “community partnership,” “e-assessment,” “teacher support,” “end of lockdown,” “distance learning,” “student dropouts during COVID,” “online versus traditional learning,” and “blended learning integrated into e-learning.”

Step 2: Sorting the literature, keeping the most relevant studies and excluding the duplicates and the irrelevant ones

511 articles were found. Their abstracts were sorted. Only the most relevant articles were kept, and duplicates and irrelevant ones were excluded. To achieve this step, the researchers laid out parameters for inclusion and exclusion (Table 1). 142 articles were included after the abstract screening process, and later when the full texts of all those articles were examined thoroughly, 47 articles were kept. Two experts were consulted during this process to guarantee inter-rater reliability insofar as the parameters for inclusion and exclusion are concerned.

Table 1: Parameters for inclusion/exclusion

Inclusion	Exclusion
1. Must contain “tertiary or higher education,” “covid,” and “e-learning or online/virtual learning;” as main components.	1. Ambivalent articles which were not confined to e-learning.
2. Must be directly related to e-learning.	2. Not related to tertiary education.
3. The language is English.	3. Not in English.
4. Ought to be a paper from a peer-reviewed journal or has been presented at a conference.	4. The material was not an article from a peer-reviewed journal but a book review, a nonprofessional site or a thesis.
	5. When multiple articles tackled exactly the same issue, the researchers were sufficed with one of them.

Step 3: Evaluating the selected papers with regards to the inclusion/exclusion parameters

The researchers read the full texts meticulously of the 142 articles that were initially included. Later, the two experts also read them, and all four researchers and the two assistants met and discussed what to keep and what to exclude. Ultimately, 47 articles were deemed relevant to the present study.

Step 4: Gathering data

At this stage, the researchers scrutinized and categorized the data that they elicited from the articles. They created recommendations of all the topics that were yielded by those articles; then they classified them into 11 methodological groups: e-learning material, community partnerships, autonomous e-study skills, active learning versus passive learning, e-assessment, teacher support, safe and smooth reopening of educational

institutions, making blended learning an integral part of the virtual learning experience, student dropouts, educational programs via distance learning, and outcomes of e-learning.

Step 5: Data analysis

Once all data has been gathered and classified into the eleven categories explained above, both the researchers and the experts delved into the data and compared and contrasted all the topics in the categories. They analysed the data throughout the different topics and produced a concise summary of the available literature. By so doing, the researchers were able to assess the similarities and dissimilarities between the different topics as well as their merits and demerits (Table 2).

4.2 Circulars from PSAU and the Saudi MOE as well as the researchers' virtual teaching experience

For nearly a year and a half, the researchers gathered a substantial number of COVID-related circulars issued by PSAU and the Saudi MOE in the period 1 April 2020 and 30 Aug 2021. Table 3 provides a list of the most important issues tackled in those circulars. The researchers' aim was to pinpoint the chief concerns and procedures of PSAU and the MOE and to use those concerns and procedures to deduce the most tenable suggestions for future practice beyond the pandemic. In addition, to further consolidate and validate their suggestions for reorienting traditional tertiary institutions beyond the pandemic, the researchers took advantage of their own experience teaching online for nearly two years during the lockdown.

5. Results

The chief purpose of the current study is to lay out a few suggestions for remodelling conventional institutions of higher education in such a way as to make them better prepared and equipped for virtual learning as they progress past the COVID era. To make such suggestions possible, two kinds of data were gathered: at the international level, COVID-related literature was collected, sorted and examined; at the local level, circulars from the Saudi MOE and from PSAU were collected and analysed.

In the review of the literature, 511 articles were found at the preliminary search. The majority of those had been published in 2020 and 2021. 142 articles were filtered in after the abstract screening process. Eventually, 47 articles in their full text were kept for use in the present study. Table 2 provides a synopsis of how this selection and screening process went on until the researchers were able to zero in on the most relevant articles for their current paper. Under each search term in the first column, the table also provides a list of the selected articles relevant to that particular term.

As for the official COVID-related circulars from the Saudi MOE and PSAU, 15 such documents were found. Eight of them were closely related to the purpose of this study. Four of those circulars came from the MOE for tertiary institutions nationwide, and four from PSAU as regulations within the university. Table 4 provides a brief overview of the main findings from the selected 47 articles.

Table 2: No. of articles yielded by the preliminary search, shortlisted articles, and articles retained for this study

Search terms	Preliminary search	Shortlisted articles	Selected articles
"Tertiary education" or "higher education" AND "Covid" AND "e-learning" or "online learning" or "virtual learning" AND: E-learning material Adnan and Anwar (2020) ¹ Cahapay (2020) Neuwirth, Jović and Mukherji (2020) Omodan (2020)	38	15	4
Community partnerships Azzahra (2020) Lee (2020)	38	7	6

¹ Full article details are in the References section.

Search terms	Preliminary search	Shortlisted articles	Selected articles
Malkus and Christensen (2020) Munro (2018) Nguyen (2022) Reimers and Schleicher (2020)			
Online self-study Abood and Al-Ani (2016) Zhang et al. (2020)	20	11	2
Active learning / passive learning Bennett and Raymond (2019) Healy and Smyth (2017) Malhotra (2020) Van Klaveren et al. (2020) Yelamarthi and Drake (2014)	71	18	5
E-assessment Aboagye (2020) Khan and Jawaaid (2020) Oncu and Cakir (2011) Palloff and Pratt (2008) Sharadgah & Sa'di (2020) Tereseviciene et al. (2020) Xiong and Suen (2018)	116	16	7
Teacher support Leitner, Ebner and Ebner (2019) Martin et al. (2019) Sangster, Stoner and Flood (2020)	37	11	3
Blended learning integrated into e-learning Kozubai and Shemet (2020) Skulmowski and Rey (2020)	20	13	2
Student dropouts Bariham, Ondigi and Kiio (2020) Islam et al. (2020) Noman, Kaur and Nafees (2021)	12	5	3
Distance learning on a global scale Beaman and Davidson (2020) Gunawardena (2014) Sutton (2020) Verger, Parcerisa, and Fontdevila (2019) Zhao (2020)	104	12	5
Outcomes of e-learning Damoense (2003) Cavus and Ibrahim (2007) Eom (2011) Eom, Wen and Ashill (2006) Holmes (2018) Keramati, Afshari-Mofrad and Kamrani (2011) Saba (2012)	36	20	7
Total	511	142	47

Table 3: Official COVID-related circulars from the Saudi MOE and PSAU

Circular	Issuer	Content
Move from traditional classes to virtual classes	MOE	Schools and universities should switch from FTF to virtual teaching in compliance with physical distancing rules to curtail spread of the virus.
Ways to arrange for e-assessment	MOE	Making use of online assessment for the remaining coursework and exams; this includes uplifting the values of internal assessment from 50% to 80% of the total score
Non-stringent measures because of atypical situation	PSAU	Lenient measures regarding absenteeism and allowing students to remain in class notwithstanding the number of virtual classes missed
Flexibility of e-class timetables	PSAU	Faculty members may agree with their students on whatever timing of classes suits al.
Resumption of virtual learning for the coming semester	MOE	Resumption of online study for the second semester of 2020/2021.
Traditional assessment and FTF classes for classes of a practical nature	PSAU	In the first and second semesters of 2020/2021, students took tests on campus because online assessment had hitherto caused some problems; all classes of a practical nature be held on campus
Plan of action for safe on-campus testing	PSAU	classes that had over 15 students were split up into groups, with each group comprising a maximum number of 15 students; a different classroom was allocated for each group to prevent overcrowding.

Table 4: A brief overview of the main findings/recommendations on the basis of the selected 47 articles

Article(s)	Content / Recommendations
Adnan and Anwar (2020)	Limited access to educational material due to internet connection issues or financial matters
Cahapay (2020)	Make sure no students are left behind by for example providing students with loaner gadgets to access the online material.
Neuwirth et al. (2020)	Nonavailability of proper devices to access online material can impede the VL experience
Omodan (2020)	
Malkus and Christensen (2020)	building a technological infrastructure to provide stable access to the internet
Lee (2020)	
Azzahra (2020)	providing educational material to students free of charge
Nguyen (2022)	running orientation workshops to acquaint teachers and students with the different digital platforms
Reimers and Schleicher (2020)	Traditional universities should partner with universities that have long experience in VL
Munro (2018)	Community partnerships help universities create online material.
Abood and Al-Ani (2016)	importance of catering for self-study skills for a successful e-learning experience
Zhang et al. (2020)	
Bennett and Raymond (2019)	All students should be actively involved in the learning process
Healy and Smyth (2017)	
Malhotra (2020)	Current e-learning practices during COVID are a challenge because they are not encouraging active learning.
Van Klaveren et al. (2020)	Educational institutions should build a culture of active learning.
Yelamarthi and Drake (2014)	Traditional universities with little VL experience are going to encounter great challenges as they strive to go digital.
Aboagye (2020)	
Sa'di, Abdelraziq and Sharadgah (2021)	Inability to meet acceptable e-assessment standards will cast doubt on the validity and reliability of e-learning.
Sharadgah & Sa'di (2020)	
Xiong and Suen (2018)	
Khan and Jawaid (2020)	Different anti-cheating techniques, including anti-cheating software, to prevent cheating in e-tests
Tereseviciene et al. (2020)	
Palloff and Pratt (2008)	
Sangster, Stoner and Flood (2020)	Traditional universities should keep up with VLEs.
Leitner, Ebner and Ebner (2019)	Training workshops for faculty members
Martin et al. (2019)	Different ways to support educators during the e-learning experience

Article(s)	Content / Recommendations
Di Domenico et al. (2020)	Educational institutions reopening fully, provided safety guidelines are observed
Kozubai and Shemet (2020) Skulmowski and Rey (2020)	Benefits of blended learning
Bariham, Ondigi and Kiio (2020) Islam et al. (2020) Noman, Kaur and Nafees (2021) Zhao (2020)	Many college students dropped out of their studies during the COVID lockdown due to a multiplicity of reasons.
Verger, Parcerisa, and Fontdevila (2019) Gunawardena (2014)	The idea of a global educational programme has been around for quite a while.
Beaman and Davidson (2020) Sutton (2020) Cavus and Ibrahim (2007) Eom (2011) Damoense (2003) Eom, Wen and Ashill (2006)	The idea of an international distance-learning programme may be tenable especially during the COVID lockdown. Assessment in class and in VL is almost the same, with only subtle differences.
Holmes (2018) Keramati, Afshari-Mofrad and Kamrani (2011) Saba (2012)	There are some factors that play a role in e-learning but that do not exist in traditional education.

6. Discussion

The researchers based this study on two sources of data: the global literature on the topic of COVID in relation to teaching and learning and the circulars from the Saudi MOE and PSAU during the lockdown due to the pandemic. The ultimate purpose was to lay out a few tenable suggestions for traditional tertiary institutions that would make them better prepared for virtual learning whenever the need for it arises in the future as those institutions move past the COVID era. The current study puts forward the following suggestions for a smooth, unimpeded shift from offline to online teaching in the future after COVID.

6.1 Make sure that educational material is accessible

Based on findings from the documents, it is incontestably true that one of the most pressing hurdles that detracted from the virtual learning experience was that not all students could access the learning material online. This limited access is due to limitations in internet connection and financial matters (Adnan and Anwar, 2020, p.49), as well as nonavailability of the proper devices that could keep up with the online demands (Omodan, 2020, p.11). Cahapay (2020, p.269) points out that it is vitally important for e-learning to be a success to make sure that no students are left behind. In this regard, a particular case impressed the researchers: a number of colleges at New York State University launched an initiative that aimed to make sure all students were given equal opportunities during the e-learning experience, and that was offering the students the option to have loaner laptops free of charge (Neuwirth, Jović and Mukherji, 2020, p.145). Researchers believe that the first priority of traditional HEI is to establish free educational platforms such as Blackboard as a learning management system. Then it should spread among educators and students the culture of employing these systems by activating hybrid classes.

This stage will be accompanied by many obstacles such as (1) institutional barriers (e.g. insufficient training, inappropriate training times, only generic training offered, shortage of technical staff support, lack in non-copyright educational resources, and unavailable financial support to develop materials), (2) faculty barriers (e.g. no enough time to develop e-learning material, lack basic skills on how to use technology, resistance to change, preference of personal interaction over online, difficulty to handle the classroom instruction and control students' engagement, and typing everything by faculty is consuming), technological barriers (e.g. technology requires too much work, time and effort to prepare materials/activities, lack of system reliability. None availability of internet connection, inadequate computers and software, and inadequate financial support for developing learning materials), and student barriers (e.g., no motivation, lack of experience, and less opportunity for interaction with other students " (Al Meajel and Sharadgah, 2018).

6.2 Initiate more partnerships between the college/university and the various institutions in the local community

The authors believe that partnerships with the local businesses and the public and private institutions are likely to play a pivotal positive role in alleviating the challenges that get in the way of virtual learning. The wholesome benefits expected from these benefits include: building a technological infrastructure like providing stable access to the internet (Malkus and Christensen, 2020; Lee (2020)), creating learning material (Munro, 2018, p.10), providing educational material free of charge for students who need them (Azzahra, 2020, p.6), and running orientation workshops to give training to teachers and students and make them better acquainted with the different digital platforms (Nguyen, 2022, p.292). In addition to partnerships with the local businesses and institutions, traditional tertiary institutions should also partner with other, more experienced universities and attempt to emulate them in their endeavour to ameliorate their virtual teaching practices (Reimers and Schleicher, 2020, p.4).

6.3 Boost self-study skills

In the time of the COVID lockdown, most of the educational material that was delivered online as actually made primarily for traditional FTF teaching and not for virtual learning; that is why the authors think that the mode of e-instruction during the lockdown was no more than an experience of learning the same material in the same manner but via a different channel. By and large, students did not have the necessary self-study skills for a successful e-learning experience (Zhang, et al., 2020, p.5). When students listened to lectures and did the same assignments that they would have done in class, the learning effect expected was never guaranteed (Zhang, et al., 2020; Abood and Al-Ani, 2016). For this reason, the authors believe that it is incumbent upon tertiary institutions to work on developing their students' self-study skills by means of blending formal and informal teaching for the purpose of enhancing active learning which can ensure the attainment of the intended learning outcomes and warrant autonomous learning.

6.4 Inculcate a culture of active learning as a replacement for passive learning

What is meant by active learning is that "all students are required to be involved in the learning process" (Bennett and Raymond, 2019, p.89; Healy and Smyth, 2017), and passive learning may be identified as "traditional lectures... and activities where the teacher facilitates the transfer of knowledge". Because virtual learning is a new-fangled realm for traditional tertiary institutions, those institutions are going to encounter serious challenges as the teachers may find it difficult to thwart passive education in the online world of teaching, needless to say that the textbook material itself was not primarily made for e-learning (Malhotra, 2020; Van Klaveren et al., 2020). This detriment may cause the students to lose zest for the material they are being taught. Accordingly, a few steps ought to be taken in order to get the students to change their learning habits from passive to active learning. This process has got to be careful and gradual so that the students do not suddenly feel out of their comfort zone. Yelamarthi and Drake (2014, p.181) point out that educational institutions should be able to introduce a culture of active education by immersing "students in active learning through individual and group problem solving, demonstrations, hands-on activities".

6.5 Modify methods of online assessment

Aboagye (2020) states that tertiary institutions that have been running entirely offline will naturally encounter serious challenges in assessment during the pandemic. Inability to meet acceptable e-assessment standards will detract from their validity and reliability (Sa'di, Abdelraziq and Sharadgah, 2021; Oncu and Cakir, 2011). Xiong and Suen (2018, p.257) also posit that, due to intrinsic differences between traditional assessment and e-assessment, new assessments challenges are going to present themselves in a virtual learning environment that hitherto had not been an issue prior to the shift to online learning. Sharadgah and Sa'di (2020, p.761) reported that in their study 75% of faculty members believed that the grades their students obtained online were unreliable despite the fact that in their university had introduced drastic changes to their assessment practices to help assuage the impact of the sudden shift from traditional assessment to e-assessment. Accordingly, it is a pressing exigency for traditional tertiary institutions to address the issue of e-assessment validity and reliability. Based on these facts and observations, a few suggestions and solutions can be put forward: (1) create an emergency plan that can handle any abrupt lockdowns; (2) give educators intensive and adequate e-assessment training; (3) prevent cheating, and this can be done by taking advantage of a whole host of anti-cheating software (Khan and Jawaid, 2020, p.2); cheating can also be precluded utilizing biometric software for face and voice detection (Tereseviciene, et al., 2020, p.28), and also through making a different exam for each student (Palloff and Pratt, 2008), or by doing away with e-assessment altogether and running

exams in physical classrooms at the university; (4) provide a dedicated server for e-exams on the university's website in order to thwart online traffic congestion during exams; (5) institute a committee in each programme whose job is to continuously oversee and review e-assessment practices during the lockdown and report to the university's authorities any assessment anomalies that need to be addressed.

6.6 Give further support to educators

It is likely that e-learning is going to continue to be a well-recognized mode of instruction in the future, even beyond the COVID pandemic, and so traditional educational institutions ought to be vigilant to the importance of keeping up with VLEs (Sangster, Stoner and Flood 2020, p.66). Drawing hindsight from their own experience teaching online during the COVID lockdown, the researchers believe that a few issues must be addressed that relate to supporting the educators in their e-teaching endeavour. One of the good practices already visible in many hitherto traditional tertiary institutions is that they have been running webinars that aim to give intensive training to the faculty members in on e-education. However, Leitner, Ebner and Ebner (2019, p.95) mention that such workshops focused mostly on the technicalities of the medium rather than on the educational side of it. Also, because the transition to e-learning during the pandemic happened so abruptly at abnormal times, it is not unlikely that traditional institutions will quickly jettison e-learning as soon as the pandemic subsides.

Martin, et al. (2019, p.7) put forward four different types of support for e-learning to be a successful experience: (1) administrative support (e.g., reduction of class size, financial support to make VLE learning possible, lessening of the teaching load, less administrative red tape); (2) staff support (such as providing the teachers with on-call assistance from technicians); (3) academic support (e.g., advice and workshops on new e-teaching strategies); (4) digital support (such as different types of software and hardware needed in e-learning, workshops, etc).

6.7 Blended learning integrated into e-learning

As tertiary institutions reverted to physical, FTF education, it may be advisable to integrate e-learning and traditional learning into teaching. This mode of teaching is known as blended learning. PSAU already had blended learning in use even before the pandemic hit, but that mode of education was being implemented only by a small portion of the university's professors (Al Meajel and Sharadgah, 2018). The vast majority of them had been conducting their classes entirely in traditional ways. But now due to the COVID restrictions, blended learning can be a great way to mitigate FTF meetings in actual physical classrooms. Blended learning also has the benefit of providing constant access to the course material, which ensures a flexible learning experience (Kozubai and Shemet, 2020, p.249; Skulmowski and Rey, 2020, p. 3).

At PSAU, blended learning was applied during the academic year 2020/2021. Most classes were run online, but formal assessments like exams were held on campus, provided social distancing rules and other regulations be observed. As an added precaution, PSAU made it clear to its faculty that they should exempt students with Corona symptoms from on-campus testing and to offer them different means of taking the tests.

6.8 Student dropouts

Because the shift to VLE was rather abrupt and unprecedented, some students at traditional universities felt out of their depth and dropped out of their studies. They probably decided to leave because they were unable to access online material or because they were digitally disadvantaged (Bariham, Ondigi and Kiio, 2020). Other students left college because they had to seek work and make money during the financial crisis that ensued in many parts of the world as a result of the COVID lockdowns (Noman, Kaur and Nafees, 2021; Islam, et al., 2020). As many college students around the world dropped out of their studies, PSAU was no exception. Students at PSAU mentioned two chief causes of dropout. Some students came from large families with five or six siblings going to school/college who owned only one computer that they had to share between them. The other reason is limited internet access.

For those reasons, it is incumbent upon traditional tertiary institutions to think ahead and be prepared to talk to students who are likely to drop out before they actually do drop out. a few remedial measures can be taken; for example, the colleges may give those students loans so they purchase laptops and/or reliable internet subscriptions. Teachers are also partly responsible; they should do all they can, vailing themselves of their experience in the groves of academia, to ensure that students continue to be motivated in VLE. As for digital

literacy among some students, universities should run extensive training workshops that teach less advantaged students the fundamentals of computer technology and e-learning so as to make sure no students are left behind.

6.9 Distance learning on a global scale

The idea of an international educational programme has been around for quite a while (Zhao, 2020; Verger, Parcerisa, and Fontdevila (2019); Gunawardena, 2014). This idea has been an abstract concept to date, but it seems that the abrupt and drastic changes in education due to the pandemic are likely to spur up this idea into becoming a real thing (Sutton, 2020). Beaman and Davidson (2020, p.2) posit that, because of the pandemic, universities have started wondering if it were feasible to create international distance “learning programs fuelled by the internationalization strategies of universities”. In this study, the authors believe that it is vitally important to develop distance learning programs at a global scale for a number of reasons. For one thing, such programs are going to boost cooperation and the sharing of learning projects between institutions. The varied types of expertise from the different institutions in different educational and cultural arenas will also enrich and diversify such programs both quantitatively and qualitatively. A third benefit of these grand programs is that they would provide internationally accepted standards for assessing the students. A global project like this requires an internationally recognized single body to represent all tertiary institutions collectively. This body will require each university that wishes to join in to share thorough data about its VLE experience and practices. This data is scrutinized and then it can be decided whether a particular university is eligible to join in, or whether it still needs to work on a few areas before the body decides that it does meet the conditions for joining in. In this regard, it should be noted that quality assurance units in educational institutions should play a pivotal role in expediting this process by working on the set conditions for joining the global distance programs.

6.10 Outcomes of e-learning as opposed to traditional learning

Because VLE education is becoming more and more popular, educators are starting to ask the inevitable question: is there a way to compare e-learning outcomes to outcomes in traditional FTF education? Interestingly, the literature indicates that assessment in both modes is more or less the same, with only slight, insignificant differences (Sa'di, Abdelraziq and Sharadgah, 2021; Cavus and Ibrahim, 2007). That said, the current study has also found out through its review of the literature that there are some factors that play a role in online learning but that are non-existent in traditional education, and so those factors must be kept in check in order to ensure the reliability and consistency of e-learning outcomes. One of those factors is that students are able to share ideas and answers during tests more easily than in traditional testing (Damoense, 2003, p.40). Other factors include student attitude to e-learning, digital literacy, learner self-sufficiency (Eom, 2011, pp.239-240), the need to foster student self-motivation and providing facilitation techniques (Eom, Wen and Ashill, 2006, p.215; Holmes, 2018), the quality of the information (Saba, 2012), and readiness of the educational institution for VLE education (Keramati, Afshari-Mofrad and Kamrani, 2011).

7. Study limitations and future research

The generalizability of this qualitative piece of research may be affected by a few limitations. This work is confined to traditional tertiary institutions in KSA. Similar research on traditional universities elsewhere is bound to provide a wider, clearer picture of the topics. Comparison of the findings from similar studies in different parts of the world will make the findings more generalizable. In addition, the pandemic status quo in each country is different and unique, and so the practices that can be applied in one country and yield positive results should not be believed to be automatically applicable to all other countries. This fact puts another damper on the generalizability of the findings. Moreover, further research is needed that discusses likely future scenarios and recommendations from the perspective of the lawmakers, administrators and the students at traditional universities.

8. Conclusions

This study used data elicited from two sources: the existing literature that tackles the issue of how tertiary institutions around the world shifted towards e-learning during the pandemic, and an analysis by the researchers of COVID-related circulars that were issued by the Saudi MOE and by PSAU. The review of the related literature and the analysis of the circulars enabled the researchers to produce a number of suggestions aimed at improving the e-learning experience of conventional tertiary institutions so that they may be better prepared to move on beyond traditional classroom teaching. Although this study does not recommend that

conventional tertiary institutions become 100% online, it does suggest that those institutions that have already seen the benefits of e-learning during the COVID lockdown make some learning content digitally accessible, build community partnerships, encourage self-study skills among students, help students change their learning style from passive to active, revisit the current e-assessment practices, give further support to teaching staff, reopen their buildings and classrooms gradually and smoothly when the restrictions ease, keep an eye on what factors influence the outcomes of e-learning, tackle the issue of student dropouts during the pandemic, and recognize the importance of adopting blended learning and developing e-learning programs on an international scale.

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Implications of Mobile Learning for Sustainable Inclusive Education: A Systematic Review

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Abstract: The evolution of wireless technology and the development of mobile applications cover more and more areas of human activity. These can be used not only for communication, but also for educational purposes. This research aims to analyze implications of Mobile Learning as a didactic strategy for the development of an inclusive education that is committed to improving education for sustainable development. Following the quality standards of the PRISMA statement, a systematic review of research focused on didactic experiences that use Mobile Learning for the attention of students with educational needs in the context of education for sustainable development has been carried out. The Web of Science (WoS) and Scopus databases have been used during the period 2010-2020, obtaining a sample of 21 publications. Results reveal the growing interest of the international scientific community in this research. It is a didactic strategy that facilitates the teaching-learning process for students with functional diversity, a tool to support the teaching task and a promoter of an inclusive education that is committed to sustainable learning. Among its limitations, aspects related to the teacher, the implementation of mobile technology in the teaching-learning process or its use as a learning tool stand out. Mobile Learning has become a new educational paradigm, which establishes a binomial between technology and education to respond to the objectives of the 2030 Agenda. It has become a new educational paradigm in line with our model of society based on information and knowledge and access to Information and Communication Technologies. In this way, a binomial has been established between technology and education that aims to implement benefits for the agents involved at a quantitative and qualitative level for the implementation of an inclusive education that caters to students with functional diversity and is committed to improving education for sustainable development.

Keywords: Mobile Learning, E-learning, Inclusive Education, Sustainability, special needs education.

1. Introduction

Mobile Learning is focused on the use of mobile technology as a support for the development of the didactic process (Kukulska et al., 2011). This methodological strategy favors instant and accessible learning for students from anywhere and at any time, capable of creating knowledge, satisfying their curiosity, enhancing collaborative learning or enriching learning experiences (McQuiggan et al., 2015). The introduction of Mobile Learning in education aims to change the teaching-learning process towards a model based on teaching innovation (Middleton, 2015), expanding the scope of the teaching process beyond the context of the educational institution (Sattarov and Khaitova, 2019).

The adoption of the 2030 Agenda for Sustainable Development is committed to ensuring inclusive, equitable and quality education, while promoting lifelong learning opportunities for all people. In addition, it points out how the expansion of technologies and global interconnection have great potential to overcome the digital divide between the poor and the rich, developing knowledge societies and scientific and technological innovation (UN, 2015). Including the Sustainable Development Goals in the curriculum implies analyzing the socio-cultural context of classrooms in order to transform it and incorporate a global vision of social reality into the educational process (Dieste, Coma and Blasco, 2019; Jiménez and Felices, 2018; Mesa, 2019; Ortega and Pagés, 2017).

Thus, Mobile Learning is a didactic strategy capable of promoting a teaching-learning environment that is committed to equity and equal opportunities among students, in response to the provisions of the 2030 Agenda. Therefore, it is about taking advantage of the potential of Information and Communication Technologies in the educational field to strengthen educational systems, disseminate knowledge among students, provide access to information, as well as promote quality learning that is committed to the development of a more sustainable society in which all students have a place, regardless of their characteristics, needs, expectations and/or individual interests.

2. Literature Review

Different authors underline the importance of technologies for the advancement of the Sustainable Development Goals (Chin and Jacobsson, 2016; Seegolam, Sukhoo and Bhoyroo, 2015; Tjoa and Tjoa, 2016). The new communication tools and learning environments based on web 2.0 technology represent a real potential towards the development of a new learning process, being the focus of interest towards education for sustainable development (Boulahrouz, Medir and Calabuig, 2019).

Therefore, it is proposed to use technologies to solve problems such as poverty, exclusion, economic and social development or climate change, associated with the rational use of resources provided by nature (Ziemba, 2017); it is, therefore, a means to support and meet the needs of students in an inclusive environment (Hamburg and Lütgen, 2019). Education, from this perspective, must respond to social demands to train students in a comprehensive manner and establish relationships between classroom teaching and the society in which it develops (Boni and Calabuig, 2017).

The literature review reveals the development of didactic experiences using digital technologies for Education for Sustainability, primarily climate change and biodiversity, as well as for citizenship education and urban planning (Caragliu, Del Bo and Nijkamp, 2011; Navadakhsh and Motlaq, 2009; Moore, Rydin and Garcia, 2015).

The use of mobile devices in the educational context facilitates student-centered learning (Chih-Hung and Chin-Chung, 2021; Tinoco and Tinoco, 2018). An important feature of Mobile-Learning is that the traditional transfer of knowledge from teacher to student is changed and students can actively participate in the learning process (Navarro et al., 2016).

More specifically, and in the context of inclusive education, it allows helping students with disabilities to be independent and improve their quality of life (Gentry et al., 2010). It enables a personalized learning process according to the individual needs of each student (Diegmann et al., 2015; Lai, Chen and Lee, 2019), providing the user with access to broader and more flexible information sources and teaching resources (Ally, Grimus and Ebner, 2014; McQuiggan et al., 2015; Reyhav and Wu, 2015).

The implementation of Mobile Learning in the classroom favors student interest and motivation towards learning (Diacopoulos and Crompton, 2020; Fombona and Pascual, 2013; Soykan and Özdamli, 2017), knowledge acquisition (Chee et al., 2017) and the development of digital competencies (Gómez, Atienza and Mir, 2015; Prasad, 2016; Sevillano and Vázquez, 2015; Sungkur, Panchoo and Bhoyroo, 2016). In addition, it enhances the creation of collaborative learning environments (Nguyen, Barton and Nguyen, 2015; Shadiev et al., 2018; Wilkinson and Barter, 2016) and the development of basic skills (information search and retrieval and organization) and higher skills (problem solving, decision making and critical thinking) (Ramos, Herrera and Ramírez, 2010). In turn, it enables the development of digital competencies (Gómez, Atienza and Mir, 2015; Prasad, 2016; Sevillano and Vázquez, 2015; Sungkur, Panchoo and Bhoyroo, 2016). However, some aspects must be taken into account for an effective implementation of Mobile Learning in the classroom, related to the connection to a fast and wireless Internet network, the appropriate screen size of the devices, as well as the language used for the configuration of the applications (Royle, Stager and Traxler, 2014). In addition, there are some disadvantages derived from their possibilities as a source of distraction for the student, due to the excess of information available on the network, and the technical problems that can cause the immersion of these applications in the classroom (Gikas and Grant, 2013). Rataj and Wójcik (2020) point out how the successful implementation of mobile learning in the classroom depends on the acceptance of the technology by the users involved.

Other research (Boude and Sarmiento, 2017; Sánchez et al., 2019) highlights the lack of technopedagogical training of teachers as one of the limitations in the implementation of Mobile Learning, as well as the scarcity of technological resources available to educational centers and the need to have previous didactic experiences that serve as a reference for teachers (Fernández, 2018; Florian and Beaton, 2018; Stenman and Petterson, 2020). In addition, and in relation to the teacher, this methodology is influenced by their expectations of effort, performance, confidence, system functionality and social influence (Al-Adwan, Al-Adwan and Berger, 2018; Chao, 2019).

The literature analysis reveals different review research works related to the study of the scientific production on Mobile Learning (Hinojo, Aznar and Romero, 2018), the pedagogical, technological and social interaction aspects of this methodology (González and Sosa, 2021), its implications towards learning practices (Crompton and Burke, 2018) and the use of innovative pedagogies from mobile devices (Burden et al., 2019). In addition, technological and pedagogical variables for the implementation of Mobile Learning from an inclusive perspective have been examined (Crisol, Herrera and Montes, 2020), as well as the review of scientific evidence on the use of Information and Communication Technologies for Education for Sustainable Development (Boulahrouz et al., 2019).

3. Method

3.1 Objectives

This research bets on Mobile-Learning as a didactic strategy for the development of an inclusive education, which values diversity as an enriching element of the teaching-learning process and as an enabler of human development. The aim is to achieve a "school for all" that is committed to quality education for sustainability and responds to the global challenges of the planet. It must offer an educational response to students with educational needs, understood as those who present barriers that limit their access and participation in the teaching-learning process due to disability, severe behavioral, communication and language disorders, vulnerability, high intellectual abilities, late incorporation into the educational system or personal conditions or school history.

This work aims to answer the following research questions:

- RQ1: What is the international scientific production during the period 2010-2020 on the use of Mobile Learning for an inclusive education based on sustainability?
- RQ2: What mobile applications have been used in these experiences for the development of an inclusive and sustainable education?
- RQ3: What are the potentialities of Mobile Learning for inclusive education and sustainable learning in students with educational needs?
- RQ4: What are the limitations derived from the implementation of Mobile Learning in a teaching-learning process that addresses inclusive education and sustainable development in students?

3.2 Design

The methodology used in this research responds to a systematized literature review, being its main characteristics: a) systematic, which has scientific rigor and is not arbitrary; b) complete, including all the production with scientific rigor related to a specific topic; c) explicit, detailing the procedure to locate the sources and the criteria taken into account; d) reproducible, the process can be checked by other researchers (Onwuegbuzie and Frels, 2015).

This work performs a systematic review of the literature in the international databases Web of Sciences (WoS) and Scopus has been carried out during the period 2010-2020, both inclusive. The search was carried out from December 2020 to March 2021. These databases have been selected because of their recognition and prestige in the field of science worldwide, guaranteeing strict scientific quality criteria. For its part, the review has been limited to the last 10 years to analyze the most current documents on the research problem; in addition, it has been found that prior to 2010 research on Mobile Learning, inclusive education and sustainable development has been relatively scarce at the international level. In addition, the research has been limited to works published in Spanish and English, as these are the most widely used languages at the international level, in addition to Spanish being my native language.

The search and selection of the publications included in this work has been carried out by three independent researchers, experts in conducting review research and whose lines of research are related to the area of Inclusive Education and Educational Technology. In this research we have followed the quality standards set out in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement to ensure the internal consistency of the systematic review (Urrútia and Bonfill, 2010), these being: description of the eligibility criteria, sources of information and search for publications; selection process of the papers; procedure for data extraction and synthesis of the results obtained. In addition, the criteria of the Database of Abstracts of Reviews of Effects Reviews (DARE) of the Centre for Reviews and Dissemination (CDR) of the University of York have been used through the following questions:

- Are the inclusion and exclusion criteria for publications appropriate and described?
- Is the literature search likely to have covered all studies of relevance to the topic?
- Have the reviewers assessed the quality and validity of the included studies?
- Are the basic data adequately described?

2.3. Procedure

The process for the systematic analysis of the literature requires an initial search of the publications in the selected databases. Thus, the preliminary analysis for the search of the documents is carried out according to the search equation based on the key descriptors that are part of this work: "Mobile Learning", "Mobile Devices", "Educational Needs", "Inclusive Education" and "Education for Sustainability". These terms have been used both in Spanish and English, in the title, abstract and keyword sections of each of the databases, being complemented through the AND and OR operators.

The second phase includes the filtering of the results based on the inclusion and exclusion criteria of the publications, which are described in Table 1:

Table 1: Inclusion and exclusion criteria for publications

Inclusion criteria	Exclusion criteria
▪ Articles published in quality scientific journals pose a peer review process. ▪ Research that describes didactic experiences based on the implementation of Mobile Learning as a methodological strategy for a teaching-learning process that addresses inclusive education and sustainable development. ▪ Publications written in Spanish or English. ▪ Publications related to the areas of knowledge of Social Sciences and Educational Research. ▪ Documents published between 2010-2021, inclusive. ▪ Open access publications, available for consultation.	▪ Duplicate works. ▪ Theoretical or review studies. ▪ Articles not related to the general objective of this work. ▪ Publications with restricted access. ▪ Books or book chapters, communications to congresses, doctoral theses, Final Degree or Master's Theses, etc.

In the third phase, the quality of each of the publications was evaluated by reading the full text, with the intention of ensuring the affinity and relevance of the publication according to the general objective of this research. This evaluation yielded a total of 21 publications that serve as primary sources of data for this literature review. Figure 1 shows the process followed for the search, selection and review of the publications up to the establishment of the definitive sample.

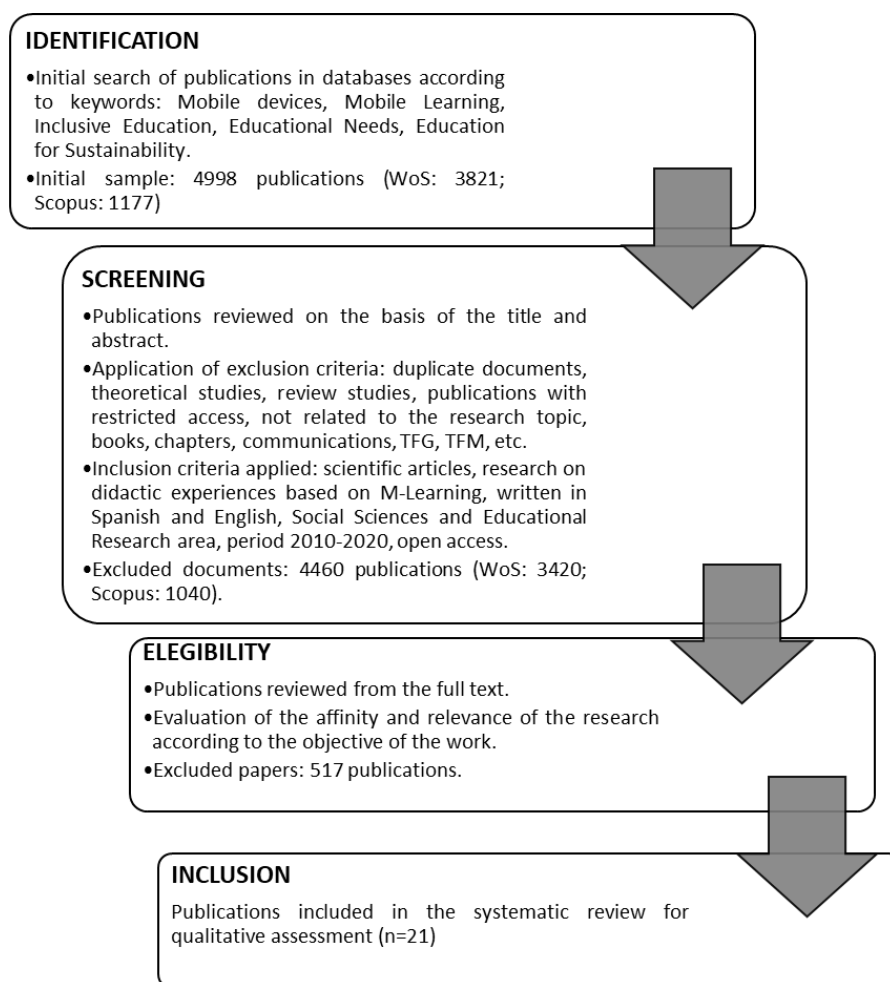


Figure 1: Flow chart for the sample search and selection process

3.3 Data analysis

Publications management software "Mendeley" was used to organize the selected publications in each database. Once the definitive sample had been established, the debugging and extraction of information for each of the publications was carried out using Microsoft Excel software. This made it possible to analyze and synthesize the information qualitatively according to the research questions and the variables considered of interest by the research team.

4. Results

4.1 Analysis of scientific production

The evolution of publications on Mobile Learning, inclusive education and sustainable learning has been growing in recent years, specifically from 2013 onwards, as shown in Figure 2. This reveals the interest of the international scientific community in the implementation of didactic experiences based on mobile learning as a strategy for the development of quality inclusive education, which is committed to sustainable development and considers attention to diversity as a learning opportunity for all.

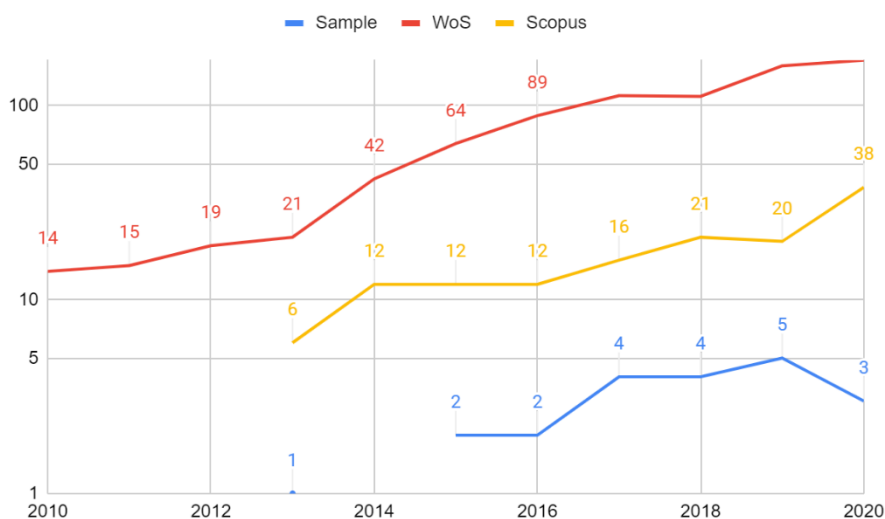


Figure 2: Evolution of publications on Mobile Learning and sustainable inclusive education

According to the geographical location in which these teaching experiences have been developed, Figure 3 shows how Spain is the country with the highest volume of publications in scientific journals of international impact on Mobile Learning and sustainable inclusive education (18.2%), followed by Turkey, Saudi Arabia and Colombia (9.1% respectively).

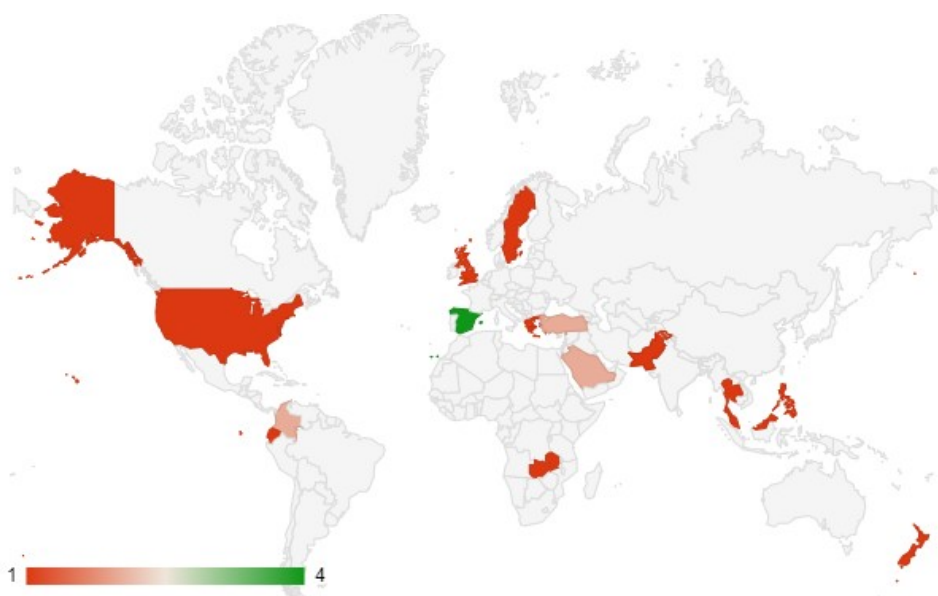


Figure 3: Distribution of publications according to geographic location

4.2 Mobile applications for inclusive and sustainable education

Mobile applications used in the didactic experiences respond to the characteristics of students with educational needs for the development of inclusive and sustainable education. In general, they are inexpensive mobile platforms that are easy to access for both teachers and students and that enable the development of functional, dynamic and interactive didactic experiences capable of facilitating the teaching-learning process for students with educational needs. Figure 4 shows how these applications are related to the learning of communication skills for students with educational needs (28.6%), reading and writing (23.8%), basic mathematical concepts (19.0%) and Augmented Reality (14.3%).

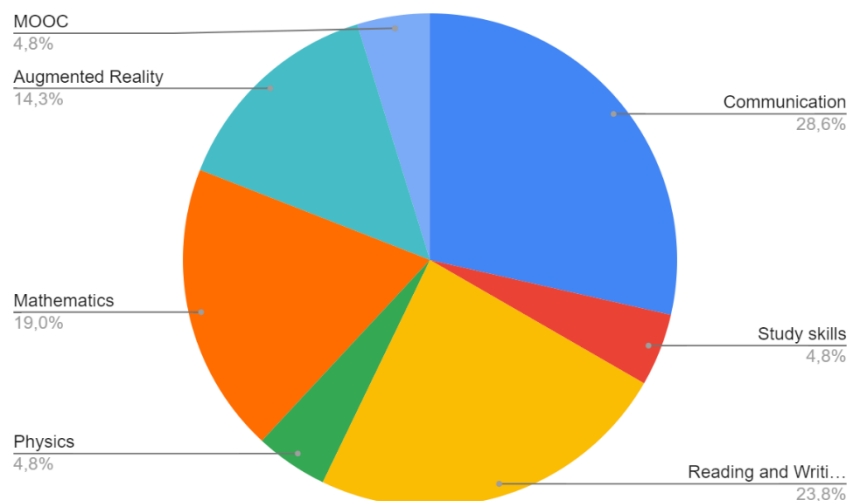


Figure 4: Distribution of publications according to the type of mobile applications

Taking as a reference the educational stage in which such experiences have been developed, Figure 5 shows that most of the publications deal with the use of Mobile Learning for students with disabilities in Primary Education (43.5%), followed by Secondary Education (17.4%) and Higher Education (13.0%).

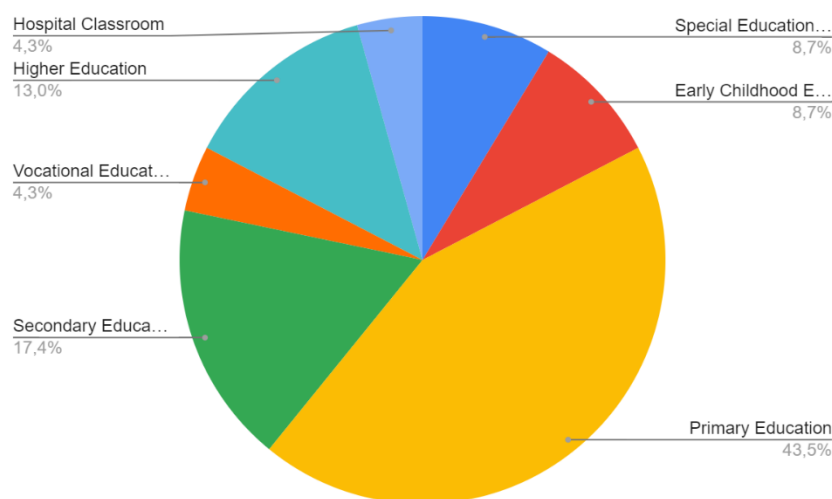


Figure 5: Distribution of publications according to educational stage

Regarding the type of disability of the students targeted by the didactic experiences, Figure 6 shows that 43.4% of the publications deal with the implementation of mobile platforms aimed at students with intellectual disabilities (Down syndrome, autism) or hearing impairment (severe and/or profound, with cochlear implant). In addition, 34.8% of the publications reviewed focus on students with learning difficulties (dyslexia) and visual impairment.

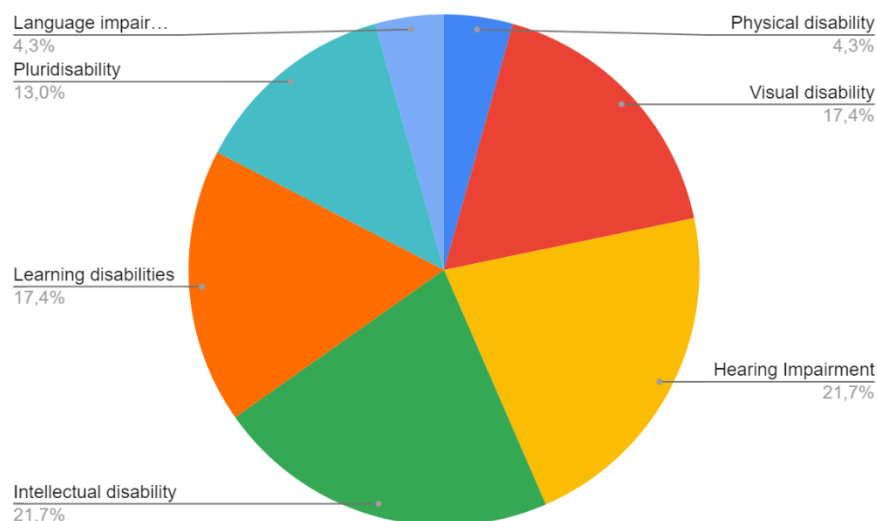


Figure 6. Distribution of publications according to type of disability

4.3 Potential of Mobile Learning for Inclusive Education and Sustainable Development

The analysis of the publications has revealed some of the possibilities of Mobile Learning as a didactic strategy applied to a teaching-learning process that addresses inclusive education from a perspective related to sustainability, as shown in Table 3.

In the first place, its functionality as a facilitating element in the teaching-learning process of students with functional diversity stands out. The creation of learning environments supported by mobile devices allows mediation in student learning (Kamaruzaman et al., 2016; Lersilp and Lersilp, 2019; Pegalajar and Colmenero, 2013), favoring access to knowledge and assimilation of information (Cano et al., 2018; Hayhoe, et al., 2015; Walker, McMahon, Rosenblatt and Arner, 2017) based on the development of innovative learning experiences that connect with the immediate reality in which the student develops (Cano et al., 2018; Park, So and Cha, 2019; Walker et al., 2017; Willacy and Calder, 2017). It is, therefore, an opportunity to improve academic performance (Bigueras, Arispe, Torio and Maligat, 2020; Cárdenas and Inga, 2020; Gkeka, Agorastou and Drigas, 2020; Ojanen et al., 2015; Parvez et al., 2019; Tangarife, 2018), learning feedback (Cano et al., 2018; Willacy and Calder, 2017), as well as to increase motivation and concentration in the study (Cano et al., 2018; Gkeka et al., 2020; Nordström et al., 2019; Parvez et al., 2019).

In addition, it is a strategy to support the teaching task and improve the quality of educational practice. The incursion of Mobile Learning in the field of inclusive education has added new values associated with the necessary collaboration between family-school for the development of innovative didactic experiences (Ojanen et al., 2015; Willacy and Calder, 2017), capable of developing effective methods based on meaningful learning for students with functional diversity (Cárdenas and Inga, 2020; Karanfiller, Göksy and Yurtkan, 2017).

Finally, it highlights the use of mobile technology as a guarantee for the development of an inclusive, equitable and quality education that promotes equal learning opportunities for all. It serves to reduce many of the barriers faced by students with disabilities, limiting their learning and the participation of all students in the teaching-learning process. It is an alternative that facilitates the implementation of individualized teaching (Al-Megren and Almutairi, 2019; Jiménez, Serrano and Prendes, 2017; Karanfiller et al., 2017; Pegalajar and Colmenero, 2013; Walker et al., 2017; Willacy and Calder, 2017), which meets the needs and characteristics of students and the context in which it is developed, in addition to promoting the participation in the classroom of students with functional diversity (Bülbül, Yigit and Garip, 2016; Kamaruzaman et al., 2016; Yousaf et al., 2018), their normalization and inclusion in the school context (Cano et al., 2018; Cárdenas and Inga, 2020; Kamaruzaman et al., 2016; Lersilp and Lersilp, 2019). It also relies on collaborative work among peers (Bülbül et al., 2016; Cano et al., 2018; Cárdenas and Inga, 2020; Nordström et al., 2019), allowing students with difficulties to compensate for their deficits in the teaching-learning process (Bigueras et al., 2020; Nordström et al., 2019).

Table 3: Potentialities of Mobile Learning for inclusive education and sustainable development

Dimensions	Indicators	References
Facilitator of the sustainable teaching-learning process	Mediation of learning at the communicative, cognitive, visual and auditory levels	Kamaruzaman et al. (2016); Lersilp and Lersilp (2019); Pegalajar and Colmenero (2013)
	Promotes access to knowledge and assimilation of information	Cano et al. (2018); Hayhoe et al. (2015); Walker et al. (2017)
	Offers innovative, interactive and fun learning opportunities through the exploration and manipulation of everyday life situations	Cano et al. (2018); Park, So and Cha (2019); Walker et al. (2017); Willacy and Calder (2017)
	Improves academic performance	Bigueras et al. (2020); Cárdenas and Inga (2020); Gkeka, Agorastou and Drigas, (2020); Ojanen et al. (2015); Parvez et al. (2019); Tangarife (2018)
	Allows for learning feedback	Cano et al. (2018); Willacy and Calder (2017)
	Promotes motivation and concentration towards study	Cano et al. (2018); Gkeka et al. (2020); Nordström et al. (2019); Parvez et al., (2019)
Supporting teaching for sustainable education	Shows teachers and families the importance of developing effective instructional methods	Ojanen et al. (2015)
	Support for the development of innovative didactic experiences in the teaching-learning process of students	Cárdenas and Inga (2020); Karanfiller, Göksy and Yurtkan (2017)
	Enables family-school collaboration	Willacy and Calder (2017)
Promotes sustainable inclusive education	Facilitates the development of individualized teaching according to the needs of students, their families and teachers involved in the teaching-learning process	Al-Megren and Almutairi (2019); Jiménez, Serrano and Prendes (2017); Karanfiller et al. (2017); Pegalajar and Colmenero (2013); Walker et al. (2017); Willacy and Calder (2017)
	Allows students with disabilities to participate in the classroom, assuming new responsibilities	Bülbül, Yigit and Garip (2016); Kamaruzaman et al. (2016); Yousaf et al. (2018)
	Promotes collaborative work among peers	Bülbül et al. (2016); Cano et al. (2018); Cárdenas and Inga (2020); Nordström et al. (2019)
	Promotes the normalization and inclusion of students with disabilities in the school context	Cano et al. (2018); Cárdenas and Inga (2020); Kamaruzaman et al. (2016); Lersilp and Lersilp (2019)
	Compensate for the difficulties of students with disabilities	Bigueras et al. (2020); Nordström et al. (2019)

4.4 Limitations of Mobile Learning for Sustainable Inclusive Education

The integration of Mobile Learning as an effective teaching strategy for inclusive quality education that addresses individual needs and offers learning opportunities to all for the sustainable development of society also encounters some limitations, as shown in Table 4.

The teacher is defined as one of the fundamental educational agents involved in the development of sustainable inclusive education. They are responsible for transmitting knowledge to future generations, who will be in charge of transforming the knowledge society towards values related to sustainability. For this reason, it needs a process of permanent training and digital competence training that allows it to know the didactic possibilities of these tools in the educational field (Del Cerro and Morales (2018); Gkeka et al. (2020); Ojanen et al. (2015); Pegalajar and Colmenero (2013); Tangarife (2018); Willacy and Calder (2017). Likewise, it must have positive perceptions and attitudes towards the development of educational innovation processes and the use of technologies to improve the quality of their teaching practice (Hayhoe et al., 2019). Finally, the need for support and incentives from the Administration, through the different educational policies for the development of this type of innovative didactic experiences that require time, effort and risk on the part of the teacher, stands out (Del Cerro and Morales, 2018).

In addition, the incorporation of this technology in the teaching-learning process of students with functional diversity requires the participation of the educational community for an effective implementation, as well as individualized support for students with disabilities (Ojanen et al., 2015). In addition, this new conception of the training process requires a series of changes in the teaching-learning process, which must be adjusted to the needs of the students to whom it is addressed (Bülbül et al., 2016; Willacy and Calder, 2017). It is necessary to

prepare teaching guides that serve as a support tool for teachers for their effective implementation in the classroom (Cano et al., 2018). On the other hand, it is of interest the realization of interdisciplinary projects that advocate the use of such technologies in the teaching process of students with disabilities (Tangarife, 2018), as well as the importance of the student's continued use of this strategy in their training process for the development of a quality inclusive education (Nordström et al., 2019).

Finally, and taking into account the nature of mobile technology as a learning tool, it is necessary to carry out a prior assessment to identify possible individual needs of the students to whom it is addressed, as well as the context in which it is developed (Bigueras et al., 2020; Cano et al., 2018; Cárderas and Inga, 2020); Hayhoe et al., 2015). Therefore, applications should be subject to a process of continuous updating and improvement, including different levels of learning and degrees of difficulty (Al-Megren and Almutairi, 2019; Karanfiller et al., 2017; Parvez et al., 2019); Tangarife, 2018). In addition, sometimes, access to such devices may be costly or subject to technical difficulties inherent to the use of technology (Walker et al., 2017; Willacy and Calder, 2017), as well as accessibility problems for students with disabilities (Park et al., 2019).

Table 4: Limitations of Mobile Learning for sustainable inclusive education

Dimensions	Indicators	References
In relation to the role of the teacher	Updated teacher training	Del Cerro and Morales (2018); Gkeka et al. (2020); Ojanen et al. (2015); Pegalajar and Colmenero (2013); Tangarife (2018); Willacy and Calder (2017)
	Positive perceptions and attitudes towards ICT and educational innovation	Hayhoe et al. (2015)
	Continuous support and incentives from the Educational Administration	Del Cerro and Morales (2018)
Regarding the implementation of technology in the sustainable teaching-learning process	Involvement of families and the educational community for an effective incorporation of these tools in the classroom	Ojanen et al. (2015)
	Reorganization of the teaching-learning process to facilitate the participation of students with disabilities	Bülbül et al. (2016); Willacy and Calder (2017)
	Individualized support for students to use the applications efficiently	Nordström et al. (2019); Willacy and Calder (2017)
	Investment of time resources for the development of the teaching-learning process	Cáderas and Inga (2020); Nordström et al. (2019)
	Shortage of interdisciplinary projects based on the use of mobile platforms for students with disabilities	Tangarife (2018)
	Development of teaching guides as support material for teachers	Cano et al. (2018)
	Lack of continuity among students regarding the use of the mobile application after the development of the didactic experience	Nordström et al. (2019)
In relation to mobile technology as a learning tool	Pre-assessment of the mobile platform to identify its functionality, the learning environment and the individual needs of the targeted learners	Bigueras et al. (2020); Cano et al. (2018); Cárderas and Inga (2020). Hayhoe et al. (2015)
	Updating and redefinition of the mobile platform with different degrees of difficulty and levels of student learning	Al-Megren and Almutairi (2019); Karanfiller et al. (2017); Parvez et al. (2019); Tangarife (2018)
	High cost of accessing mobile devices and difficulties arising from the technical properties of the technology	Walker et al. (2017); Willacy and Calder (2017)
	Difficulties in accessibility of the platform for students with disabilities	Park et al. (2019)

5. Discussion

The interest of this work lies in the need to improve the quality of life for all and promote shared economic prosperity, social development and environmental protection of all countries, responding to the Sustainable Development Goals proposed by the United Nations in 2015 in the document "Transforming our world: the 2030 Agenda for Sustainable Development".

The analysis of the publications reveals the growing interest among the international scientific community in this topic. It alludes to the implementation of Mobile Learning as a didactic strategy for a teaching-learning process based on the principle of inclusion as an enriching element for all (Muntaner, 2019). In addition, it bets on education for the sustainable development of the student with functional diversity, expanding the scope of the teaching-learning process outside the classroom (Ally et al., 2014; McQuiggan et al., 2015; Reychav and Wu, 2015; Sattarov and Khaitova, 2019).

From the perspective of teaching innovation (Middleton, 2015), the didactic experiences described reveal how mobile technology enables the development of a new learning process based on sustainable development (Boulahrouz et al., 2019; Ziemba, 2017). It is a means to respond to the demands of students in an inclusive environment (Hamburg and Lütgen, 2019), establishing relationships between the classroom and the context in which it unfolds (Boni and Calabuig, 2017). Mobile applications allow the creation of virtual teaching environments that enable students with educational needs to have access to ubiquitous, universal and personalized learning (Echeita, 2017), responding to an inclusive, equitable and quality education as approved in the 2030 Agenda (UN, 2015).

Among the possibilities of Mobile Learning as a didactic strategy for sustainable inclusive education towards students with functional diversity, it is worth highlighting the mediation capacity of mobile devices in a student-centered teaching-learning process (Chih-Hung and Chin-Chung, 2021; Pegalajar and Colmenero, 2013; Tinoco and Tinoco, 2018), which facilitates the construction of knowledge, the resolution of learning problems and the development of skills and abilities in the student from anywhere and anytime (Cano et al., 2018; Park et al., 2019; McQuiggan et al., 2015; Willacy and Calder, 2017). In addition, its use as a support tool for the teaching task that bets on educational innovation (Cárdenas and Inga, 2020; Karanfiller et al., 2017) and guarantees principles based on equity and equal opportunities for all is highlighted. Even, its potential to promote sustainable inclusive education, capable of guaranteeing individualized attention to the student, responding to their particular needs and enhancing their normalization in the environment in which they develop, is highlighted (Al-Megren and Almutairi, 2019; Lai et al., 2019; Walker et al., 2017). Mobile technologies are tools with enormous potential to develop the Sustainable Development Goals (Chin and Jacobsson, 2016; Seegolam et al., 2015; Tjoa and Tjoa, 2016) from the context of inclusive education (Bigueras et al., 2020; Nordström et al., 2019). It favors autonomy and improvement of the quality of life of the student with disabilities (Gentry et al., 2019), interest and motivation towards study (Diacopoulos and Crompton, 2020), knowledge acquisition (Chee et al., 2017) and the development of digital competences (Gómez et al., 2015; Sungkur et al., 2016; Sevillano and Vázquez, 2015).

Mobile Learning has become a new educational paradigm in line with our model of society based on information and knowledge and access to Information and Communication Technologies. In this way, a binomial has been established between technology and education that aims to implement benefits for the agents involved at a quantitative and qualitative level for the implementation of an inclusive education that caters to students with functional diversity and is committed to improving education for sustainable development.

In addition, this work has highlighted some of the limitations of Mobile Learning as an effective teaching strategy for inclusive quality education that supports sustainable development: In relation to the teacher, the implementation of Mobile Learning in the educational context requires adequate technopedagogical training (Boude and Sarmiento, 2017; Del Cerro and Morales, 2018; Gkeka et al., 2020; Sanchez et al., 2019; Tangarife, 2018; Willacy and Calder, 2017), as well as favorable attitudes and perceptions to integrate technology in the classroom (Al-Adwan et al., 2018; Chao, 2019; Hayhoe et al., 2015). Regarding the implementation of technology in the teaching-learning process, it is necessary to reorganize the didactic process to facilitate the active participation of students with functional diversity (Bülbul et al., 2016; Willacy and Calder, 2017), individualized student support to facilitate the effective use of these applications (Nordström et al., 2019) or the development of teaching guides as didactic support material (Cano et al., 2018). Finally, and for the use of mobile technology

as a learning tool, it is necessary the previous evaluation of the mobile platform (Bigueras et al., 2020; Cárdenas and Inga, 2020), the constant updating and redefinition of these tools according to the needs of the targeted students (Al-Megren and Almutairi, 2019; Tangarife, 2018), as well as the difficulties of accessibility for students with functional diversity (Park et al., 2019; Royle et al., 2014).

As suggestions for improvement, it is proposed to facilitate the technological training of active teachers, providing them with strategies and skills to implement mobile technology in their daily work in the classroom. Mobile technology should be incorporated into the teaching-learning process not as a simple didactic tool, but as a resource capable of offering an inclusive educational response that is committed to the sustainable development of the student. To this end, and from the educational field, it is necessary to focus on teaching innovation as a fundamental element for a quality educational system. This requires a highly qualified teacher, with professional skills to implement ICT in the classroom, motivation and positive attitudes towards the use of ICT for sustainable development in an inclusive school context.

6. Conclusions

Mobile Learning is defined as a learning strategy that is committed to the development of the goals set out in the 2030 Agenda, focused on the transformation of society towards a more sustainable world. The didactic experiences reviewed combine three key concepts: mobile technology, inclusion and sustainable education, with the intention of transforming the didactic process, improving the quality of education, and favoring equal opportunities for all students.

This work performs a generalist analysis, since it analyzes the development of didactic experiences based on the implementation of Mobile-Learning for any educational stage or type of disability in students, this being one of the main limitations of the research. However, and for future research, the possibility of going deeper into the use and implications of Mobile Learning for students with a specific type of disability is considered, as well as analyzing the perceptions of the main educational agents involved in the implementation of this strategy in the classroom (family, teachers and students). This will allow us to determine the point of view of each of them and, as a consequence, to analyze the factors that favor or hinder its implementation in the school context.

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Contextualizing Lecturer Performance Indicators to Online Teaching and Learning Activities: Insights for Application during the COVID-19 Pandemic And Beyond

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Abstract: The purpose of this research study is to explore insights to create more contextual lecturer performance indicators (LPIs); and to gain a fairer and more useful evaluation tool for lecturers in the online environment during the COVID-19 pandemic. This significant change in conditions has forced higher education to understand the new requirements, especially of lecturers, who have played a central role in creating engaging moments for students in online classes. This study adopts a qualitative approach, based on the need for a more in-depth exploration of new phenomena. It explores students' daily lives in class, which were expressed through social media, and gains further understanding through in-depth interviews with students and lecturers. The results indicate that most of the items taken from the Social-Task-Technology-Fit (STTF) framework remain the same; there are not many changes compared to the era before the pandemic. However, some aspects have new meanings that need to be revisited to capture the lecturers' performance in the new context. Three new themes emerged from the exploration study which have never been discussed in previous studies on LPIs for online teaching, especially in abnormal conditions such as a pandemic. The first theme concerns the variations in digital literacy of lecturers and the implications for lecturers' performance. The second theme is the dynamic ratio of social versus task activities, which implies the need to focus on academic (task-oriented) or non-academic (social) tasks. The third theme is the degree of controllability of each performance. This study provides awareness of the importance of weighting in evaluating lecturer performance, especially when not all lecturers are digitally literate, not all factors are controllable, and the ratios between social versus task requirements are not the same. These weighted evaluations have never been discussed in previous studies, which mainly used quantitative surveys. In addition, these insights can also be applied to online learning beyond the pandemic. The study results can be used by higher education information management to design more contextual LPIs for the early detection of issues with lecturer performance.

Keywords: Contextual, lecturer performance indicators, online learning, COVID-19, student satisfaction

1. Introduction

Worldwide, the spread of the COVID-19 virus has caused significant changes in social and organizational interactions, and the vulnerable education sector is no exception. However, the learning system has to continue, especially to meet the needs of students who are like customers in the context of higher education. The general trend of education systems worldwide has been to respond to the pandemic with 'emergency e-learning' prototypes, marking a rapid transition from face-to-face classrooms to online learning systems. This significant change in conditions has forced higher education to understand the new requirements, especially of lecturers, who have played a central role in creating engaging moments for students in online classes. Therefore, universities should also adapt lecturers' quality measurements (Latip et al., 2019). The tools for lecturer quality evaluation, or lecturer performance indicators (LPIs), need to be adjusted, using more relevant measures. This study explores insights to create more contextual LPIs, and to gain a fairer and more useful evaluation tool for lecturers in the online environment.

Higher education institutions have equipped campuses with various technologies through platforms and devices to support virtual learning, even purchasing sophisticated equipment to be able to better provide online learning (Bradford and Wyatt, 2010; Baber, 2020). Many institutions and corporations have increased their readiness to conduct online meetings to maintain the quality of their online interaction. However, the main actors who deliver services to students are the facilitating lecturers, so the focus should be on the technology and the extent to which lecturers have used this technology to serve students.

Understanding of the latest conditions regarding changes in student satisfaction in terms of lecturer performance is generally still superficial. Several studies using quantitative surveys have mapped factors that

influence student satisfaction in the classroom during the ongoing COVID-19 pandemic, especially those related to lecturer performance (Basuony et al., 2021; Butler, Samuels and Peditto, 2021; Yeung and Yau, 2022). Several surveys identified factors significantly affecting student satisfaction, for example, a study by Basuony et al. (2021) in Egypt identified platform type, class time, level of interest, self-motivation, and task, while a study by Gopal, Singh and Aggarwal (2021) in India highlighted effective communication and creating a comfortable discussion space.

Student satisfaction during the learning process was not only recorded at the end of a lecture through a survey sheet but was recorded while the process was still ongoing. Stories built through narratives, either directly or indirectly (through social media), are expressions of students' daily lives that reflect satisfaction with their lecturers (Hansen and Lee, 2013; Maulana and Setiawan, 2021). A study by Shehzadi et al. (2020) stated that stories on the internet about online learning experiences affect the reputation of higher education as a brand. A pleasant learning experience in the classroom will trigger students to talk about positive aspects of their social network (Baber, 2020; Chen et al., 2021; Maulana and Setiawan, 2021). Universities should ensure that students get an online learning experience commensurate with their expectations (Mark, 2013). Therefore, lecturers, as central actors who interact directly with the students, should be guided to create exciting moments during online classes.

Narratives about the new phenomena of online learning could be collected in the form of diverse stories derived from personal experiences of online classes. Insights into the changing phenomena of students' views on the quality of lecturers during this pandemic are not only obtained by employing surveys but can be observed from students' daily lives talking about campus life stories. By observing social media, insights to improve LPIs can be collected as materials for designing the new LPIs for online learning situations, especially in the context of the COVID-19 pandemic.

This study aims to enter directly into students' lives and to explore more deeply what changed in students' perspectives on the ideal lecturer during this pandemic. This study tries to capture insights directly from student stories and experiences related on social media, complemented by validation through in-depth interviews. Insightful stories from students' experiences can be used as input for compiling new LPIs, because they can provide a more complete picture of the online learning situation within the framework of a pandemic. Insights from this research are expected to be material for a more contextual LPI design, according to the needs emerging during a pandemic. In addition, they can also be applied to online learning beyond the pandemic.

This paper continues with a review of factors influencing student evaluations of lecturer performance, looking at what changes have occurred during the COVID-19 pandemic when all teaching and learning activities had to be conducted online. The following sections present the research methodology, results, discussion, conclusions, and recommendations of the research study.

2. Literature review

2.1 Lecturer performance indicators

Lecturer performance, which is one of the components of student evaluations, significantly contributes to student satisfaction, affecting a university's image and student loyalty (Helgesen and Nettet, 2007). In addition, university image is frequently related to students' selection of educational institutions.

To facilitate the detection of problems in evaluating lecturer performance, the factors used in assessing the success of lecturers in terms of their work are grouped into specific categories. In 1995, a framework known as the Task-Technology-Fit (TTF) was developed by Goodhue and Thompson (1995); this framework was used as the basis for the present study. Lu and Yang (2014) have recently added a new dimension, by dividing performance into three categories, namely task-oriented, technology-oriented and social-oriented characteristics (Social-Task-Technology Fit or STTF framework).

The change from face-to-face learning to online learning, especially during the pandemic, has caused a shift in university students' value needs and satisfaction. Therefore, the way to assess lecturer performance also needs to be revised. Of the three categories, namely tasks, technology and social aspects, it is necessary to review which category has changed the most. Not only that, even for each factor in each category, the relevance must be reappraised. Even though the type of factor is recorded using the same terms, this does not necessarily mean

the same thing. Moreover, this needs attention from university managements, so that the method used to assess lecturers is contextual to the latest situation during this pandemic.

There have been many discussions in previous studies about the tasks, technology, and social aspects of teaching performance, which were discussed in terms of all the aspects or only a few aspects that happened to be the topic of study. The next sections elaborate on the extent to which each aspect had attracted the attention of researchers and universities during the pre-pandemic period. Then, it is also considered whether new perspectives and insights need to be considered, so that the assessment of lecturers in online learning is not confined to the past context but adapted to the present.

2.2 Task-oriented factors

Teaching quality is an essential factor that lecturers must consider to increase student satisfaction. The knowledge and competencies possessed by lecturers have positive implications for student learning motivation (Latip et al., 2019; Baber, 2020; Long, Ibrahim and Kowang, 2013; Opatha, 2020). This can be seen in the way lecturers give attractive, broad-minded presentations about the material they teach (Long, Ibrahim and Kowang, 2013; Gee, 2018), thereby making the material clearer for the students. At the same time, this way of teaching increases students' responsiveness, impacting their engagement with lecturers (Patras and Hidayat, 2020; Saxena, Baber and Kumar, 2021). Students appreciate lecturers who are committed to paying attention to their academic achievements (Sopiah and Sangadji, 2020). In offline learning, lecturers directly motivate students towards academic achievements (Latip et al., 2019). Therefore, knowledge, competence, motivation, responsiveness and clarity in explaining the material describe the teaching qualities of lecturers that can increase students' satisfaction.

To provide teaching that is easily understood and accepted by students, teachers need to develop various teaching methods. This is important because engaging teaching techniques can increase student interest, attention and satisfaction (Bradford and Wyatt, 2010; Long, Ibrahim and Kowang, 2013; Tratnik, Urh and Jereb, 2019; Gee, 2018). This is in line with the results obtained by Opatha (2020), according to which students observe lecturers' teaching habits or culture to determine the suitability of the learning methods applied by the teacher. Students in the pre-pandemic period tended to prefer face-to-face learning with teachers because they could take advantage of institutional learning facilities (Bradford and Wyatt, 2010; Tratnik, Urh and Jereb, 2019). In addition, students could interact directly with one another and the teachers (Long, Ibrahim and Kowang, 2013). Quality lecture notes, engaging learning activities, and helpful input and assignments provided by the lecturers according to the capacity and courses taught are aspects that determine student satisfaction (Gee, 2018; Hartshorne et al., 2020).

2.3 Technology-oriented factors

The infrastructure aspect has been widely discussed. Shehzadi et al. (2020) and Rapanta et al. (2020) have suggested that a university's readiness to provide electronic information infrastructure affects student satisfaction with the online learning experience. The quality of e-service and e-information positively contributes to student e-learning, which ultimately leads to student satisfaction (Shehzadi et al., 2020). Lecturers also need to consider students' readiness to participate in online learning experiences (Rapanta et al., 2020).

Lecturers need to focus on students' ability to access technology during online learning during the pandemic, because not all students have equal access to digital devices and technology (Joshi, Vinay and Bashkar, 2021; Pokhrel and Chhtri, 2021). Another problem is access to the internet network, which is vulnerable to instability (Basuony et al., 2021). Teachers need to provide a backup system for student attendance when there is internet network disruption (Rapanta et al., 2020). In addition, there are many disturbances beyond a student's control that can hamper learning, such as external interruptions, power outages and lightning storms that impact the stability of the internet network (Hamdan et al., 2021).

2.4 Social-oriented factors

One widely discussed factor that affects students' satisfaction with their online learning experience is social presence, which refers to students' perceptions of the absence or presence of other people in the classroom (Richardson et al., 2017). Social presence is one factor that influences students' satisfaction with their online learning experiences (Zhan and Mei, 2013; Andel et al., 2020; Richardson et al., 2017). In the context of online learning, student-student interactions are limited to cyberspace interactions, which can lead to feelings of

isolation (Baber, 2020; Tümen Akyildiz, 2020). Weidlich and Bastiaens (2017) also suggested that social interaction affects student satisfaction in online learning. From these studies, it can be concluded that social aspects need to be considered when implementing online learning. Poor social interaction or a lack of other people in the classroom during online learning can result in students' dissatisfaction with the learning experience.

Table 1: Performance indicators of lecturers

Indicator	Description	References
Technology oriented		
Digital literacy	Ability to operate technology	Ryan and Scott, 2008; Tomczyk, 2020; Wu et al., 2022; Çetin, 2021 Shehzadi et al., 2020; Rapanta et al., 2020; Krumsvik, 2014; Laurillard, 2008
Access to technology	Availability of technology tools	
Task oriented		
Knowledgeable (content)	Competent in subject matter and clarity of content	Douglas, Douglas and Barnes, 2006; Voss, Gruber and Szmigin, 2007; Long, Ibrahim and Kowang, 2013; Gee, 2018; Fielding, Dunleavy and Langan, 2010; Gibson, 2010
Class dynamic skills	Engaging discussion	Samian and Noor, 2012; Su and Wood, 2012
Creativity	Fun experience	Wong, Tong and Wong, 2017; Mourlam et al., 2020; Gao, Jiang and Tang, 2020; Çetin, 2021; Su and Wood, 2012
Committed & Motivated	Focused, monitoring student attendance	Amzat, 2017; Xiao and Wilkins, 2015; Dachner and Saxton, 2014; Dziuban et al., 2015
Social Oriented		
Sociable & Friendly	Social presence and interaction	Richardson et al., 2017; Baber, 2020; Tümen Akyildiz, 2020; Zhan and Mei, 2013; Andel et al., 2020
Accessible	Accessible	Douglas, Douglas and Barnes, 2006; Fielding, Dunleavy and Langan, 2010; Gibson, 2010; Su and Wood, 2012
Empathy	Empathy	Douglas, Douglas and Barnes, 2006; Meyers et al., 2019; Stojiljković, Djigić and Zlatković, 2012

2.5 Expectations of lecturers during the COVID-19 pandemic

According to Xiao and Wilkins (2015), increasing tuition fees leads to students demanding more for their money, which shifts the role of lecturers according to the students' perspectives. There is a shift in the expectations regarding lecturers, in which students perceive that the lecturer must provide something more than just teaching. One of these is that the lecturer will be a tutor who can guide students; students expect to have an engaging experience during the teaching and learning process (Wong, Tong and Wong, 2017). During the pandemic, when students have to continue to pay tuition fees to universities, even though the service they receive is much reduced, the service level of lecturers must be maintained, even increased.

There have been many studies that have raised this shift in student satisfaction regarding lecturers during the pandemic, in various countries, including Egypt (Basuony et al., 2021), China (Lei and So, 2021), Sri Lanka (Hettiarachchi et al., 2021), Thailand and Indonesia (Darawong and Widayati, 2021), New Zealand (Adler et al., 2021), and Canada (Butler, Samuels and Peditto, 2021). Almost all of these studies used quantitative tools in the form of surveys. Studies that use qualitative tools are still limited; one example is the study by Bell (2022) in the United Kingdom, which used in-depth interviews and group discussions. This study was qualitative because it wanted to explore more insights into student satisfaction during the pandemic. The difference with studies in the UK is that these studies enter directly into students' lives, based on their stories on social media. Many of the reasons for this change in student satisfaction have no references to compare them with, because pandemics are very rare and unpredictable, and therefore the context of COVID-19 is a unique situation.

The factors that are still the same for the success of lecturers are lecturers' materials, which students expect to be able to understand clearly, as demonstrated in the studies of Gopal, Singh and Aggarwal (2021) and Adler et al. (2021). These studies have indicated that lecturers are expected to have sufficient communication skills and enthusiasm for teaching (Gopal, Singh and Aggarwal, 2021; Adler et al., 2021; Butler, Samuels and Peditto, 2021).

The ability of lecturers to deliver their material must also be supported by the ability to use the learning technology effectively (Lei and So, 2021; Paliwal and Singh, 2021; Carillo and Flores, 2020).

The various aspects presented as the results of these studies indicate that what is prominent among the things students want from lecturers concerns emotional and relationship factors, such as being approachable, caring, and empathetic, as described by Bell (2022). Meanwhile, prompt feedback, understanding the learners' needs, and available help are also characteristics of lecturers highlighted by Hettiarachchi et al. (2021). A study by Butler, Samuels and Peditto (2021) conducted in Canada also focused on two important things for student satisfaction in this pandemic era, namely the characteristics of being supportive and caring.

Because learning is no longer done in face-to-face interactions, lecturers increasingly play an essential role for students, with the findings of several studies indicating that students see aspects such as responsiveness, accessibility, and empathy as being more critical than lecturer competencies in providing the learning itself (Sitanggang, Luthan and Hamid, 2021; Darawong and Widayati, 2021). This demonstrates that, in online settings, the social presence of other parties, especially lecturers, is something that students value (Carrillo and Flores, 2020).

The factor of personalizing interactions and creating a comfortable space is an aspect that was previously not really important in face-to-face learning. This also applies to involvement outside class, which was previously not a concern of students, considering that classroom meetings have dominated interactions between lecturers and students, as discussed in a study conducted by Adler et al. (2021) in New Zealand.

A study by Kanwar and Sanjeeva (2022), conducted in India, emphasized that, in addition to teaching material provided by the lecturer, it is also expected that the lecturer will provide additional skills and knowledge to students, as well as guidance regarding their future careers. This can be conveyed through fun but still educational learning (Finlay, Tinnion and Simpson, 2022). Using a qualitative technique, Yeung and Yau (2022) found that students had difficulty following the lessons given in an online learning setting when lecturers were in a hurry to provide explanations without noting how the students responded and whether they understood or not.

3. Methodology

3.1 Social media posts

The data collection for this study was done by capturing posts on three social media platforms: Twitter, Facebook, and Instagram. The search was conducted using keywords such as "lectures in class", "likes about online class", "dislikes about online class", "pandemic and online class", and "online lecture experience". Social media posts created by active students in Indonesia were captured during the data collection and related to the implementation of online classes during the pandemic. This process took place over one month, in February 2021, by which time online classes had been implemented for approximately one year at various universities in Indonesia.

This data collection method is a reliable method used in qualitative research to provide a complete and comprehensive understanding of the conditions of students in the online learning environment (Kozinets, 2002). This study captures approximately 300 social media posts created by current students and related to their experience of online lectures. The profiles of the students, as the social media generators, are presented in Table 2.

Table 2: Profiles of some of the students as social media post generators

Account	Platform	Profile
@charxxxx	Twitter	Student from a top public university, follower 356, many retweets about things about the university
@Auslxxxx	Twitter	Student from top private universities, 432 followers, and many follow accounts discussing the condition of the university
@elfaxxxx	Instagram	Student from a public university, follower 973, Often posts with attributes related to the university
@insxxx	Instagram	Student from top private universities, with followers of 784, often post on Instagram, but only a few related to universities
HerlixxWaxx	Facebook	Student from a public university, follower 1527, Joined a group discussing the current state of the university

Account	Platform	Profile
@rennxxxx	Twitter	Student from a public university, the number of followers is less than 100, not very active on Twitter, the number of posts is small
@JIMxxx	Twitter	Student from private universities, with 282 followers, often comment on posts that talk about university
@nataxxx	Twitter	Student from top public universities have 443 followers, are less active on Twitter, and only occasionally post and participate in comments about universities
@Bentxxx	Twitter	Student from top public universities, with 117 followers, participate in discussions about universities on Twitter.
@pierxxx	Twitter	Student from one of the top public universities, have 200 followers, and only occasionally post related to the university.

3.2 In-depth interviews with current students

The results of the social media data capturing were categorized into several themes and then used as a guide to form questions for the in-depth interviews to elaborate on the findings. In-depth interviews were conducted with eight students from several private and public universities in Indonesia. The selected informants have the characteristics of being undergraduate students in Indonesia who have experienced face-to-face lectures before the pandemic and online lectures during the pandemic, and actively use social media. In-depth interviews were conducted by asking questions on themes regarding the lecturers' performance found from social media listening and digging further on other matters related to the students' likes and dislikes regarding the lecturers during the implementation of online learning during the pandemic.

Table 3: Profiles of the students participating in in-depth interviews

Initial	M/F	Major	University Year
LE	F	Management	Second
MRF	M	Chemical engineering	Second
IS	M	Industry engineering	Second
PA	F	Communication	Second
SA	F	Management	Third
YY	F	Nursing study	Third
ZA	M	Management	Fourth
DA	F	Psychology	Fourth

3.3 In-depth interviews with lecturers

To get a more comprehensive picture of lecturers' performance, the findings were further elaborated by conducting in-depth interviews with five lecturers. This was done to get the perspectives from lecturers on their efforts to provide online learning during the pandemic and to identify the factors that hindered their online teaching. A sample of interviewees was obtained through purposive sampling based on specific criteria; this method helped to obtain robust information (Malterud, Siersma and Guassora, 2016). The selected informants are senior lecturers with more than ten years of teaching experience, between the ages of 40 and 60. The informants came from both public and private universities; these were chosen to learn about variations in the online learning culture, if any. A study by Daumiller and Dresel (2020) found that there are differences among the learning cultures of different universities and faculties. In addition, these lecturers were chosen because they do not only teach, but also act as facilitators for students in the class. How to build different engagements will be illustrated through variations in the work experiences of the lecturers. The different ages will provide an overview of the challenges and obstacles of online learning, especially those related to technology literacy.

Table 4: Profiles of the lecturers participating in in-depth interviews

Initial	M/F	Description
RZ	F	Age of 50, teaching Human Resources Management at Business School, has extensive business experience
AS	M	Age of 55, teaching Digital Marketing at private university, acting general manager at the corporation.
ASA	F	Age of 40, teaching Brand management, at business school, active as an industry mentor
DT	F	Age of 48, teaching entrepreneurship at public university, active as a business coach
CE	F	Age of 45, teaching Fisheries Aquaculture at a public university and engaged with many fisheries' community

4. Results

The results indicate that most of the items taken from the Social-Task-Technology-Fit (STTF) framework remain the same; there are not many changes compared to the era before the pandemic. However, some aspects have new meanings that need to be revisited to capture the lecturers' performance in the new context. Three new themes emerged from the exploration study which have never been discussed in previous studies on LPIs for online teaching, especially in abnormal conditions such as a pandemic. The first theme concerns the variations in digital literacy of lecturers and the implications for lecturers' performance. The second theme is the dynamic ratio of social versus task activities, which implies the need to focus on academic (task-oriented) or non-academic (social) tasks. The third theme is the degree of controllability of each performance while having the same weight for LPIs.

4.1 Digital literacy variations

A lecturer's ability and capability to use technology helps him or her to perform teaching tasks better (Davies, 2011; Hettiarachchi et al., 2021). This was already realized before the pandemic, since also in face-to-face classes the use of modern and sophisticated technology assists the teaching and learning process. The main difference between face-to-face and online classes is that in face-to-face classes a lecturer still has other alternatives to compensate for his or her lack of understanding of technology. For example, a lecturer's breadth of insight, and the way he or she teaches and interacts with the students naturally, are all added values that absorb his or her shortcomings in the use of technology.

During the pandemic lockdown, when online teaching was the only alternative and digital literacy was a must, the situation was different. Students became more critical of a lecturer's ability to use technology. According to the students, without adequate mastery of technology, the work of lecturers in online classes will be ineffective and inefficient. Students sometimes have to wait a long time for the lecturer to solve a problem with the equipment, and then the day's session does not go smoothly. One student commented:

I used to be the happiest student in this lecturer's class. The discussion in class was engaging, with many examples of real-life cases. However, my favourite lecturer is currently spending more time on technical issues. Sometimes when he needs to share the screen, we have to wait for a long time. We feel that the acquisition of material is no longer effective. (Interview, student, ZA)

Lecturers are also aware that their limitations in technology are obstacles to carrying out their duties as good facilitators in online classes during the pandemic. When asked whether they like teaching from home, in general, they agreed that they like it for time flexibility and not having to be stuck in traffic. However, they expressed their concerns about how they would provide interactive and good learning when meeting face-to-face. There are many who only use the standards for mastery of online meeting application technology such as Zoom meetings. At the same time, the students and management have high expectations of becoming more advanced in mastering technology.

It is challenging to liven up the class atmosphere, even though I was known as one of the favourite lecturers at the university. It seems now that creativity alone is not enough. One must have mastery of the latest teaching software. However, with so much work pressure, I do not have time to learn these technologies. This makes me anxious and I no longer enjoy teaching. (Interview, lecturer, DT)

The aspect of digital literacy aspect was previously captured in LPIs in terms of competence (Douglas, Douglas and Barnes, 2006; Fielding, Dunleavy and Langan, 2010; Gibson, 2010); however, it is still mainly limited to competency skills using technology in general, not explicitly affecting teaching success. In online teaching, lecturers' greater digital literacy encourages intense interaction with students. A fun learning process is realized with the smooth use of learning technology.

The availability of online learning support tools that is not matched with the ability to operate them will be in vain. Lecturers themselves can control this aspect of digital literacy. The daily teaching activities carried out by lecturers should be a trigger to improve their digital literacy. When online teaching takes place, lecturers are expected to be able to operate the latest technology and applications; this ability must be continuously improved. Especially in the current era of information technology (IT), learning applications are constantly updated and changed.

When studying online like this, we who want to have the convenience must follow the development of online platforms. However, the same should apply to our lecturer. If the lecturer does not keep up with the development of new learning technology, the class will become boring. (Interview, student, IS)

This study suggests that access to technology is a mandatory requirement that lecturers must meet when teaching online. In the current era of technology and communication, the availability of adequate teaching equipment is an essential aspect. This study provided evidence that most lecturers who have adequate teaching equipment tend to provide student satisfaction. This is also in line with the results obtained by Krumsvik (2014), Laurillard (2008), Rapanta et al. (2020), and Shehzadi et al. (2020), all of whom indicated that there is a positive correlation between student satisfaction and the use of learning support devices. Adequate teaching equipment for online learning includes laptops, cameras, leading internet connection providers, virtual whiteboards, microphones, props, and lighting assistance. With all of these tools, the online learning system is easy to use.

The importance of technological aspects for learning is in line with the student satisfaction survey component proposed by Bradford and Wyatt (2010), Long, Ibrahim and Kowang (2013), and Gee (2018), only the way in which to achieve this has changed. In face-to-face classes, student satisfaction can be achieved by using videos, teaching aids, impromptu quizzes, discussion groups, or asking the students for their direct participation (e.g., coming to the front of the class). Some things that can still be done in online settings to prevent boredom and overcome the issue of the students not being physically present are online quizzes, break-out group sessions, and playing exciting videos.

Lecturers can control the aspect of using learning support devices, because they can manage the access to these devices. In addition, universities, as service providers, can facilitate lecturers obtaining adequate learning support tools.

It is costly to be fully equipped, but my lecturer said he needs to do it. He bought and invested in an iPad with an e-pen during the pandemic, so he could write and elaborate on an online board when talking about challenging aspects, just like if we were in a typical onsite classroom. (Interview, student, DA)

4.2 The dynamic of social versus task performance

In face-to-face classes, much of the discussion about performance relates to activities using the 'in-class' versus 'outside class' dichotomy. 'In-class' relates to academic activities, while 'outside class' relates more to non-academic activities, that is, social relationships. At a time when 'in-class' settings no longer dominate meetings between lecturers and students, but has been replaced by continuous interaction, the dichotomy needs to be revisited.

All explanations about student satisfaction are more directed to in-class learning. Before the pandemic, students talked about learning experiences when they met face-to-face on campus, especially in the classroom where they studied and met with lecturers. However, in this pandemic period, in-class learning is no longer the only opportunity for interaction with lecturers; in some cases, students even interact more via WhatsApp chat.

The social factors discussed in the STTF framework in the pre-pandemic period focused on non-academic interactions where relationship building with lecturers took place. Lecturers who were accessible and friendly outside the class were open to discussions with students when meeting them on campus and at events. However, this was more non-academic related. Interestingly, during the pandemic, outside class interaction is about relationship-related aspects and academic interactions. Classwork is continued outside the class, and this has become routine and part of the total experience.

In the task-oriented performance, commitment and motivation discussed in face-to-face learning are more about timely commitment, materials according to the curriculum, and motivation around teaching preparation and making the class successful (Xiao and Wilkins, 2015; Dachner and Saxton, 2014; Dziuban et al., 2015). When learning online, students must focus on listening to the lecturer, but the lecturer must also focus on the audience. This is because online learning time tends to be more flexible, thus providing an opportunity for anyone in the Zoom meeting to do other things at the same time.

The theme that emerged during the exploration study is the ratio between the types of activities, namely task-oriented activities and social-oriented activities, as part of the teaching-learning journey. Tasks versus social activities can be used to replace the in-class versus outside class dichotomy.

4.2.1 Social-related indicator: Communication

Social relations between lecturers and students must be built consistently. This is important because lecturers and students tend to interact less directly in online learning, only through virtual involvement. The lecturer needs to maintain this involvement so that the students feel comfortable. As proposed in this study, one way to modify lecturers' activities is through lecturers' efforts to continue communicating with their students outside the classroom, through WhatsApp groups. In this case, lecturers can also send invitations to students' social media accounts in order to increase the closeness virtually established with their students.

My lecturer was entertaining. He extended the class discussions after class by creating a WhatsApp group (WAG). Moreover, he answered all the questions on the WAG, and when contacted via email, the response was also swift. (Interview, student, IS)

I am devastated. It's been two days since I sent a message on the WAG but there has been no reply, even though this is about our class group assignment. In the end, we worked with limited understanding. (Interview, student, SA)

4.2.2 Social-related indicator: Empathy

Before the pandemic, the emotional attachment was already significant, but this study found that the intensity had even increased. Empathy is at an average level, but this empathy is of a more holistic nature. Some lecturers even helped think about how to deal with the problems of students who were far from their parents and later caught COVID-19. They extended their service to more than a facilitator in the classroom.

I noticed that students were not present for several meetings, and I asked their friends if there was a problem. When I heard that they had been exposed to the virus, we lecturers had to be ready to intervene. Teaching work requires more dedication. (Interviews, lecturer, CE)

At the beginning of the online class, my lecturer said that there must be a two-way conversation, and lots of questions and answers because it's online. The WhatsApp group was specially created for extending the class discussion. (@JIMxxx, on Twitter)

Introverted students feel more pressured by online meetings; when the lecturer calls on them to answer questions, they feel unable to explain the answers, because they feel all eyes are on them on the screen.

My introverted soul was immediately scared; then panic attacks started, even before class. From waking up until class started, my heart was pounding very loudly, I had cold shivers and excessive anxiety. (Herlixx Waxx, on Facebook)

Empathy for students is when the lecturer realizes that with this online learning, everything must be considered from all angles. For example, lecturers should understand that students also get many assignments from other lecturers. Not understanding the student's holistic situation is included in one of their complaints:

My lecturer has never thought about our mental condition. It's been COVID, and there are lots of assignments, lots of mental burdens. I am almost burnt out. The lecturer put too much on our plates. (Interview, student, LE)

The study results indicate that empathy is an intangible indicator in terms of students interacting with their lecturers, both in online classes and outside of classes, through discussions and communication on the internal campus website and WhatsApp groups. Therefore, as a good lecturer in the online environment, it is essential to find a way to read the non-verbal responses from students so that the created dialogue produces optimal output, as expected. It seems essential for lecturers to empathize with students. Empathy can be built by building communication through lecturer–student interactions. This sense of empathy supports the bond between lecturers and students (Douglas, Douglas and Barnes, 2006). Student satisfaction can be realized when lecturers build good relationships with students.

An aspect that is no less important is showing concern for students' difficulties when they are studying online from home. Meyers et al. (2019) realized the importance of the role of lecturers in maintaining the psychological wellbeing of students. This can have implications for a comfortable and enjoyable learning process. The lecturer's concern for students is essential in providing this psychological service. Students need psychological and emotional support from lecturers, particularly in the case of a pandemic where they are bored with the online learning routines.

4.2.3 Task-related indicators: Teacher commitment and motivation

The interview results indicate that lecturers often perform activities other than teaching activities during online learning. One respondent shared that his lecturer participated in other webinar activities that coincided with the teaching schedule of his class. The lecturer should stay focused on teaching by not performing other activities in parallel. This will encourage the creation of a conducive learning space during online learning. This is also supported by the findings of Student A's netnography on Twitter; according to him, lecturers carry out other activities besides teaching and other lecturers expressed the same opinion.

It seems that my lecturer is currently on a webinar elsewhere because the response is not instant, and the answer is unclear and not relevant. Key management should be aware of their lecturers' habits and that they run parallel sessions, because it ruins our learning. (@Auslxxxx, on Twitter)

During this pandemic, as a lecturer, I am also confused about dividing my time, because sometimes external webinars or meetings coincide with the teaching schedule. Like it or not, they have to be parallel. (Interview, lecturer, RZ)

This commitment aspect is controllable, because lecturers can manage their activities while prioritizing teaching. The respondents said that lecturers did not teach according to the lecture schedule during the online learning process, which should have been agreed upon at the beginning of the semester. During class schedules, lecturers only make announcements through the class WhatsApp group and ask students to study material through YouTube channels. This makes students dissatisfied, even though the material presented has been discussed a lot; it still requires two-way interaction between lecturers and students. As a result, students complain that they have to pay full tuition fees but do not get the full attention of the lecturer.

Here he is, he's coming for five minutes, then gives us the task to go to his YouTube channel, then he's gone. I'm disappointed that I can't discuss and gain insight from him today. This session is supposed to be synchronous. (Interview, student, YY)

When I am needed elsewhere, my role is more important there, because it is an urgent matter in the corporation. Sometimes I ask students to open my material on my YouTube channel, and then I will evaluate their understanding by asking questions asynchronously. (Interview, lecturer, AS)

4.2.4 Task-related indicators: Using creativity for engaging experiences

In this study, it was found that creating an engaging class is an essential aspect that students expect from an online environment. Students appreciate lecturers' efforts, as can be observed from the following excerpt:

One of my best lecturers is willing to explain concepts with interactive PPT slides. Besides that, he uses quizzes such as Kahoot or Quizizz. Then also, we study in groups in the break-out of the Zoom room, and he goes around to see which students have issues and need help. (Interview, student, MRF)

4.2.5 Task-related indicators: Monitoring student attendance

Some interviewees admitted that they thought that online learning allowed them to perform other activities simultaneously. Of course, this is a problem, because these students do not focus on the provided material. They tend to do other things that are not relevant to learning (e.g. opening social media, surfing online, and doing homework). Therefore, the lecturer must continuously control the class through different means.

In blended learning, the terms 'synchronous meeting' (face-to-face or online) and 'asynchronous meeting' (not face-to-face) can be adjusted according to the parties' respective available times. Synchronous meetings are expected to be more frequent than asynchronous meetings, because too many asynchronous meetings will reduce interaction and likely decrease understanding. Attendance at asynchronous times can be ensured by carefully evaluating student assignments.

Sometimes I feel there is an opportunity to do non-class-related things because the lecturer doesn't care whether we are present or not. He was busy talking to himself while teaching via Zoom. This is not good; it made us lazy. (Interview, student, SA)

This is an indicator for measuring lecturer obedience, which is no different from the face-to-face learning process. The lecturer's task is to verify students' attendance in class, as revealed previously (Baber, 2020; Young, Young and Cartwright, 2020; Zhan and Mei, 2013). During offline classes, lecturers ensure student attendance

through attendance and direct physical interaction. While online, lecturers need to ensure that all students install their audio and cameras properly to ensure attendance.

4.2.6 Task-oriented indicator: Being responsive and interactive

Students feel that it is essential that lecturers note their presence. During face-to-face lectures, students can ask the lecturer directly to get real-time answers. However, during online lectures, students must wait indefinitely for the lecturer to answer their questions. A student said that he expected quick feedback from the lecturer, similar to what he would expect in a face-to-face environment. Lecturers need to modify their methods to be more responsive and interactive in online classes. This is in line with the results obtained by Nasser-Abu Alhija (2017), Paladino (2008), and Su and Wood (2012), according to which responsive lecturers increase student satisfaction with lecturers when learning online.

An unpleasant experience was conveyed by a respondent who said that he had activated the raise-hand feature of the online meeting application during the online class, but that the lecturer had ignored it. This experience indicates that lecturers have not modified their way of dealing with students who want to participate. Lecturers are still guided by face-to-face teaching, where students raise hands which can be seen directly.

During the online class, I wanted to ask the lecturer, then activated the raise-hand feature, but it was ignored. I feel agitated. (@charxxx, on Twitter)

Sometimes there are lecturers who respond very fast, within a few minutes; however, there are also those who answer after a few hours or even some who only answer after I have been waiting for a few days, so it's useless. (@Bentxxx, on Twitter)

4.2.7 Task-oriented indicators: Reducing external distractions and interruptions

In the case of face-to-face learning taking place in the classroom, both lecturers and students only focus on activities in the classroom. However, online learning, conducted at home, involves various unavoidable distractions and interruptions from the surrounding environment. These disturbances include the atmosphere and surrounding conditions that are not conducive and interfere with the lecturer's assignments or homework. This disrupts the process of delivering material and, as a result, students have difficulty understanding the material that has to be delivered. To avoid this issue, lecturers must arrange quiet rooms and educate the family to leave them alone during classes.

My lecturer teaches while taking care of the baby. Right from the beginning of the class, the baby was already crying. During class the baby also cried, until my lecturer finally turned off the camera and the sound. It's also hard to focus on listening to the explanation. (@pierxxx, on Twitter)

4.3 Controllability factors

This study found one striking uncontrollable factor that affects teaching success: the network and the signal/clarity. Academically, this aspect is a novelty for this study and needs to be noted. This specific technology-related dimension is also critical, as it is not included in the current LPIs. To obtain more holistic and contextual LPIs, university managements should include this factor with caution, that is, not place too much emphasis on evaluating lecturers on things that are beyond their control.

At first, I thought the network would be smooth, but the lecturer's network was bad, so suddenly I didn't have the chance to participate in the quiz. (@JIMxxx, On Twitter)

After waiting for two hours, there was no sound. It turned out that the lecturer's house was out of light! (@nataxxx, on Twitter)

I feel that general things such as task orientation and managing student interaction can be controlled. However, what is worrying is that some things in running this class are beyond my control. And, if because of that, I am considered to perform poorly, that is not fair. I've been struggling to keep the sessions successful. (Interview, lecturer, ASA)

The aim of the weighting between controllable and uncontrollable factors is so that lecturers will be alert to various factors that depend on their willingness. However, it is not the intention that they should be involved in excessive efforts to overcome problems that are beyond their control. The ability of lecturers to satisfy student needs in terms of controllable and uncontrollable factors depends on student–student interactions, student–lecturer interactions, teaching methods, and the organizational structure (Dary and Pickeral, 2013; Sulak, 2018).

As discussed by Bradford and Wyatt (2010), Vonderwell and Zachariah (2005), and Zahedi and Dehghan (2019), in the case of online learning, lecturers can only rely on the sound and images presented on digital screens. In this context, the network becomes a critical component to support learning for both students and lecturers. However, internet service providers with reputable networks remain limited. In addition, network and signal stability are highly vulnerable. Dependence on the use of networks and signals for online learning is inevitable. These two components are essential aspects that must be considered to conduct successful teaching sessions.

The performance quality of the service provider, which plays an important role, is beyond the lecturer's control, because he or she cannot directly control the network and signal stability during online teaching. Likewise, previous studies have discussed face-to-face learning, indicating that support from institutions significantly influences the success of a lecturer's teaching process (Rapanta et al., 2020).

During face-to-face learning, support is provided concerning access and licences for premium platforms, and there is the presence of technical department staff or IT staff to help lecturers identify and overcome the 'time-consuming problems' they face (Joshi, Vinay and Bhaskar, 2021). However, such support is not available during the online learning process. Networks and signals that play a significant role are beyond the control of both lecturers and universities. It is increasingly important to focus on this factor in an online learning environment amidst the automation and system uncertainty that can occur at any time and cannot be controlled by the user. One student related that she cancelled a quiz during class due to a network problem. This can cause delays in the effectiveness of the teaching and learning processes.

Table 5 summarizes the three themes that emerged from this research study and elaborates on the lecturer performance indicators that should be considered, especially to create a pleasant learning experience in an online learning environment.

Table 5: Emerging themes and weighted lecturer performance indicators

	Theme	Condition	Weighted LPIs
1	Digital literacy Variation	- Low - High	- Lecturer with a high level of digital literacy: technology-oriented performance indicators weigh higher than course content delivery indicators (task) - Lecturer with a low level of digital literacy: technology-oriented performance indicators weigh lower than course content delivery indicators (task)
2	Social vs Task-related dynamic	- Social is more important than task - Task is more important than social	- Task is more important than social – in a pandemic: social factors should be given higher weight than task-oriented factors - In normal conditions: social factors should be given a lower weight than task-oriented factors
3	Controllability	Controllable vs uncontrollable factors	Controllable factors should be given a higher weight than uncontrollable factors

5. Conclusions, implications and recommendations

This study enriches previous studies that discussed the same topic, namely the expectations of students in online classes during the COVID-19 period. Most previous studies have used a quantitative approach that failed to reveal fresh insights. By contrast, this study, using a qualitative approach, based on data obtained from social media and in-depth interviews with two essential stakeholders, namely students and lecturers, achieved a deeper understanding and validity through triangulation.

Based on the results and discussions, the researchers conclude that universities should stop using generic LPIs and redesign the LPIs contextually. It is suggested that a weighted system between performance variables be introduced, considering the three themes derived from this study: (1) the degree of digital literacy of the lecturer; (2) the dynamic expected ratio between task-based (academic) and social (non-academic) performance; and (3) the controllability of each aspect.

This study demonstrates that sudden situations such as this pandemic should not pressure lecturers who have shown strong dedication and high performance in teaching. One of the factors, namely the level of digital literacy of a lecturer, cannot be achieved instantly. Universities need to cluster groups of lecturers based on their level of digital literacy and give different weights to LPIs in technology-related performance aspects. Digital literacy, which varies from lecturer to lecturer, is homework for universities, and this depends on the extent to which a university is willing to invest in talent development. By categorizing lecturers according to their level of digital literacy, the issues that arise around this technology aspect can be handled contextually.

Important aspects that need to be considered in designing the contextual LPIs are the social versus task-related performance expectations based on the macro environment. A resourceful lecturer during the COVID-19 pandemic will give more attention to social or non-academic aspects than task or academic aspects. The reason is that students are not only in an online environment but also in an uncertain situation and experiencing health pressures. Social aspects, which were initially only limited to outside class activities aiming to maintain relationships, must be extended more widely during the pandemic. Empathy and paying attention to students are factors from the beginning until the course is finished, and serve as an ongoing service, not just an event. Overall attention, both academic and non-academic, is present in social factors, but not limited to outside class activities, but feature throughout the teaching-learning journey.

The same goes for controllability. The new LPIs design should give greater weight to aspects that the lecturer can control, and conversely, give less weight to aspects that the lecturer cannot control. Giving more weight to controllable aspects signals to the lecturer that what is under control should be done as well as possible. Lecturers need to be confident that their performance in carrying out teaching tasks is appropriately and fairly assessed. Something that happens with the network signal and internet-related problems should not reflect on them because this aspect is beyond their control.

The results of this study can be used for HEI management to design more contextual LPIs, tailored to what the lecturer can and cannot do and based on current student expectations. This will subsequently make it easier for lecturers to focus their efforts on creating quality teaching. Contextual LPIs can be used not only during a pandemic but also in other contexts, where it is necessary to first look at the boundaries of the assessment corridor and how controllable or uncontrollable an aspect is. By using a contextual evaluation, universities can get information about their lecturers' portfolios faster, and corrective action can be taken immediately. In addition, because the assessment is fairer, lecturers will not be anxious to face changes in the macro environment.

To maintain their performance, it is always preferable for lecturers to keep updating themselves with technology capability, to be prepared for any global environment changes. It is also recommended that universities keep lecturers informed about students' trends and current needs and how they can juggle between academic and non-academic task versus related social aspects in their interaction with students. Universities are urged to allocate resources to focus on human capital development, particularly for digital literacy competency.

The limitation of this study was the difficulty identifying students who write stories on social media, because not all of them use their real identities. Especially students who submit complaints tend to be careful about responding to further questions from researchers. Future research should look at the differences in the opinions of students from public versus private universities, considering that students at private universities are more demanding because the tuition paid is higher.

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Talismans of Digital Literacy: A Statistical Overview

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Abstract: The individuals living in the 21st century have become the consumers of digital innovations and have to adapt, adopt and adapt to the new norm of surviving and thriving in the digital society. Familiarity with the latest technologies is not the only requirement for survival. One also needs to have relevant digital competencies to complete tasks with optimized outputs and efficiently deal with the chain of digital changes. The current study introduces the South Pacific digital literacy framework (SPDLF) driven by 6 essential literacies and sixty attributes. The study intends to provide a three-stage statistical validation for the South Pacific digital literacy framework. The three stages of validation include; (1) evaluating the strongest predictors of digital literacy from the six literacies in the SPDLF, (2) evaluating the significant predictors of each of the six literacies and (3) evaluating the significant attributes from a total of sixty attributes in the SPDLF. The results show that all attributes in the SPDLF are statistically significant, therefore, all attributes are significant contributors to digital literacy in the South Pacific digital literacy framework.

Keywords: Digital literacy, digital literacy framework, south pacific, digital age, 21st-century education

1. Introduction

The third millennium witnessed the involvement of new technologies, which transformed the ways society functioned. The livelihood of people has changed through the increasing inclusion and usage of ICT resources and tools. Industries such as agriculture, transportation, communication and education have been automated to improve efficiency and productivity. The education sector has seen technology as a powerful catalyst for extensive changes in the education system and the stakeholders experiencing the evolution of education from Education 1.0 to Education 4.0 (Himmetoglu Aydog & Bayrak., 2020; Tejedor et al., 2020; Feerrar, 2019). To elaborate further, Himmetoglu Aydog & Bayrak. (2020) define Education 1.0 as the downloading education, Education 2.0 as open access education, Education 3.0 as knowledge-producing education and Education 4.0 as innovation-producing education. Maphosa and Bhebhe (2019) add that Education 3.0 advanced the facilitation processes; thus, the students were learning virtually and the access to education was from anywhere at any time. On the other hand, Education 4.0 focuses on the use of smart technology, artificial intelligence, big data, and robotics in the teaching and learning processes (Tejedor et al., 2020, Feerrar, 2019). Education 4.0 reflects the innovations in teaching and learning practices, such as the use of digital technology and digital platforms for lifelong learning (Himmetoglu Aydog & Bayrak., 2020).

Student attributes in Education 4.0, as described by Himmetoglu et al. (2020), include cybersecurity knowledge, producing new information and using appropriate technologies, using technology effectively, the ability to differentiate between right and wrong information and distributing information safely using various online platforms. With Education 4.0 in place, there is a demand for higher education institutes (HEI) to graduate students with the relevant competencies to adapt to the technology-enabled work environment (Tejedor et al., 2020). Hence, many HEI worldwide is developing and expanding programmes to ensure that their graduates are well equipped with the required skills for digital workplaces (Feerrar, 2019). The collective shaping of individuals is referred to as digital literacy, which has become one of the essential surviving skills in the 21st century.

The term digital literacy has been defined as skills or competencies, or abilities of an individual to use digital technologies and knowledge of norms and practices that revolve around the appropriate use of relevant digital technologies (Reddy, Chaudhary & Sharma., 2020b; Feerrar, 2019; Maphosa & Bhebhe, 2019). There are several global definitions and frameworks developed for digital literacy; however, the emphasis range from the baseline knowledge about technology or computer literacy, and critical thinking to online engagement and ethics (Feerrar, 2019). These definitions and frameworks assist in measuring digital competencies and can help strategize the implementation of appropriate digital literacy programmes. Researchers believe that the digital competencies of students need to be measured so that the existing digital divide can be narrowed, particularly

in developing countries (Tejedor et al., 2020; Maphosa & Bhebhe, 2019). According to Tejedor et al. (2020), introducing educational technology itself does not improve teaching and learning outcomes. It needs to be used effectively and that is achievable through proper training. Dashtestani & Hojatpanah (2020), add that it is often assumed that the “Net Generation” learners are digitally literate and know how to use educational technologies presented to them effectively. However, this has been proved wrong by the many studies conducted, which showed that students who were above 30 years exhibited characteristics of digital natives (Tejedor et al., 2020). This means that although the “Net Generation” users are well versed in the use of new digital technology, there is a gap between personal and academic use of technology. The supposed digital natives are consumers of the digital content available to them rather than content creators for academic learning (Dashtestani & Hojatpanah, 2020; Reddy, Chaudhary & Sharma., 2020b; Tejedor et al., 2020).

The HEI is responsible for providing structured learning experiences. With Education 4.0, digital literacy can be used as the basis to prepare the graduates with the relevant skills needed for technology-enabled workplaces. Since the framework for digital literacy at higher education differs per individual, professional organizations, government and country, the current paper works on a digital literacy framework developed for the South Pacific. The reader is referred to the work of Reddy, Chaudhary & Sharma.(2020a). The developed framework, namely the South Pacific digital literacy framework (SPDLF) consists of 6 inter-related literacies, namely media literacy (M), information literacy (Info), visual literacy (V), communication literacy (Comm), computer literacy (C) and technology literacy (T). The SPDLF has been adopted from Covello’s digital literacy framework and the definition for each literacy has been modified to meet the digital literacy requirements of the 21st century. Each literacy in the SPDLF has a number of attributes as shown in Figure 3. In total, sixty attributes will be used to measure the digital competencies of students. The sixty attributes have been developed to meet the requirements for the 21st century and the literacies in the SPDLF. This paper is a continuing work on digital literacy in the South Pacific by Reddy et al. (2020a, 2020b, 2020c). While the authors have conducted studies on measuring digital competencies of students at a regional university, this sequel aims (1) to provide a statistical validation of SPDLF, (2) to determine the strongest predictors of digital literacy from the SPDLF, (3) to determine the significant predictors of each literacy and (4) to evaluate the significant predictors of digital literacy from the sixty attributes that are part of the SPDLF.

Globally, studies on digital literacy have shown the digital literacy competencies of individuals, the frameworks of digital literacy, the contributions of digital literacy in education, the importance of digital literacy in the 4th industrial revolution, digital literacy as predictors of other literacies etc. The current study is the first of its kind in literature that evaluates each literacy’s significant predictors/contributors in the digital literacy framework. This study also evaluates the significant predictors/contributors to overall digital literacy. Moreover, the paper provides a statistical validation of the South Pacific digital literacy framework developed to measure individuals’ digital literacy competencies in the South Pacific and beyond. Digital literacy plays an important role in Education 4.0, thus knowing the significant contributors to digital literacy is important. Since the studied attributes for digital literacy are aligned to the 21st century required skills, the results of the study can be used by relevant stakeholders in the education sector and other interested organisations to revise and improve their digital literacy education curriculum and programmes.

The content of the paper is distributed as the following; contribution to the field of digital literacy by researchers including South Pacific in the literature review section, the description of the instruments to collect and measure digital competencies in the methodology section and the analysis of the data in the results and discussion section. Finally, the paper essays recommendations on ways digital literacy programmes can be aligned to improve the digital literacy of individuals in the South Pacific.

2. Literature Review

2.1 Digital literacy and its components

The theoretical understanding of digital literacy is extensive. While some researchers incorporate skills and competencies, others harness multi-literacies. The ideas and initiatives around digital literacy keep changing due to two reasons; technology keeps evolving, and new frameworks are continuously designed as per individual, organization, and country needs (Hamaguchi, Nematollahi & Minter, 2020; Radovanovic et al., 2020; Durak, 2019). The standard and global definition for digital literacy given by UNESCO (2018) are:

Digital literacy is the ability to define, access, manage, integrate, communicate, evaluate and create information safely and appropriately through digital technologies and networked devices for

participation in economic and social life. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy, data literacy and media literacy.

The above definition addresses the various dynamics and forms of digital literacy competencies needed for survival in the digital age. Although frameworks are being developed using the global definition from UNESCO, the dimensions in the country-based frameworks differ and reflect the sustainable development and progress of the country. For example, UK uses 7 elements of digital literacy (Radovanovic et al., 2020), Singapore uses 5 elements (Government of Singapore, 2020), the US uses the TPACK framework (digitalliteracy.US, 2020), Malaysia uses 3 element framework (Saubari & Baharuddin, 2016) while in the South Pacific a 6 element digital literacy has been designed (Reddy, Chaudhary & Sharma., 2020b). As stated above, the digital literacy framework developed by Reddy et al.(2020a, 2020b) is referred to as the South Pacific digital literacy framework (SPDLF). The SPDLF consists of 6 elements- media literacy, information literacy, visual literacy, communication literacy, computer literacy and technology literacy. As such, the definition of digital literacy in the South Pacific context is (Reddy, Chaudhary & Sharma., 2020b):

Digital literacy is an individual's ability to find and evaluate information, use this information effectively, create new content using this information and share and communicate this newly created information safely using appropriate digital technologies.

Research shows that essential components of digital literacy have been drawn by observing the requirements and demands of the digital society. As such the framework developed by (Reddy et al., 2020c) targets the essential digital competencies needed to bridge the persisting issue of the digital divide in the South Pacific. Although the framework has been piloted in the education sector, the authors believe that it can be applied to any context in the South Pacific and beyond. Moreover, the 6 elements or literacies that are part of the framework have been individually or inter-relatably researched upon. The next few paragraphs reflect prior research on the 6 literacies that are part of the study.

Reddy, Chaudhary & Sharma. (2020b), in their comprehensive review on digital literacy, state that the first literacy associated with digital literacy is visual literacy, which is seeing, interpreting, and communicating information to others. Researchers have defined visual literacy as a set of abilities that enables an individual to effectively find, interpret, evaluate, use, and create images and visual media (Kedra, 2018; Meeks, 2017). To add on, Hamaguchi, Nematollahi & Minter.(2020), Pem (2019) and Kedra (2018) state that an individual is visually literate if he/she has the knowledge and skills to interpret and understand visual messages, knows visual grammar and can use the visuals to communicate. The scholars, in their view, also state that there is no one definition of visual literacy since new technologies develop much faster and individuals deeply immerse themselves into using these new technologies. Learners are passive consumers of visual culture, they receive visual messages in the classroom, but to what extent they can derive meaning from them is another question (Kedra & Zakeviciute, 2019). Considering the above ideas, visual literacy has been reconceptualized as the ability to use digital technology to read, interpret and understand the information presented in pictorial or graphic images, communicate this information and convert it into visual representations.

Next, technology literacy has been defined as having the ability to use digital technology to improve learning, productivity, and performance (Reddy et al., 2020a; Durak, 2019). Many researchers have integrated technology literacy with computer literacy or information communication literacy but the authors of the current paper believe that technology literacy in the 21st century has separate competencies and needs to be separately learnt and measured as technology literacy involves a lot more than just knowing how to use technological devices. The notion is also supported by the work of (Durak, 2019; Julia & Isrokatun, 2019) which shows that technology literacy is beyond the ability to collect, manage, produce and transfer information and must not be mixed with computer or information literacy of individuals. Literature shows that the studies of technology literacy are now expanding their horizon from education and STEM fields to human resource management, from people with disabilities to facilitating elections (Jibia et al., 2020; Susanti et al., 2019; DeCoito & Richardson, 2018; Allison et al., 2017).

Next, computer literacy is an individual's understanding of how to use computers, digital technologies and their applications for practical use (Reddy et al., 2020a; Tsai et al., 2020; Fraillon et al., 2018). Recently, computer literacy has been classified as one of the fundamental and educational goals in many countries as its competencies consist of the use of computers, information gathering, evaluation and management, information production transformation and creation, digital communication, information sharing and responsible and safe

use of digital technologies (Tsai et al., 2020; Makhmudov, Shorakhmetov & Murodhosimov., 2020). Studies on computer literacy are now ranging from early childhood education to the older generation because there is a growing need for individuals to be computer literate (Tsai et al., 2020; Makhmudov, Shorakhmetov & Murodhosimov., 2020). Additionally, digital platforms being the medium of information distribution, is putting more emphasis on individuals to be computer literate. Therefore, computer literacy becomes an integral part of all spheres of 21st-century life.

The next literacy is information literacy, which is the ability to reflect on the nature of the information, its technical and social infrastructure and philosophical context and impact (Library, 2020). Since information literacy enables people to find relevant and credible information particularly using websites frequently to look for resources, it has become an integral part of educational institutes in the 21st century (Guo & Huang, 2020; Reddy, Chaudhary & Sharma.,2020b). The work of Aharony and Gazit (2020) and Konovalenko and Nadolska (2020) add that information literacy makes teaching and learning effective irrespective of the level of education. Information literacy has also been marked as an important determinant of online information search capabilities and a significant competency that impacts an individual's acceptance of technology (Aavakare & Nikou, 2020; Coklar, Yaman & Yurdakul., 2017).

Likewise, media literacy which had been integrated with information literacy in many studies from literature, will be treated as a separate component in this study. Media literacy has become a lifelong process and is defined as the ability to access and create communication signals and recognize the property, wealth, and values underlying the messages (Reddy, Chaudhary & Sharma ., 2019; Ainura et al., 2018). Researchers add that media literacy has become a lifelong process as the use of the Internet for various purposes evolved in the 21st century (Simons et al., 2017; Sas, Meeus & Simons., 2017). Media literacy has been remarked in health care, particularly food communication, news reporting and online social behaviour (Festl, 2019; Austin et al., 2018; McGlinn & Casey,2018). The current authors believe that with the growth of technology and the media industry, individuals in the 21st-century must be media literate to be well-versed and comprehensive media users.

The final component of digital literacy is communication literacy which only a few researchers have separately studied (Ghasemi & Rasekh, 2020; Reddy, Chaudhary & Sharma., 2020b). Communication literacy has always been considered part of information literacy or media literacy (Zoubi, 2021; Lofthus & Silseth, 2019; Simon et al., 2017). The work of Ghasemi and Rasekh(2020) and Reddy, Chaudhary & Sharma. (2020b) define communication literacy as using digital technologies to communicate effectively as individuals and work collaboratively in groups, using publishing technologies, the Internet and the Web 2.0 tools and technologies. Communication literacy has been listed as an important literacy in the 21st century by only a few authors (Author et al., 2020b; Keskin, Ozata & Banar, 2015) and was adopted from Covello (2010). Since digital technologies and digital platforms have created and increased social interaction, one needs to have the ability to use these safely and effectively. Although individuals practise the act of communication literacy, there has not been any study done on communication literacy or the attributes of communication literacy. Through this study, the authors of the paper will highlight the attributes of communication literacy and their importance for 21st-century individuals.

The studies conducted on the above-discussed literacies vary amongst researchers. The characteristics of the attributes or features that define each literacy differ from one study to the other. For the current study, the characteristics selected to define each literacy are presented in Table 10 in the appendix. From the given characteristics/attributes of digital literacy, the strong predictors of digital literacy are evaluated.

2.2 Education 4.0 and Digital Literacy

The 4th Industrial Revolution (4th IR) brought changes in the education setting, making Education 4.0 the desired approach to learning. Education 4.0 harnesses the potential of digital technology and provides open education resources for lifelong learning (Chaka, 2020; Lestari & Santoso, 2019). On the contrary, Hariharasudan and Kot (2018) state that although Education 4.0 promotes an abundance amount of information and increases dynamic learning processes, it is often hindered due to weak alliance in adapting technology-enabled learning and lack of digital literacy skills. The work industry in the third millennium requires digital literacy skills to be productive and efficient; therefore the need for graduates to have digital literacy skills has become a requirement (Lestari & Santoso, 2019; Hariharasudan & Kot, 2018). As such, in collaboration with industries, HEI needs to come up with new programs to develop relevant digital literacy skills for its graduates. The idea of upskilling the digital competencies of graduates will transcend them to thrive in a digitally enabled work environment (Lestari &

Santoso, 2019; Abel et al., 2018). All in all, many scholars and researchers in the literature have invariably classified digital literacy as the gateway to Education 4.0.

Education 4.0 is best described as promoting life coping skills such as leadership, collaboration, creativity and innovation using digital technology, information and media literacy, knowledge about cyber-physical systems, artificial intelligence, Internet of Things (IoT), cloud computing, mobile technologies, open and smart education and blockchain (Tejedor et al., 2020, Feerrar, 2019; Lestari & Santoso, 2019; Hariharasudan & Kot, 2018). Figure 1 shows a summary of Education 4.0 which has been gathered from literature (Chaka, 2020; Lestari & Santoso, 2019; Hariharasudan & Kot, 2018; Abel et al., 2018). Education 4.0 for the current study has been categorised into four categories of life-coping skills, smart learning modes, transformation technologies and smart education tools.

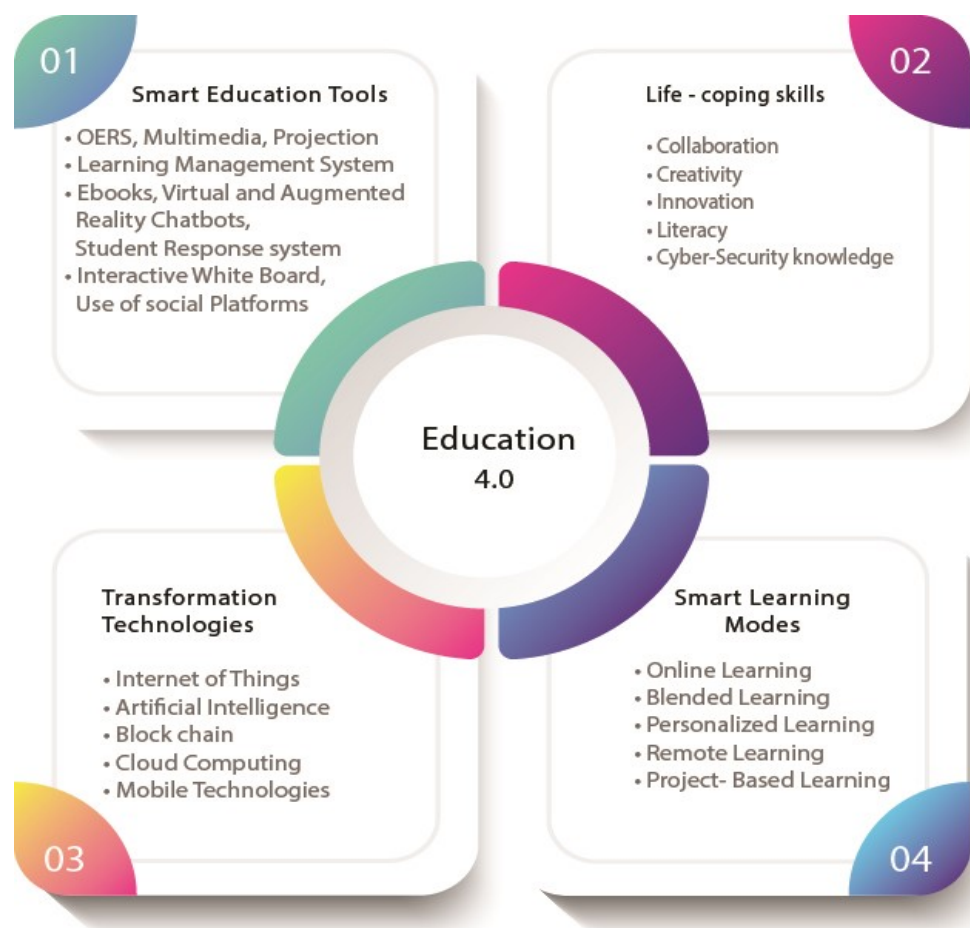


Figure 1: Education 4.0 summarised

Based on the characteristics of Education 4.0 listed by prior researchers and the characteristics of digital literacy discussed under "Digital literacy and its components", the authors of this paper have come to a conclusion that digital literacy and Education 4.0 have a strong relationship. Figure 2 describes the relationship between Education 4.0 and digital literacy. Figure 2 shows that the goals of Education 4.0 and the characteristics of digital literacy are similar; hence, it can be stated that digital literacy complements Education 4.0. Digital literacy enhances students' skills and enables them to successfully use technology-enabled systems (Abel et al., 2018). Digital literacy is also a manifestation of classroom performance, staff and student readiness for technology-enabled learning and lifelong learning (Makhmudov, Shorakhmetov & Murodhosimov, 2020). If a student has relevant characteristics of digital literacy, then he/she will accomplish the goals set by education institutes in the 21st century.



Figure 2: Relationship between Education 4.0 and digital literacy

2.3 Education 4.0 and Digital Literacy in the South Pacific

The impact of the 4th industrial revolution on the South Pacific region is similar when compared to the rest of the world. In the third- millennium, the South Pacific region is standing on the cusp of a digital revolution due to the permeation of digital technologies, the Internet and improved network infrastructure (GSMA,2019; Vula,2019; Raturi,2018; Sharma et al., 2018a). The proliferation of the digital revolution has been accelerated by the “Net Generation” in the South Pacific region and with this realization, the education sector has gone under reforms to meet the demands of learners who become the future workforce (Reddy et al., 2020a; Reddy, Chaudhary & Sharma., 2019; Sharma et al., 2019a; Sharma et al., 2019b). The governments of the South Pacific countries have also worked in collaboration with the industries, non-government organisations, and tertiary institutions to prepare a digitally skilled workforce in the region (Asian Development Bank,2019; The Fijian Government, 2019; Council of Regional Pacific Community, 2018; PRIF, 2015). The adaptation of new technologies will support transportation, renewable energy, manufacturing, agriculture, ICT, education and other service-related sectors (Sharma et al., 2019a; Council of Regional Organisations in the Pacific,2018; Park, 2018; Raturi, 2018). For the current research, the authors will reflect on the impact of the 4th industrial revolution on the education sector.

The University of the South Pacific (USP) is playing an active role in driving technology-enabled learning in the South Pacific region. The university is owned by 12 member countries across the region and is responsible for integrating ICT and digital technologies to deliver its teaching and learning processes (Reddy et al., 2020a; USP, 2019; Sharma et al., 2019a; Raturi, 2018; Sharma et al., 2018a). Some of the technology-enabled facilities at USP include (Sharma et al., 2018b):

1. distance flexible learning, which includes blended learning, cohort-based learning, online learning, tablet learning through the use of assistive technologies such as teleconferencing, learning management systems, smartphones, mobile devices and Big Blue Button.
2. virtual classrooms using the Remote Education and Conferencing Tool (REACT) services.
3. Online Mathematics Diagnostic Tool (OMDT) is an intelligent testing system that diagnoses student's knowledge in different areas of mathematics.
4. early warning system (EWS) to track student activity and performance via the learning management system Moodle.
5. lecture capture system which records lectures that include the audio, the lecture slides that are projected on the screen and lecturers' annotations in class.

Other universities in the South Pacific region like the University of Fiji, The Fiji National University, the University of New Caledonia, Solomon Islands National University and the National University of Samoa facilitate their teaching and learning processes similarly. The South Pacific researchers have termed these facilitation processes in the 4thIR as technology-enabled education or ICT-enabled education or digital education (Sharma et al., 2019b; Nand & Sharma, 2019; Raturi, 2018). However, if the above education processes or services are evaluated, they can be classified as active components of Education 4.0, captured in Figure 1. Therefore, to the best of the authors' knowledge, this study is the first from the South Pacific region, which recalibrates the education processes of the 21st century in the region as Education 4.0. Therefore, the term Education 4.0 will be used onwards in this paper to describe digital learning in the South Pacific region.

The global education sector demands its learners to be digitally literate for the successful implementation and facilitation of Education 4.0. Scholars have stated that many countries are implementing digital literacy education to successfully drive Education 4.0 (Tejedor et al., 2020; Feerrar, 2019; Lestari & Santoso, 2019). While the concept of digital literacy has been rapidly adopted by developed countries and integrated into their education system, for developing countries like the South Pacific, the process has just begun (Reddy, Chaudhary & Sharma., 2020b). The work of the authors Reddy et al.(2020a, 2020b) introduces the digital literacy scale, digilitFj, and the digital literacy intervention program, DLIP, which have been designed and developed using the South Pacific digital literacy framework. DigilitFj measures the digital literacy competencies of individuals and DLIP provides digital literacy remediation for improving the digital literacy competencies of the individuals. For more information, the reader is referred to “ Measuring the digital competency of freshmen at a higher education institute” and “Digital Literacy: A Review of Literature” document details the status of digital literacy in the South Pacific. For details on the DLIP, the reader is referred to as “Contextualized Game-Based Intervention for Digital Literacy for the Pacific Islands” (Reddy et al., 2021). The above work on digital literacy that is designing and developing SPDLF, digilitFj and DLIP is the first digital literacy initiative that provide an opportunity to measure and address the digital literacy issues in the South Pacific.

Additionally, the paper looks at the strong predictors of digital literacy from two perspectives; which literacy is the strongest predictor of digital literacy and which generally attributes from the sixty chosen are its strong predictors. The term strong predictor refers to an attribute that forecasts the occurrence of an event that is likely to happen. Usually, for such studies, a regression analysis is used and the coefficients are used to evaluate the strong predictors (Kar & Ilavarasan, 2017). There have been no prior studies that have evaluated strong predictors of digital literacy using any of the frameworks that have been developed to measure digital literacy. The authors of this paper believe that doing such evaluations is necessary as the results obtained can contribute to the effective championing of digital literacy education/ skills.

3. Research Objectives

Using the South Pacific digital literacy framework (SPDLF), the following objectives have been formulated:

1. To evaluate strong predictors of digital literacy from the 6 literacies
2. To evaluate the significant predictors of each literacy
3. To evaluate the significant predictors of digital literacy from the chosen sixty attributes in the SPDLF

4. Methodology

This exploratory research design study uses quantitative analysis to provide a three-stage statistical validation to the SPDLF, as shown in Figure 3. The study explores the (1) strong predictors of digital literacy from the six literacies- Figure 3, Process 1, (2) significant predictors of each literacy- Figure 3, Process 2 and (3) significant predictors of digital literacy from the sixty attributes- Figure 3, Process 3. According to USC Libraries (2020), quantitative analysis involves data collection through the use of closed-ended questionnaires or polls and then performing calculations using mathematical and numerical analysis to determine the relationship between variables. The current research uses the data collected to measure students' digital literacy status in the Fiji Islands. The data for the study was from 2755 senior high school students from the Fiji Islands in the final term of their senior high education. There is a need to evaluate the digital literacy of the mentioned sample as they would be soon entering higher education institutes where Education 4.0 is practised. To have a successful learning journey in HEI, the students need to have digital skills, and this research determines the important contributors to digital literacy from the sample. The attributes of the data set are described in Table 10 in the appendix. The Statistical Package for the Social Sciences (SPSS) was used to perform the following analysis; normality test for the data set, correlation analysis and multiple linear regression analysis to evaluate the strong predictors of the different literacies and the strongest predictors from the sixty attributes of digital literacy. For the validation of the attributes in the SPDLF, an Exploratory Factor Analysis(EFA) was carried out. The factor loadings for the sixty attributes were calculated to decide which ones to keep and which ones to delete. The factor loadings for almost all the variables were 0.5 and above and for those variables whose factor loading were 0.3 and 0.4, the authors decided to keep them as they were important for the study.

Figure 3 illustrates the SPDLF, which has been used to design and develop digilitFJ and DLIP. The processes shown in Figure 3 show the approach used for the data analysis – the three-stage validation process. Process 1 involves evaluating the significant predictor of digital literacy from the 6 literacies chosen for the study. In contrast,

process 2 involves evaluating the significant contributor of each literacy based on the attributes of each literacy. Finally, process 3 involves evaluating the significant contributors to the overall digital literacy.

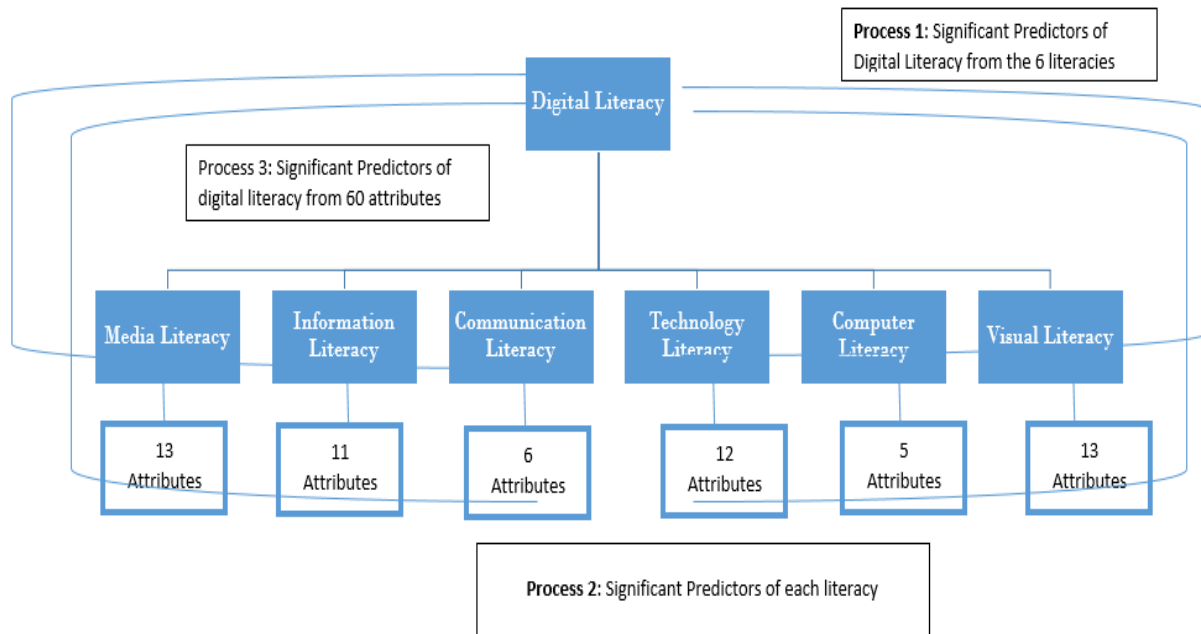


Figure 3: The three-stage validation process from the SPDLF

4.1 Data Set

As mentioned in the Introduction, the digital literacy framework has 6 literacies and sixty attributes. Table 11 in the Appendix shows a description of the attributes.

4.2 Data Analysis

The Kolmogorov-Smirnov and Shapiro-Wilk test were performed to evaluate the normality of the data set. As the sample size is 2755, the results from Kolmogorov-Smirnov will be used. According to Laerd (2020) to determine the normality of a data set with a population size greater than 50, it is best to use the Kolmogorov-Smirnov normality test. A spearman's correlation analysis was also performed to evaluate the relationship between the 6 literacies and between each literacy with digital literacy. The mentioned result will rely upon the importance of each literacy concerning digital literacy and if it corresponds with the digital framework that has been developed for the study. The multiple linear regression is also carried out to evaluate the contribution of each variable and attribute in different instances like:

1. evaluating the most significant contributor from the 6 literacies to digital literacy
2. evaluating the most significant contributors to each literacy
3. evaluating the most significant contributors to digital literacy from the 60 attributes that are given in Table 10.

According to Kenton (2021), multiple linear regression (MLR), also known simply as multiple regression, is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The independent variable is the parameter that is used to calculate the dependent variable or outcome. For this case, there are multiple independent variables and only one dependent variable hence, performing an MLR, enabled the team to evaluate the most significant contributor/s to the outcome of the dependent variable.

5. Results

5.1 The normality test

The Kolmogorov-Smirnov test was utilized and as per the results, the sig value is 0.00, which is < 0.01 ; therefore, the null hypothesis is rejected and it can be concluded that the data is not normally distributed. Therefore, to evaluate the relationship between the different literacies, spearman's correlation was performed.

5.2 The correlation Analysis

Table 1 shows the correlation between the 6 literacies with digital literacy and the correlation between the 6 literacies. According to the results, each literacy has a significant relationship with digital literacy. The correlation coefficient values for each literacy with digital literacy range from 0.8 to 0.9, indicating that there is a very strong correlation between each literacy with digital literacy (statstutor, 2019). As far as the relationships between the 6 literacies are concerned, the relations can be described as moderate to a very strong relationship as the correlation values range 0.57 and above (statstutor, 2019).

Table 1: Correlation between the different literacies

	<i>Digital Literacy</i>	<i>Communication Literacy</i>	<i>Computer Literacy</i>	<i>Information Literacy</i>	<i>Media Literacy</i>	<i>Technology Literacy</i>	<i>Visual Literacy</i>
<i>Digital Literacy</i>	1.000	.790	.785	.896	.864	.896	.896
<i>Communication Literacy</i>	.790	1.000	.670	.664	.615	.588	.611
<i>Computer Literacy</i>	.785	.670	1.000	.600	.567	.630	.593
<i>Information Literacy</i>	.896	.664	.600	1.000	.809	.778	.814
<i>Media Literacy</i>	.864	.615	.567	.809	1.000	.762	.757
<i>Technology Literacy</i>	.896	.588	.630	.778	.762	1.000	.827
<i>Visual Literacy</i>	.896	.611	.593	.814	.757	.827	1.000

5.3 Significant contributors to digital literacy

The stepwise multiple linear regression was performed to evaluate the strongest predictor of digital literacy from the 6 literacies used for this study's digital literacy framework. For each literacy, each variable was independent variables and overall literacy were independent variables. Table 2 shows the standardized beta values (β) from the multiple linear regression analysis. Looking at the weights for each literacy, it can be stated that all the literacies significantly contribute to digital literacy. The weights for the given literacy show that the most significant contributor to digital literacy is *computer literacy*, followed by *technology* and *visual literacy*, followed by *communication* and *media literacy*. *Information literacy* has the lowest weight, however, there is no statistical difference in the weights of each literacy. Therefore, all literacies are significant contributors to digital literacy.

Table 2: Significant contributors to digital literacy

<i>Variable</i>	<i>Standardized Coefficients</i>
	β
<i>Information Literacy</i>	.174
<i>Computer Literacy</i>	.208
<i>Technology Literacy</i>	.205
<i>Communication Literacy</i>	.185
<i>Media Literacy</i>	.185
<i>Visual Literacy</i>	.205

5.4 Significant contributors for each literacy

5.4.1 Communication literacy

There are 5 attributes of communication literacy and Table 3 shows the standardized beta values (β) for each. As per the result, C1 (Using a digital platform for personal use – online booking and appointments) is the most significant contributor of digital literacy, followed by C2 (Participating in online chats and forums for learning and research) and C5 (Using Open Educational Resources (OERs)). However, the results in Table 3 also show

that the β values differ by 0.01; therefore, there is no significant difference in the β values. All the attributes of communication literacy are important.

Table 3: Significant contributors to communication literacy

<i>Communication Literacy</i>	<i>Standardized Coefficients</i>
	<i>Beta (β)</i>
<i>C1</i>	.261
<i>C2</i>	.259
<i>C3</i>	.248
<i>C4</i>	.234
<i>C5</i>	.258

5.4.2 Computer literacy

Table 4 displays the standardized beta values (β) for computer literacy. Computer literacy has 6 attributes and Comm3 (Resolving basic technical equipment problems) is the most significant contributor for computer literacy, followed by Comm5 (Using of office applications) and then Comm2 (Using anti-virus software). However, the β values for all the attributes of computer literacy differ by 0.01, hence, there is no significant difference in the β values. All attributes are important for an individual to be computer literate. Although Comm4 (Using google to search for topics) is slightly lower than the other attributes, it will also be considered an important contributor to computer literacy.

Table 4: Significant contributors to computer literacy

<i>Computer Literacy</i>	<i>Standardized Coefficients</i>
	<i>Beta</i>
<i>Comm1</i>	.196
<i>Comm2</i>	.201
<i>Comm3</i>	.214
<i>Comm4</i>	.180
<i>Comm5</i>	.207
<i>Comm6</i>	.199

5.4.3 Information literacy

Table 5 shows the significant contributors to information literacy. The most significant contributor of information literacy is *Info7* (Sharing files legally with others) followed by *Info2* (Citing references for online resources used), *Info6* (Collaborating safely with others online, for example, secured password, aware of spams and fake websites) and *Info8* (Adding comments to blogs, forums or web pages for online communications). The standardized beta values (β) for other attributes are lower, but there is no statistically significant difference between the 11 attributes of information literacy, hence, all the attributes shown in Table 5 are significant contributors to information literacy.

Table 5: Significant contributors to information literacy

<i>Information Literacy</i>	<i>Standardized Coefficients</i>	<i>Information Literacy</i>	<i>Standardized Coefficients</i>
	<i>Beta</i>		<i>Beta</i>
<i>Info1</i>	.120	<i>Info7</i>	.138
<i>Info2</i>	.129	<i>Info8</i>	.129
<i>Info3</i>	.123	<i>Info9</i>	.126
<i>Info4</i>	.120	<i>Info10</i>	.118
<i>Info5</i>	.127	<i>Info11</i>	.116
<i>Info6</i>	.129		

5.4.4 Media literacy

Table 6 shows the standardized beta values (β) for the thirteen attributes of media literacy. M2 (Choosing appropriate media) is the most significant contributor to media literacy followed by M3 (Creating new content word/excel/powerpoint) and M11(Creating pdf documents). Since β values for the thirteen attributes of media literacy differ by 0.01 therefore there is no significant difference in the β values. All the attributes of media literacy will be treated as significant contributors to media literacy.

Table 6: Significant contributors to media literacy

<i>Media Literacy</i>	<i>Standardized Coefficients</i>	<i>Media Literacy</i>	<i>Standardized Coefficients</i>
	<i>Beta</i>		<i>Beta</i>
M1	.106	M8	.116
M2	.113	M9	.100
M3	.112	M10	.104
M4	.107	M11	.112
M5	.105	M12	.109
M6	.110	M13	.093
M7	.098		

5.4.5 Technology literacy

Technology literacy has twelve attributes and the standardized beta values (β) are given in Table 7. The attribute T4 (Knowing how to use search engines and online directories) and T7 (Knowledge about password protection) have the highest β values making them the most significant contributors of technology literacy. The highest value is for T10 (Knowledge of word processing, spreadsheet, database and presentation software) followed by T2 (Planning, creating and editing presentations, video, animations, simulations and podcasts). Since the β values for the other attributes differ by 0.001, there is no significant difference in the β values. All the attributes will be considered significant contributors to technology literacy.

Table 7: Significant contributors to technology literacy

<i>Technology Literacy</i>	<i>Standardized Coefficients</i>	<i>Technology Literacy</i>	<i>Standardized Coefficients</i>
	<i>Beta</i>		<i>Beta</i>
T1	.101	T7	.108
T2	.104	T8	.100
T3	.101	T9	.096
T4	.108	T10	.106
T5	.096	T11	.101
T6	.103	T12	.102

5.4.6 Visual literacy

Table 8 shows the standardized beta values (β) for the thirteen attributes of visual literacy. According to the results, V2 (Identifying a variety of sources for images) is the most significant contributor of visual literacy followed by V3 (Accessing required images and visual media using tools and technology to produce images and visual media) and V11(Using tools and technology to produce images and visual media). For visual literacy, there is no statistically significant difference between the β values for the thirteen attributes, hence all the attributes are significant contributors to visual literacy.

Table 8: Significant contributors to visual literacy

<i>Visual Literacy</i>	<i>Standardized Coefficients</i>	<i>Visual Literacy</i>	<i>Standardized Coefficients</i>
	<i>Beta</i>		<i>Beta</i>
V1	.106	V8	.116
V2	.113	V9	.100
V3	.112	V10	.104
V4	.107	V11	.112
V5	.105	V12	.109
V6	.110	V13	.093
V7	.098		

5.5 E: Significant contributors to digital literacy from sixty attributes

Table 9 shows the complete sixty attributes of digital literacy. For this analysis, each literacy was independent variable and overall digital literacy was dependent variable. The most significant contributors of digital literacy are *Comm3* (Resolving basic technical equipment problems), *Info7* (Sharing files legally with others), *Comm5* (Using of office applications), *T4* (Knowing how to use search engines and online directories), *T7* (Knowledge about password protection) with β value of 0.27. Table 9 also shows that the β values for technology literacy (T1-T12) range from 0.24 to 0.27 that is the highest β values amongst the sixty attributes. However, the β values for the other attributes range from 0.021 to 0.026; therefore, there is no significant difference in the β values of all the sixty attributes. As such, all the attributes will be treated as significant contributors to digital literacy.

Table 9: Significant contributors to digital literacy

<i>Attributes</i>	<i>Standardized Coefficients</i>	<i>Attributes</i>	<i>Standardized Coefficients</i>	<i>Attributes</i>	<i>Standardized Coefficients</i>
	<i>Beta</i>		<i>Beta</i>		<i>Beta</i>
V3	.025	C4	.021	Info2	.025
T12	.026	Info7	.027	T8	.025
Info6	.025	T11	.025	Comm4	.023
V11	.024	Comm5	.027	M2	.025
Comm3	.027	M6	.024	Info1	.022
M11	.024	V1	.025	Info3	.023
Info10	.022	T4	.027	M1	.023
T9	.024	Info9	.024	T10	.026
M10	.023	C5	.024	V4	.025
Comm1	.025	V8	.024	V12	.024
V9	.026	M5	.023	M4	.023
Info5	.025	V5	.024	M3	.025
C2	.024	C1	.025	C3	.023
T5	.024	M13	.021	Comm6	.025
V6	.024	M12	.024	V10	.025
Info8	.025	T6	.026	Info4	.022
M9	.022	M7	.022	T3	.025

Attributes	Standardized Coefficients	Attributes	Standardized Coefficients	Attributes	Standardized Coefficients
	Beta		Beta		Beta
T2	.026	T1	.025	V7	.024
V13	.025	T7	.027	V1	.023
M8	.025	Comm2	.026	Info11	0.22

6. Discussion

For the study, a digital literacy framework designed for PICs that consists of 6 other literacies was utilized to evaluate the digital competencies of the senior high school students in the Fiji Islands. Each literacy consisted of specific attributes and in total, there were sixty attributes, as shown in Table 10 in the appendix section. The authors claim that all the literacies and as well as all the attributes associated with digital literacy are important to define a digitally literate individual. A spearman's correlation analysis and a stepwise multiple linear regression analysis were performed to evaluate the claim.

Prior studies have shown that literacies associated with digital literacy strongly correlate with digital literacy (Hamaguchi, Nematollahi & Minter, 2020; Makhmudov, Shorakhmetov & Murodhosimov., 2020; Pem, 2019; Kedra, 2018). The results of the current study also show that the 6 literacies chosen for the digital literacy framework designed for PICs have a strong relationship with digital literacy, with the correlation values ranging from 0.8 to 0.9. Also, each literacy has a moderate to a very strong relationship with each other as the correlation values are 0.57 and above. The correlation values verify that the 6 literacies associated with digital literacy for the study are appropriate and significant.

The standardized beta values (β) obtained from the stepwise multiple linear regression indicate that all the attributes for each literacy are significant and a strong contributor in defining the literacy competencies for each literacy. For example, the standardized beta values (β) for all the attributes in media literacy are significant and predictors of media literacy. The values obtained are not different from each other; therefore, an individual must have all the attributes of media literacy to be media literate. The β values for the sixty attributes are given in Table 9 and the values obtained are closer to each other. The β values for the sixty attributes differ by 0.01, which is not statistically significant; therefore, all sixty attributes are significant predictors/contributors to digital literacy.

The results from the study statistically validate the South Pacific digital literacy framework and prove that the literacies and the attributes associated with digital literacy are statistically significant and appropriate predictors of digital literacy. Additionally, the results comprehended the results of the studies by Reddy et al. (2020b, 2020c). Therefore, the SPDLF, digitliFj, and DLIP can be used with complete trust and conviction to evaluate individuals' digital competencies reliably.

7. Conclusion

The impact of the 4th industrial revolution will continue to bring profound impacts and changes to the education landscape. Therefore the individuals of the digital society must be prepared to appreciate new technologies and learn the appropriate skills required to function using the new technologies that are introduced. The required skills to function and survive in the 21st century are digital literacy skills. Research also shows that digital literacy is driving the education sector as learners require appropriate digital literacy skills to function in the technology-enabled learning environment. Hence, the current research communicates a digital literacy framework that has been developed to evaluate the digital competencies of individuals.

The paper entails whether the attributes that are associated with digital literacy for this study are statistically significant or not. The study provides statistical validation for the South Pacific digital literacy framework (SPDLF) which has been used to design and develop the digital literacy scale, digitliFj and the digital literacy remediation tool, DLIP, to improve the digital literacy competencies of the South Pacific populace. The results obtained show that all the literacies and the attributes associated with digital literacy are statistically significant. Thus the SPDLF developed for digital literacy by the authors is valid and significant. Also, there is a strong and positive statistical relationship between 6 literacies and digital literacy thus the literacies associated with digital literacy in the SPDLF are valid and significant. Moreover, the results show that the beta values (β) for sixty attributes in the

SPDLF differ by 0.01, which is not statistically significant; therefore, all the sixty attributes are significant contributors/predictors of digital literacy. Therefore, the digital literacy framework (SPDLF) is a good measure of the digital competencies of individuals.

The theoretical component of the paper discusses that digital literacy in the 21st century is an essential component of Education 4.0. Since the results from the current study show the SPDLF, digitlitFJ and DLIP are significant and valid, it can be stated that the three tools are strong and significant components of Education 4.0. In the digital society, Education 4.0 and digital literacy can be used to improve the digital competencies of individuals and prepare individuals for the technology-enabled working environment. Moreover, the South Pacific digital literacy framework and the digital literacy scale can be used by relevant stakeholders and academics to measure the digital competencies of individuals. Furthermore, workshops and training programs to improve the digital competencies of individuals can be implemented. Education 4.0 and the tools mentioned in the paper can be used to impart essential skills to the students to prepare them for their prospective working environments.

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Appendix

Table 10: Description of data set

<i>Variables</i>	<i>Description</i>
M1	Interpreting media messages
M2	Choosing appropriate media
M3	Creating new content in word/excel/PowerPoint
M4	Communicating and presenting using media such as using Blogs and YouTube
M5	Revising existing content
M6	Participating in public debates eg using social media, emails and online forums
M7	Using different sources of information and media devices eg Internet and social networks
M8	Navigating through hyperlinks
M9	Understanding copyright
M10	Selecting possibilities through online newspapers, cookies, websites and news channels
M11	Creating pdf documents
M12	Understanding Intellectual property rights
M13	Knowing how to use computers, smartphones, tablets and smart media

Variables	Description
C1	Using a digital platform for personal use – online booking and appointments
C2	Participating in online chats and forums for learning and research
C3	Using publication technologies
C4	Using the Internet to communicate
C5	Using Open Educational Resources (OERs)
Info1	Using the information in different media, for example, podcasts or videos
Info2	Citing references for online resources used
Info3	Creating content in different media
Info4	Knowing what and how to find information on the web
Info5	Keeping a digital record of information relevant to you
Info6	Collaborating safely with others online for example secured passwords, aware of spams and fake websites
Info7	Sharing files legally with others
Info8	Adding comments to blogs, forums or web pages for online communications
Info9	Assessing whether an online resource (e.g. web page, blog, wiki, video, podcast, academic journal article) credible and trustworthy
Info10	Using advanced search options to look for information on the web
Info11	Knowing what a bibliography is
V1	Defining and identifying the need for an image
V2	Identifying a variety of sources for images
V3	Accessing required images and visual media
V4	Organizing images and the source of information
V5	Identifying the physical, technical and design components of an image
V6	Interpreting and analyzing an image
V7	Evaluating the effectiveness and reliability of an image
V8	Evaluating textual information accompanying the images
V9	Using technology to work with images
V10	Knowing how to interpret images and including them in your scholarly projects
V11	Using tools and technology to produce images and visual media
V12	Understanding and following ethical, legal, social, and economic issues surrounding images and visual media
V13	Citing images and visual media in projects and presentations
T1	Backing up and Recovery of data
T2	Planning, creating and editing presentations, video, animations, simulations and podcasts
T3	Choosing best hardware / software for a given task
T4	Knowing how to use search engines and online directories
T5	Identifying different computer platforms and software versions

Variables	Description
T6	Creating mail merge
T7	Knowledge about password protection
T8	Compressing and Decompressing files
T9	Knowledge of emerging technology and its limitations
T10	Knowledge of word processing, spreadsheet, database and presentation software
T11	Installing and uninstalling software
T12	Knowledge about web authoring tools
Comm1	Having an email account
Comm2	Using anti-virus software
Comm3	Resolving basic technical equipment problems
Comm4	Using google to search for topics
Comm5	Using of office applications
Comm6	Having and using social media accounts

Online Vs. In-Campus, Comparative Analysis of Intrinsic Motivation Inventory, Student Engagement and Satisfaction: A way forward for Post COVID-19 Era

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Abstract: The education sector was severely impacted due to the pandemic; thus, educational institutions had to shift toward an online learning system. This adaptation in the educational system posits a challenging question: which mode of learning would be best to engage and satisfy the students in the post-COVID-19 era? Therefore, drawing on the self-identity theory, this study explores the differential impact of intrinsic motivational factors (interest/enjoyment, competence, autonomy, and belongingness) on digital engagement and online class satisfaction versus on-campus psychological engagement and physical class satisfaction. Surveying 496 students from six Indonesian universities shows that digital technologies make the learning process interesting and joyful for students compared to on-campus classroom learning, thus resulting in more digitally engaged and satisfied students. Simultaneously, competence is found to be positively impacting online and on-campus students' engagement and satisfaction at an equal level. Moreover, autonomy and belongingness show more students' engagement and satisfaction within the campuses than in an online learning mode. These findings suggest that the post-COVID-19 era can take advantage of both these methods to incorporate a hybrid mix of blended learning to achieve the best learning outcomes in terms of engagement and students' satisfaction. Implications for higher education institutions and directions for future research are suggested.

Keywords: Teaching Presence, Students' Cognitive Presence, Social presence, Content Quality, Students' Satisfaction with E-learning Experience, Online Learning Readiness, Community of Inquiry Model

1. Introduction

The sudden outbreak of the COVID-19 pandemic posed many challenges to on-campus learning and forced almost all education levels worldwide to shift towards virtual learning (Dalle et al., 2021). However, the online education system and distance learning were functioning previously but not for most students across the globe. Recently all those students have also experienced online learning who had never been exposed to it earlier (Widikasih et al., 2021). Simultaneously, student engagement and satisfaction have been a hot scholarly debate agenda during the pandemic time (Crawford et al., 2020). Many scholars, educational leaders, and policymakers showed a deep concern about the future education system in the post-COVID-19 era (Karakose et al., 2022a, Cahapay, 2020). Thus, measuring students' engagement and satisfaction who experienced both learning methods becomes the need of time to determine the future education roadmap for the post-Covid -19 era. Thus, intended to provide empirical evidence from the Indonesian higher education context, this study advanced by paving a way forward for future agenda.

Digital engagement is a form of active learning that gives students autonomy to think and present information based on their cognitive and comprehensive abilities (Van Ryzin, Gravely, and Roseth, 2009). Moreover, it impacts students' online learning refers to students' interest, curiosity, optimism, and passion for learning using digital media tools and online software programs designed for student focus and learning (Crawford et al., 2020). Furthermore, on

campus, students' psychological engagement is based on students' perception of community, involvement, and desire to learn (Gray and DiLoreto, 2016). It is related to their dedication, absorption, and vigor. Hence it is highly important for quality learning outcomes as it covers students' cognitive, emotional, and behavioral reactions to in-class and out-of-class educational activities (Kim et al., 2020). In addition, online student satisfaction varies based on the asynchronous or synchronous learning form, depending on course complexity and interactivity (Dalle et al., 2021, Dalle et al., 2020). Many factors have been identified to affect online class satisfaction among students, including interactivity, self-efficacy, course content, self-regulation, and perceived usefulness (Hamdan et al., 2021). In contrast, on-campus class satisfaction can be related to students being on campus, sharing a positive learning experience, or going for face-to-face interaction (deJonge-Kannan, 2021). It is also related to the students' motivation to interact, learn, and perform.

In their study, Khalil et al. (2020) reflected that during COVID-19, students could feel a sense of loss of touch with their friends due to distance learning for a long and might want to reconnect with old friends through on-campus learning. Therefore, it is important and timely to investigate the students' preference for online or on-campus learning modes via their online or on-campus class satisfaction responses (Sumarlah et al., 2021, Parmigiani et al., 2021). Hence, this study aims to advance by examining the impact of rarely constructs such as interest, belongingness, autonomy, and competence on students' class satisfaction.

Students' interest or involvement is a critical factor because it depicts their willingness to learn and engage (Gray and DiLoreto, 2016). Showing Interest in any subject or learning method, whether online or in-campus, impacts students' satisfaction levels. Instructors and teachers implement various techniques to involve students actively in class and increase their cognitive abilities (Havice et al., 2010; Karakose, Polat, and Papadakis, 2021). Online teachers use various tools to actively involve students, such as videos, audio, images, etc. Similarly, on-campus teachers can use presentations, field trips, models, and lab experiments to involve students positively to achieve desired learning outcomes. Especially as COVID-19 has raised students' anxiety, uncertainty, and fear, their learning has been greatly affected (Khalil et al., 2020). Thus, based on the fact that increasing students' interest can lead to increased engagement and overall satisfaction (Gray and DiLoreto, 2016), the current study establishes the differential impact of interest or enjoyment on students' engagement and satisfaction in online vs. on-campus learning mode.

Another important factor rarely considered is competence, affecting students' engagement and overall satisfaction in online and offline learning modes. Competence involves students' knowledge, skills, and abilities to carry out learning tasks and compete with peers and fellows (De Las Heras, Luque-Sendra, and Zamora-Polo, 2020). It includes collaboration, communication, critical thinking, innovation and sets performance standards for active engagement in the learning process (Havice et al., 2010). Moreover, in online learning, a student needs to have the necessary skills and technological know-how to compete with fellow students successfully. Therefore, it is imperative to check the intensity to which it impacts students' engagement and satisfaction in online as well as on-campus learning modes (Yakhshieva and Sidiqova, 2020). Furthermore, autonomy is related to the feeling of being in control and possession of outcomes and is best exerted through the provision of choice and removal of external controls such as rewards and punishments (Van Ryzin, Gravely, and Roseth, 2009). In higher education, especially among college and university students sense of belongingness is an important factor for academic success (De Las Heras, Luque-Sendra, and Zamora-Polo, 2020). However, literature is scarce on the role of belongingness in the students' engagement and satisfaction. Thus, to bridge these gaps in the literature, the current study aims to investigate the predictive differences of the impact of autonomy and belongingness on students' online versus on-campus engagement and satisfaction.

Adding to that, the current study is established on self-determination theory to explore students' engagement and satisfaction with online vs. on-campus learning. It depicts human motivation based on their inner growth and psychological needs (Shearer et al., 2020). It advocates that people make choices without external benefits or interference based on the provision of choice and autonomy, which leads to psychological wellbeing (Van Ryzin, Gravely, and Roseth, 2009). It further suggests that students work towards achieving their goals based on their competence and the perception that their actions lead to a positive outcome. Thus, grounded in self-determination, the current study aims to examine the impact of students' interest/ enjoyment, competence, autonomy, and sense

of belongingness on students' digital engagement and online class satisfaction versus students' on-campus psychological engagement and class satisfaction.

2. Literature review and theoretical foundation

2.1 Student's Intrinsic Motivation Inventory and Digital Engagement in Online Class Context.

Interest/Enjoyment is referred to as motivation and emotion in research (Imlig-Iten and Petko, 2018). Individual student interest is categorized as a pre-existing investment or attachment to a particular subject. The more they feel inclined toward a subject, the more interest they take in, and the better would be the engagement (Rands and Gansemer-Topf, 2017). Moreover, self-determination theory in students learning perspective suggests that the student's interest as an emotional and psychological developmental factor impacts the overall student's engagement and learning (Cerasoli and Ford, 2014). Therefore, it is critical to realize the role of interest in increasing students' motivation to learn. In an online setting, digital engagement enables students to interact, create and transform information in a meaningful way (Mädamürk et al., 2020). Furthermore, interest/enjoyment in today's era has been linked with game-based learning for motivating students to engage digitally through simulations, music, audio, graphics, animation, etc. (Luczak and Kalbag, 2018). Simultaneously, students' competencies are built upon what they know, think, and have the ability to do and impact their academic performance (Tsai, 2020). Besides, competencies play an important role in improving digital engagement since technological know-how and possession of digital learners' skills give them an edge over others to perform better (Lee and Lee, 2020).

Moreover, students' autonomy is related to the possession of decision-making power, freedom of choice, and free will to act in their academic learning (Chik, 2018). The self-determination theory strongly advocates the role of autonomy in increasing intrinsic motivations toward achieving goals (Deci and Ryan, 2012). Autonomy has also been liked in students' active learning, in which students actively participate and create information based on their knowledge. It allows students to set their own goals, make choices around learning activities, and make decisions based on their preferences (Ting, 2015). In contrast, autonomy helps students with various opportunities to exercise power to design activities based on their preferences (Chik, 2018). Hence, by providing students' autonomy to design, conceive and interpret information and learning activities online, their digital engagement is expected to be enhanced. At the same time, students' social and psychological needs are an important factor in determining their need for engagement (Boyle et al., 2012). Parmigiani et al. (2021) reported that teachers try to provide an inclusive and diverse environment in online settings where students can participate and interact. At the same time, they face different challenges to perform, which they fulfill based on a sense of belongingness as belongingness can provide a sense of comfort and feeling of community in a virtual environment (Van Ryzin, Gravely, and Roseth, 2009), which can further be instrumental in engaging students in the online learning context.

Furthermore, self-determination theory advocates that student interest in learning and competence is critical in developing self-determined motivation that further affects their digital engagement. The self-determination theory also suggests that a sense of belongingness can give the students a feeling of intrinsic motivation to engage them actively in the learning process in an online or digital setting. Thus, based on the literature and theory support, this study proposed the following hypothesis for empirical investigation;

H1a: There is a positive association between students' intrinsic motivation inventory (interest/enjoyment, competence, autonomy, belongingness) and their digital engagement in an online class context.

2.2 Student's Intrinsic Motivation Inventory and Satisfaction in Online Class Context

Research shows that students' interest plays a vital role in increasing intrinsic motivation, working harder, performing better, and achieving academic outcomes (McFarland and Hamilton, 2005). Moreover, course design has also been linked with improving learning outcomes based on the fit between students' interests and the instruction material (Fischer et al., 2020). Although, various studies on students' online class satisfaction have investigated factors, including instructor's presence, course design, interaction, and learner's perception (Alqurashi, 2019, Park and Kim, 2020). However, very few studies have focused on the role of interest in improving students' online class satisfaction. Besides, self-determination theory postulates that students' interest generates positive feelings towards learning, improving overall satisfaction in an online setting. Hence, a positive association between students'

interest and online class satisfaction is expected. Moreover, online learning modes, especially online classes, have been a popular educational practice during the COVID-19 era (Agung, Surtikanti, and Quinones, 2020; Karakose, Yirci, and Papadakis, 2022b). Simultaneously, making an advance in the current literature, the authors aim to explore the association of students' competencies with their satisfaction in online classes. Besides, Azzajjad, Tendrita, and Ahmar (2021) demonstrated that core competencies play an important role in understanding, learning, and processing information online by forming students' performance backgrounds and abilities. Hence, based on adapting successful online learning during and after the pandemic, it is expected that students' competence can play an essential positive role in satisfying them with digital learning mode.

Autonomy gives students a sense of empowerment, which increases their confidence and ability to perform (Evans and Boucher, 2015). Freedom of choice and flexibility in the overall learning system provides increased trust and interaction between the instructor and the student (Agung, Surtikanti, and Quinones, 2020). It also helps remove barriers to communication, as it gives opportunities to the students to provide feedback (Khalil et al., 2020). Moreover, project-based learning is an example of students' autonomy, leading to a more competitive and satisfactory experience than passive learning (Chik, 2018). Therefore, we can say that students' autonomy is expected to impact online class satisfaction directly. Furthermore, belongingness makes students feel a part of the learning environment; therefore, it motivates them to perform and interact in class (Shernoff, 2010). It is also related to humans' emotional and basic need to interact, feel valued, and become an important part of any group, class, or community (Tice et al., 2021). Hence, we can say that the students' online class satisfaction can be enhanced by creating a sense of belongingness among students via increased collaboration, participation, and social activities like celebrating birthdays, cultural events, and other such things. Thus, based on the above arguments and self-determination theory, this study proposed the following hypothesis for empirical investigation:

H1b: There is a positive association between students' intrinsic motivation inventory (interest/enjoyment, competence, autonomy, belongingness) and students' satisfaction in an online class context.

2.3 Student's Intrinsic Motivation Inventory and Psychological Engagement in an On-Campus Context

Students' interest measures their emotions and feelings toward learning in a particular environment (Imlig-Iten and Petko, 2018). Research suggests that interest is related to attention and focus or curiosity towards a subject matter by either positive or negative feelings towards it (Mohd Shahali et al., 2019). At the same time, psychological engagement has been referred to as a state of presenting oneself emotionally, cognitively, and physically (Appleton et al., 2006). To engage psychologically, a student needs to experience enjoyment or be interested in achieving learning goals (Alamri et al., 2020). Therefore, it can be stated that students' interest/enjoyment can increase their psychological engagement during on-campus classes. In addition, students' competence can be enhanced by providing coherently linked, stimulating, and action-driven educational opportunities to tailor their skill levels and interests (Shernoff, 2010). Self-determination theory also suggests that students show high achievement when their psychological needs are fulfilled, and competence plays a very important role in it (Crawford et al., 2020). Hence, it is expected that competency will be directly related to on-campus students' engagement.

When students feel autonomous, they are more likely to see each learning task's value and thus engage more in the activity (Yu, Li, and Zhang, 2015). In terms of autonomy, by providing multiple options for accessing information, expressing knowledge, and becoming engaged in the learning process, teachers can ensure that the learning environment meets the widest possible range of learners' needs (Yoh, Mohr, and Gordon, 2008). As discussed in the literature, psychological engagement is related to emotional and mental contributions toward achieving learning objectives; it can be enhanced through increased interaction and the teacher's support (Nania et al., 2020). Simultaneously, research suggests that the teacher can regulate how students are supposed to complete a task and achieve learning goals by giving them autonomous power (Yu, Li, and Zhang, 2015). Hence a strong sense of autonomy is expected to increase the psychological engagement of the student. Furthermore, Spencer et al. (2020) suggested that students' belongingness is enhanced through interactivity, communication, and perception of value. Research has also observed gender differences in how various students perceive belongingness towards their fellow mates and differentially engage in various tasks while keeping men in the groups and females in dyadic relationships (Chik, 2018). Whereas, based on the literature support and self-determination theory, this study proposed the following hypothesis:

H2a: There is a positive association between students' intrinsic motivation inventory (interest/enjoyment, competence, autonomy, belongingness) and their on-campus psychological engagement.

2.4 Student's Intrinsic Motivation Inventory and Class Satisfaction in an On-Campus Context

Literature reveals that students' interest is subjective to various experiences, interactions, perceptions, and expectations (Frenzel et al., 2018). Interest/enjoyment plays a vital role in learning and retention because it generates positive feelings about the subject (Alsancak Sirakaya and Ozdemir, 2018). Moreover, Frenzel et al. (2018) suggest that joyful lectures are not only fun but tend to increase overall retention, leading to satisfaction. In the case of on-campus learning, students interact with various objects (auditorium, labs, cafeteria, gym, sports ground, etc.) and persons, including peers, teachers, juniors, administrative staff, etc. (Chang, 2001). All these interactions create interest in the students' overall education experience, and they can generate a positive feeling of satisfaction. Additionally, students' competence involves applying knowledge to develop understanding and cognitive skills to effectively and efficiently complete tasks (Pena and Yeung, 2010). It relates to active participation and interaction between instructor and peers (Kwun, Ellyn, and Choi, 2013). At the same time, universities and Institutes try to provide a supportive environment for students by providing campus-based opportunities and activities to create a unique physical learning experience (Kim et al., 2020). Moreover, Foltz et al. (2021) demonstrated that the educational institutions that best incorporate cognitive and physical on-campus activities like literacy competitions, business plans, sports competitions, etc., can help build and develop their students' competencies, leading to increased satisfaction. Thus, a positive association is expected between competence and the on-campus class satisfaction of students.

Autonomy concerning university or college campuses refers to providing students with decision-making opportunities to choose various programs and courses and credit hours based on their convenience and skills (Evans and Boucher, 2015). Multiple studies explained universities are autonomous in academic, organizational, financial, and staff autonomy (Gutiérrez and Tomás, 2019). But very few have focused on students' autonomy and exercise of authority in academic matters. Higher education, especially graduate-level students, are now being provided with programs that can be customized to suit their needs and skills (Ting, 2015). Students can participate in setting the curriculum, collaborative learning, and self and peer assessment (Gutiérrez and Tomás, 2019); this can further give them a sense of achievement and more satisfaction. Moreover, the self-determination theory states that students' empowerment can lead to higher satisfaction. In addition, most university campuses provide facilities like gyms, swimming pools, dine-in cafeterias, libraries, computer labs, photocopy, and printing facilities to create a sense of belongingness among students (Nania et al., 2020). All these facilities enhance students' satisfaction with the campus (Muslim, Karim, and Abdullah, 2012). Based on the literature support and self-determination theory, this study proposed the following hypotheses:

H2b: There is a positive association between students' intrinsic motivation inventory (interest/enjoyment, competence, autonomy, belongingness) and students' on-campus class satisfaction.

2.5 Theoretical framework of the Study

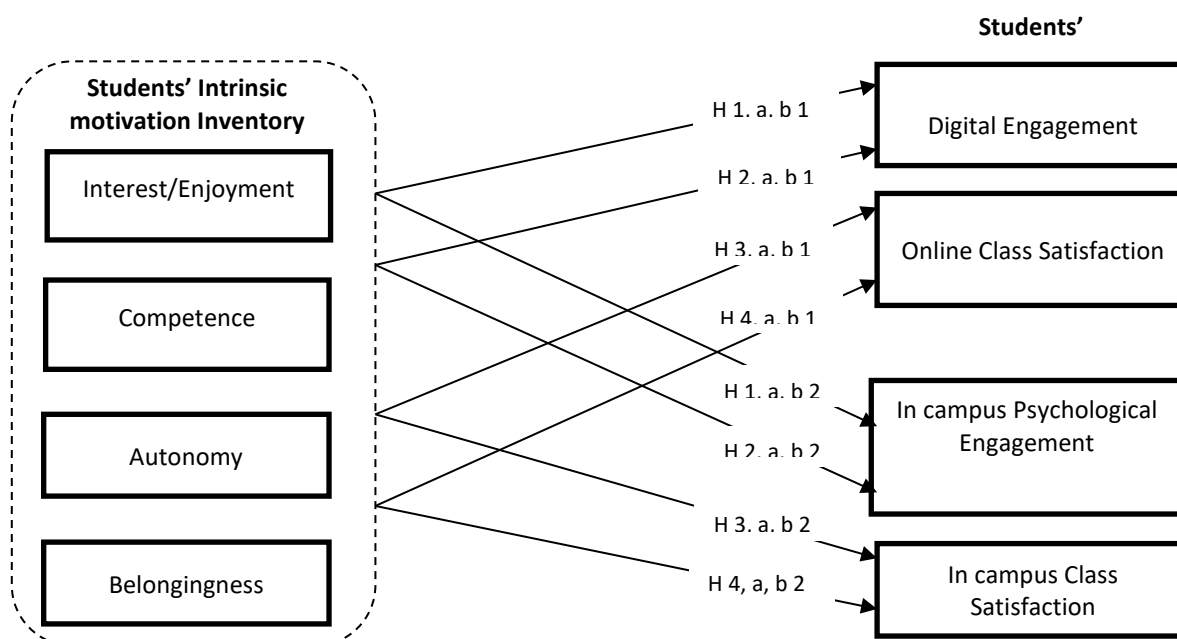


Figure1: Theoretical Framework of the study

3. Research Methodology

Using an electronic survey method, a 58 items questionnaire was distributed among university students belonging to 03 public and 03 private sector Indonesian universities in South Kalimantan province. Prior approval for approaching students was taken from the universities' administrative departments by ensuring that data obtained in this connection will be solely used for research purposes and will not be shared with any third party at any stage of this research project. The administrative departments were also requested to provide contact information of the faculty members teaching different online courses. For this purpose, administrative departments were requested to communicate with teachers who previously taught the same classes in the traditional on-campus approach. Now they are teaching the same class via an online digital approach due to COVID-19. We ensured that the same students were experiencing the traditional mode earlier and now experiencing the online mode of education. This was important to ensure that students have both experiences to give a comparative response in this research to meet study objectives. The admin departments of 6 universities provided data of 43 teachers. The authors forwarded the survey to the teachers and requested them to explain and forward it to their students via different study groups using different social media channels. Before beginning the survey, participants were briefed about their voluntary participation, ensuring their responses' anonymity. As this survey was conducted in the university setting, so most of the teachers and students were familiar with the survey language English. Thus, translation and back translation were not required as this study used original measures adopted in the English language with very good, reported reliability. In total, 700 questionnaires were circulated in accordance with the figures attained from the teachers, and 527 students completed and returned the survey for three months data collection phase. After careful evaluation and scrutinizing, 31 questionnaires were found inappropriate for the analysis based on missing values and unengaged responses. Therefore, 496 responses were used in further analysis, resulting in an active response rate of 71%.

3.1 Measures of the study

The survey consisted of 58 items and five items about demographics (gender, age, studying in semesters, weekly time for one course, and degree level). Students' Digital engagement was measured with twelve item scale adapted

from Mädamürk et al. (2020). Students' online class satisfaction was measured with a six-item scale adapted from Strachota (2006). Students' on-campus psychological engagement was assessed with an eleven items scale adopted from Gunawardena and Zittle (1997). A ten-item scale adopted from Gunuc and Kuzu (2015) was used to measure the students' on-campus class satisfaction. A 19-items scale adapted from Ostrow and Heffernan (2018) was used to measure the students' intrinsic motivation inventory, with 5-items measuring interest/enjoyment and 5-items measuring competence, 6-items measuring autonomy, and 3-items measuring belongingness. A "5-point Likert scale" ranging from "1=strongly disagree" to "5=strongly agree" was used to assess the response of the students.

3.2 Respondents' Demographic Characteristics

Table 1 depicts a detailed description of the respondents' demographic characteristics based on gender, age, studying in semesters, weekly time for one course and degree level, etc.

Table 1: Respondents' Demographic Characteristics

Variables		Number	%Age
Gender	Female	257	50.81%
	Male	239	48.18%
Age	15-20 years	103	21.76%
	21-25 years	236	47.58%
	25-30 years	91	18.34%
	31 and above	66	13.30%
Studying in Semester	1-2	121	24.39%
	3-4	128	25.80%
	5-6	130	26.20%
	7- more	117	23.58%
Weekly time for 1 course per week	Less than 1 hour	50	10.08%
	1-3 hour	92	18.54%
	4-6 hours or more	257	51.81%
	7 hours or more	97	19.55%
Degree level	Undergraduate	90	18.14%
	Graduate	293	59.07%
	Post-graduate	113	22.78%

4. Data analysis and results

To access the descriptive statistics and find out the control variables, SPSS 25 was used. The results revealed no outliers in our data set. Moreover, to satisfy the multivariate normality criterion, normality tests, including kurtosis, skewness, and Mahalanobis distance statistics, were performed for all study constructs (Henseler, Ringle, and Sarstedt, 2015). The results revealed no deviations from normality. ANOVA (Analysis of Variance) revealed that none of the demographic variables positively impacted dependent variables; therefore, no demographic variable was controlled during analysis. Whereas SmartPLS3 was used to analyze the hypothesized paths along with reliabilities, validities, factor loadings, etc. Tests of validity and reliability were performed to establish the discriminant validity amongst variables. To test the proposed hypotheses, measurement and structural models were analyzed.

4.1 Assessment of the Measurement Model

4.1.1 Confirmatory Factor Analysis; Reliability and Validity

Moreover, to evaluate the quality of research, the validity and reliability of the measures are considered. They depict the authenticity of techniques and methods applied to measure the study constructs. More specifically, reliability is accessed based on the composite reliability and Cronbach's alpha (Sarstedt, Ringle, and Hair, 2017). The measures' reliability that belongs to the same construct reflects the composite reliability (Mansoor and Paul, 2022). Simultaneously, Cronbach's alpha also presents the internal consistency of the scale used to measure a construct (Sarstedt, Ringle, and Hair, 2017). Measures' validity reflects that researchers have used the questions that fully present the issue of importance and belong to the same construct (Henseler, Ringle, and Sarstedt, 2015). In other words, the validity of the survey items depicts the degree to which they measure what they claim to measure. Hence, to assess the reliability of measures as per directions provided by, "Cronbach's α " and "composite reliability (CR)"

were calculated. Table 2 depicts the reliability of all the reflective measures based on Cronbach's α (above 0.70) and CR values. Besides, measures' "convergent and discriminant validity" was also assessed. As "factor loadings" of all indicator variables were $\Rightarrow$ 0.70 with significant loading of each item ($p < 0.01$) onto its underlying variable, and "average variance extracted" (AVE) of latent variables was above 0.50 for all study constructs. Therefore, "convergent validity" was established as per the criteria prescribed by (Mansoor, 2021; Sarstedt, Ringle, and Hair, 2017).

Table 2: Factor loadings, reliability, and validity

Constructs/indicators		Factor Loadings								AVE	CR	Cronbach's α
		1	2	3	4	5	6	7	8			
Students' Engagement	Digital									0.572	0.915	0.811
SDE1		0.744										
SDE2		0.755										
SDE3		0.783										
SDE4		0.694										
SDE5		0.766										
SDE6		0.775										
SDE7		0.773										
SDE8		0.759										
SDE9		0.698										
SDE10		0.721										
SDE11		0.776										
SDE12		0.712										
Students' Online Class Satisfaction	Online Class									0.517	0.865	0.787
SOCS1			0.738									
SOCS2			0.703									
SOCS3			0.715									
SOCS4			0.728									
SOCS5			0.744									
SOCS6			0.683									
Students' Psychological Engagement	On-campus									0.548	0.906	0.825
SIPE1				0.769								
SIPE2				0.679								
SIPE3				0.774								
SIPE4				0.781								
SIPE5				0.736								
SIPE6				0.751								
SIPE7				0.716								
SIPE8				0.709								
SIPE9				0.679								
SIPE10				0.772								
SIPE11				0.722								

Constructs/indicators	Factor Loadings								AVE	CR	Cronbach's α
	1	2	3	4	5	6	7	8			
Students' On-campus Class Satisfaction									0.551	0.908	0.809
SICS1				0.783							
SICS2				0.719							
SICS3				0.719							
SICS4				0.706							
SICS5				0.726							
SICS6				0.769							
SICS7				0.789							
SICS8				0.724							
SICS9				0.745							
SICS10				0.775							
Interest/Enjoyment									0.538	0.854	0.797
IE1					0.714						
IE2					0.712						
IE3					0.725						
IE4					0.773						
IE5					0.743						
Competence									0.546	0.857	0.837
COM1						0.770					
COM2						0.763					
COM3						0.707					
COM4						0.769					
COM5						0.682					
Autonomy									0.566	0.887	0.814
ATN1							0.760				
ATN2							0.725				
ATN3							0.771				
ATN4							0.745				
ATN5							0.726				
ATN6							0.785				
Belongingness									0.529	0.771	0.784
BEL1								0.769			
BEL2								0.707			
BEL4								0.704			

"Note: CR, composite reliability; AVE, average variance extracted.

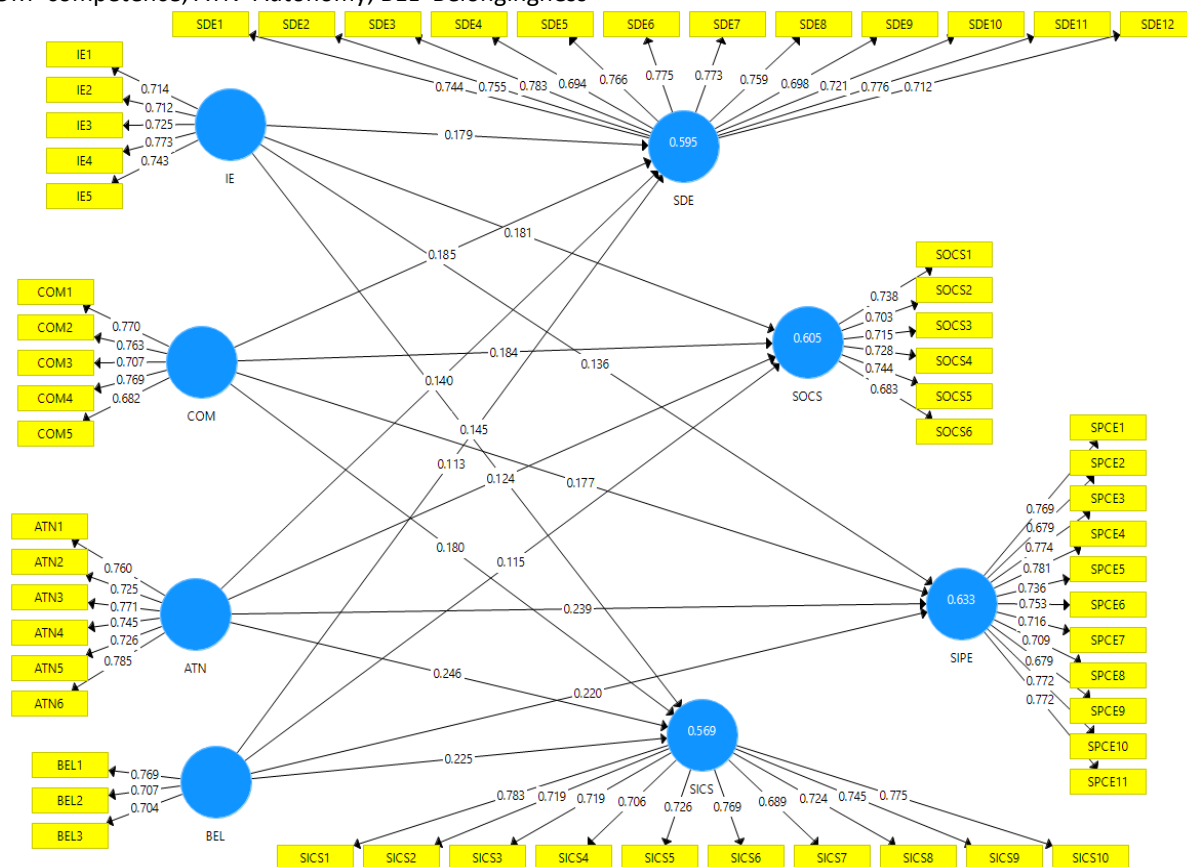
While using SmartPLS3, the most appropriate measure of discriminant validity is the Heterotrait-Monotrait (HTMT) ratio (Henseler, Ringle, and Sarstedt, 2015, Mansoor and Paul, 2022). The HTMT ratio value should be less than 0.9. As depicted in Table 3, all values were less than 0.9 for the entire model. In addition, the square root of the AVE of each latent variable is greater than the correlation coefficients between that latent variable establishing the discriminant validity of the measures.

Table 3: Heterotrait-Monotrait Ratio

Constructs	Mean	STD.	1	2	3	4	5	6	7	8
SDE	3.76	0.81	0.756							
SOCS	4.23	0.33	0.453	0.719						
SIPE	4.08	0.42	0.401	0.494	0.740					
SICS	3.79	0.77	0.387	0.521	0.482	0.742				
IE	4.07	0.38	0.423	0.389	0.331	0.319	0.733			
COM	4.18	0.27	0.365	0.342	0.428	0.379	0.501	0.738		
ATN	3.82	0.71	0.423	0.389	0.400	0.439	0.433	0.297	0.752	
BEL	4.11	0.33	0.565	0.442	0.421	0.429	0.388	0.393	0.446	0.727

Note: The square roots of AVEs of the constructs are shown in bold in diagonal.

Where: SDE= Students' Digital Engagement; SOCS= Students' Online Class Satisfaction; SIPE= Students' On-campus Psychological Engagement; SICS= Students' On-campus Class Satisfaction; IE= Interest/Enjoyment; COM=competence; ATN=Autonomy; BEL=Belongingness

**Figure 2:** Full Measurement Model

4.2 Assessment of the Structural Model

The Bootstrapping technique was performed to assess the structural paths, and 5000 sub-samples were used to test the hypothesized links. β -coefficient, t-value, and p-value were recorded to confirm the hypothesized relationships.

4.2.1 Hypothesis Testing

Table 4 depicts the results of the direct as well as an indirect hypothesis. Results reveal a positive and significant impact of interest/enjoyment on digital engagement ($\beta = .179^{***}$, $t = 4.121$) and online class satisfaction ($\beta = .181^{***}$, $t = 4.559$), as well as on on-campus psychological engagement ($\beta = .136^{**}$, $t = 3.167$) and on-campus class

satisfaction ($\beta = .145^{**}$, $t = 3.399$), with different intensities; as the impact of interest/enjoyment on digital engagement (17.9%) is 4.3% more than that of its impact on on-campus psychological engagement (13.6%). Likewise, the impact of interest/enjoyment on online class satisfaction (18.1%) is 3.6% more than that of its impact on on-campus class satisfaction (14.5%), reflecting that more playful and enjoyment-oriented students get engaged in digital learning with more online learning satisfaction level than traditional on-campus classes. Whereas results depicted a significant and positive impact of competence on students' digital engagement ($\beta = .185^{***}$, $t = 4.932$) and online class satisfaction ($\beta = .184^{***}$, $t = 4.632$). Also, almost similar results were found regarding the association of competence with students' on-campus psychological engagement ($\beta = .177^{***}$, $t = 4.038$) and on-campus class satisfaction ($\beta = .180^{***}$, $t = 4.303$), showing no predictive differences for the impact of competences on students' engagement and satisfaction in case of both online on-campus learning modes. In contrast, results for the impact of autonomy on students' on-campus psychological engagement ($\beta = .246^{***}$, $t = 6.178$) and class satisfaction ($\beta = .239^{***}$, $t = 6.864$), was more than that of its impact on students' digital engagement ($\beta = .140^{**}$, $t = 3.211$) and online class satisfaction ($\beta = .124^{**}$, $t = 2.912$); depicting a clear impact size difference of 10.6% for engagement and 11.5% for satisfaction. This shows that on-campus classes give students more confidence and perception of the power of choice compared to the online learning session. Similar to results of autonomy, the impact of belongingness on students' on-campus psychological engagement ($\beta = .220^{**}$, $t = 5.333$) and class satisfaction ($\beta = .225^{**}$, $t = 5.945$) was more than that of its impact on students' digital engagement ($\beta = .113^{*}$, $t = 2.287$) and online class satisfaction ($\beta = .115^{*}$, $t = 2.724$) depicting a clear impact size difference of 10.7% for engagement and 11% for satisfaction. This further reflects that student feel more related and emotionally attached to on-campus learning, based on coetaneous interactions with the fellows, association with the university environment, etc. Thus, as shown in Table 4, all the hypotheses of the current study were held to be true.

Table 4: Hypothesis Testing Results

	Hypotheses	Std. Beta	t-Value	p-values	Findings
H1a1	IE $\rightarrow$ SDE	0.179***	4.121	0.000	Supported
H1b1	IE $\rightarrow$ SOCS	0.181***	4.559	0.000	Supported
H1a2	COM $\rightarrow$ SDE	0.185***	4.932	0.000	Supported
H1b2	COM $\rightarrow$ SOCS	0.184***	4.632	0.000	Supported
H1a3	ATN $\rightarrow$ SDE	0.140**	3.211	0.007	Supported
H1b3	ATN $\rightarrow$ SOCS	0.124**	2.912	0.010	Supported
H1a4	BEL $\rightarrow$ SDE	0.113*	2.287	0.017	Supported
H1b4	BEL $\rightarrow$ SOCS	0.115*	2.724	0.014	Supported
H2a1	IE $\rightarrow$ SIPE	0.136**	3.167	0.009	Supported
H2b1	IE $\rightarrow$ SICS	0.145**	3.399	0.006	Supported
H2a2	COM $\rightarrow$ SIPE	0.177***	4.038	0.000	Supported
H2b2	COM $\rightarrow$ SICS	0.180***	4.303	0.000	Supported
H2a3	ATN $\rightarrow$ SIPE	0.246***	6.178	0.000	Supported
H2b3	ATN $\rightarrow$ SICS	0.239***	6.864	0.000	Supported
H2a4	BEL $\rightarrow$ SIPE	0.220***	5.333	0.000	Supported
H2b4	BEL $\rightarrow$ SICS	0.225***	5.945	0.000	Supported

Where; *** presents a significance level at <0.000; ** a significance level at <0.01; * a significance level at <0.05.

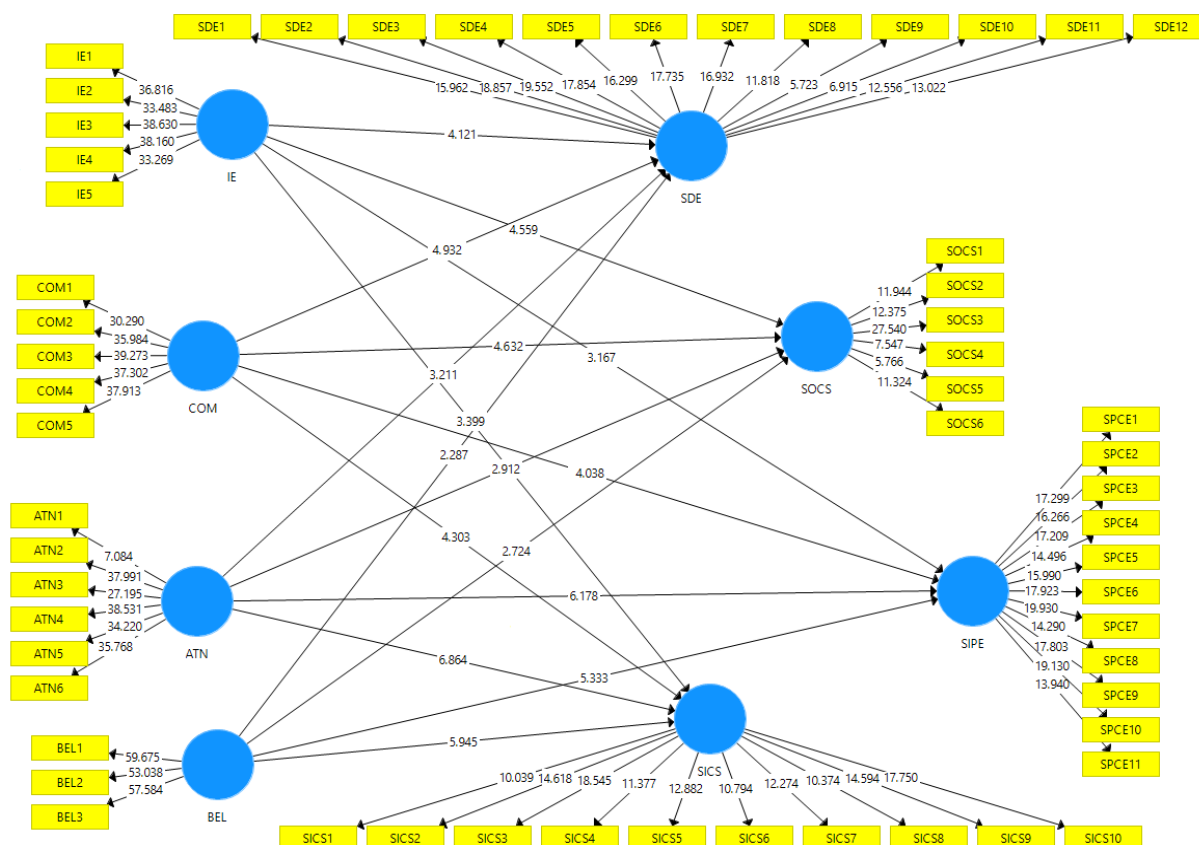


Figure 3: Full Structural Model

5. Discussion, implications, limitations, and future directions

5.1 Findings of the Study

The current study was conducted to analyze the impact of intrinsic motivational factors on students' engagement and satisfaction with online vs. on-campus classes. Post COVID-19 era will bring the pressing question of institutions to continue online learning to save costs, reach students far away at convenience, or return to traditional face-to-face learning approaches. Many studies investigated factors relating to students' online satisfaction, but very few focused on comparing traditional on-campus psychological engagement and class satisfaction with online class satisfaction and digital engagement. Therefore, the current study has been conducted to bridge this existing gap in the literature and address the policymakers' and educational leaders' concern for the efficient and effective adoption of the mode of learning.

The study results showed that students who possessed feelings of interest and enjoyment were more engaged digitally and were more satisfied with online classes than traditional on-campus classes. This is because online classes provide increased interaction through multiple mediums, including audio, video, and instant messaging, promoting a collaborative and interactive environment (Khalil et al., 2020). Especially through gamification, learning is made full of fun and joy, with clear learning objectives established (Zahedi et al., 2021). Students can also boost their creativity by engaging online, and teachers can develop the content for easy understanding through various technology apps like Learning Management System (LMS). Moreover, students may find traditional class systems monotonous and reason for boredom due to passive learning. In contrast, they feel digital engagement enables them to active learning and increase interaction (Lee and Lee, 2020).

On the other hand, competence was found to show similar positive results for on-campus and online class satisfaction and digital engagement and on-campus psychological engagement. This represents that students who

are competent and possess a variety of skills and knowledge to participate in class actively can adjust to any learning mode regardless of the system, as their intrinsic motivation is high to achieve learning-based goals (Shernoff, 2010). Therefore, the post-COVID-19 curriculum needs to be developed to polish students' skills and knowledge and help them achieve learning objectives by providing opportunities for increased engagement. Simultaneously, autonomy and belongingness results are more inclined towards on-campus class satisfaction and psychological engagement than online learning. This shows that students feel more control and perceive to have the power of choice during on-campus classes compared to online due to the design and structure of these classes and familiarity with methodology, teacher, campus, and class setup (Gutiérrez and Tomás, 2019). This can also be explained since a student during on-campus classes feels more in control of the environment and resources, whereas in an online class, a student relies more on technology apps and internet connectivity to engage digitally or online (Evans and Boucher, 2015).

Moreover, the study results related to belongingness advocate that students feel more related and emotionally attached to on-campus learning. This is because of a sense of being, close-knit relationships with fellow students through face-to-face interactions, association with the university environment and facilities, and virtual online learning. Previously research showed that virtual online learning could sometimes develop feelings of alienation and loss of touch due to lower interaction between friends and peers than in traditional systems (Ganesha, Nandiyanto, and Razon, 2021). In contrast, many studies advocate that online learning increases interaction, which is mostly virtual (Yakhshieva and Sidiqova, 2020). Whereas, based on the current study results, it is asserted that a sense of belonging arises from emotional well-being and attachment developed through supportive relationships based on time spent, mutual interests, and face-to-face interaction. These results are supported by the findings of Van Ryzin, Gravely, and Roseth (2009).

Finally, based on the mixed findings, the current study suggests a hybrid model for institutions and educational managers who wish to foresee which learning model will engage students more effectively to gain their ultimate satisfaction in the post-COVID-19 era of the new normal education system. Study results show that interest and competence greatly impacted digital engagement and online class satisfaction, whereas the sense of belongingness and autonomy was more associated with on-campus psychological engagement and satisfaction. This suggests that the post-COVID-19 era can take advantage of incorporating a hybrid mix of blended learning to achieve the best learning outcomes and students' satisfaction (Blaine, 2019). Simultaneously, educational institutions always need to keep in mind to carefully design the content and mode of learning to meet students' intrinsic motivation needs to enhance learning opportunities based on self-determination theory.

5.2 Theoretical Implications

The current study offers multiple significant theoretical implications for scholars and educational leaders. Firstly, it compares online vs. traditional learning modes of learning to determine factors leading to student engagement and satisfaction, which has not been previously investigated. Secondly, it investigates the impact of interest and enjoyment towards online and traditional teaching methods in terms of digital engagement in online classes vs. psychological engagement in traditional classes, which have not been explored previously. Thirdly, this study investigates the role of competence in determining which mode of teaching engages students effectively and which mode of learning increases their satisfaction based on the students' competence. This study's fourth major contribution is exploring autonomy's role in increasing engagement and satisfaction in on-campus and online learning modes. Fifth, the sense of belongingness was explored in this framework to investigate how students feel engaged and satisfied during on-campus learning compared to online learning due to a sense of emotional attachment and strong interpersonal relationships developed over time. Finally, this study suggests a blended learning model achieve learning objectives in the post-pandemic era. Thus, academic researchers can benefit from this study by further investigating these factors' influence on students' satisfaction and student engagement along with multiple other theories and models famous in current literature. This study can also help contribute to the literature by providing strong empirical evidence on intrinsic motivation inventory and its relationship with student satisfaction and engagement digitally and psychologically.

5.3 Practical Implications

There are various practical implications of this study for higher education institutions and universities as well as basic and school-level education systems. Firstly, after such challenging times experienced due to the current pandemic, institutions and policymakers are not engrossed in deciding which learning mode to carry forward in the post-COVID-19 era. Thus, providing a future road map for effective learning mode is a primary advance made by this research. As this study suggests, students' feelings of interest and enjoyment increase their digital engagement and online satisfaction; therefore, policymakers can incorporate gamification and other interactive digital tools that activate students' sense of joy and help them achieve their learning objectives. Based on this, finding both traditional and distance learning methods can re-evaluate intrinsic motivational factors in their current learning mode and incorporate the missing intrinsic factors. Secondly, this study shows similar results for the impact of student's competence on both traditional and online class satisfaction and digital engagement and psychological engagement, suggesting that course content and design should be carefully implemented to support students' skills and knowledge in both online and traditional system. Thus, both distance learning and on-campus approaches should observe the set of competencies required by their students to achieve desired learning outcomes. Then devising strategies to facilitate, ensure and train to equip their students with those competencies will help to advance the practice in the education system further. Also, policymakers can benefit from this study by decentralizing the learning system to suit students' capabilities and choices by supporting flexibility and collaboration to achieve satisfaction in-campus. Moreover, universities and administrative staff should focus on developing infrastructure and facilities that increase students' sense of belongingness and decrease the sense of alienation to support diversity in culture, religion, and ethnic origin. This can be achieved by providing a representative environment and inclusive culture to all international and local students through language, food, ethics, and teaching. Additionally, distance learning programs should look for inclusive approaches and programs that may improve students' belongingness to class while they are digitally engaged in the online education system. Conclusively, this research provided an overview of intrinsic motivational factors and their role in the post-COVID-19 era education system to help policymakers and educational managers create a learning-oriented environment where students are digitally and psychologically engaged and satisfied.

5.4 Limitations and Future Directions

Although this is a very comprehensive study that focused on various factors in detail to thoroughly investigate students' engagement and satisfaction in online vs. traditional on-campus learning in the post-COVID-19-era, there are still a few limitations to be considered in the future studies. This study focused on students' satisfaction, but further studies can explore the impact of students' academic performance to investigate whether the sense of enjoyment and other psychological needs impact it and which mode of learning best boosts students' academic performance. Among intrinsic motivation inventory, which factor is more linked to students' academic performance than others, can be an interesting future study. Moreover, this study explored the student's perspective; future studies can investigate teachers' perception of online vs. on-campus learning in the context of intrinsic motivation inventory. Furthermore, future studies can also explore which mode of learning effectively evaluates students' performance through examination and assessment and in which mode students feel more comfortable while taking exams. Finally, the current study focused on higher education; therefore, only university students were surveyed. Future studies can focus on primary, high school, and college-level contexts to investigate the students' preferences for online versus on-campus learning modes. Another major limitation of this research was a cross-sectional study design which was adopted due to a lack of time and financial resources. Future studies may adopt a longitudinal design to determine better causality among study variables.

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Modelling Students' Satisfaction with Computer-Based Assessment (CBA) Environments in Higher Education: The Roles of CBA Center Service Satisfaction and Perceived Trust

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Abstract: It has been extensively researched how satisfied students are with the vast majority of goods and services offered by educational institutions of higher learning. However, there appears to be a paucity of research on students' satisfaction with the facilities and services of computer-based assessment (CBA) centers in higher education institutions, especially when the centers are equipped and staffed by third-party vendors. The CBA centers are public and private examination centers in developing countries that administer computer-based tests for higher education and other external organizations. Although satisfaction with the services and facilities is essential, it has been asserted that having the feeling of trust when using the CBA is even more critical to the students. Trust is essential for the success of any technological advancement, especially in the field of education. Any educational technology that lacks the stakeholders' trust, regardless of how effective it may be, is doomed to fail to be adopted on a large scale. However, limited studies have investigated how students' trust in the CBA affects their satisfaction. Therefore, this study aims to model and analyze the roles of CBA center service satisfaction and perceived trust in the CBA in attaining overall satisfaction by exploring their roles in influencing student satisfaction. A research framework based on the updated information system success model (ISSM) is validated using a survey incorporating system quality, service quality, question content, the cost-effectiveness of CBA services, CBA center service satisfaction, and perceived trust. A total of 459 survey responses collected from three higher education institutions in Nigeria were analyzed using structural equation modelling. As a result, the findings confirmed that students' satisfaction with services at the CBA centers is a mediator between service quality, system quality, and overall satisfaction with CBA. The correlation between CBA centre service satisfaction and overall CBA satisfaction was also found to be the strongest, indicating that student satisfaction with the services and facilities at the CBA centre is crucial. CBA center managers and institutions can utilize the findings from this study to successfully implement the CBA. In enhancing students' CBA satisfaction, higher education institutions should consider focusing on the necessary steps towards improving the conditions of the CBA centers in terms of infrastructure and services rendered. Meanwhile, to increase student satisfaction besides enhancing the system and service quality and cost-effectiveness, institutions should seriously consider promoting the CBA to the students by highlighting the personal impact of the CBA in terms of trust by improving the quality and features of the CBA.

Keywords: Computer-based assessment, CBA center, CBA trust, CBA satisfaction, CBA quality factors

1. Introduction

Globally, education has been transformed by information systems (IS) and information and communication technologies (ICT). Today's computer technologies and other multimedia elements facilitate teaching and learning in various settings. As a result of this trend, electronic assessment systems (e-assessment), also known as CBT (computer-based testing) and CBA (computer-based assessments), have grown in popularity (Fagbola, Adigun and Oke, 2013). With the increased adoption of CBA in higher education, particularly during the Covid-19 pandemic, students' satisfaction is a crucial goal. The quality of the services and facilities provided at the CBA centers is expected to help achieve it. In this context, students' satisfaction is a crucial demonstration of a successful CBA implementation (Vairamuthu and Anuncia, 2016). Several studies have successfully established a correlation between perceived quality factors (system quality, information quality, and service quality) and student satisfaction with educational technologies (Mohammadi, 2015; Ramayah and Lee, 2012; Almarashdeh, 2016).

Assessment is one of the educational activities for which trust is essential, especially when the assessment is administered online and is high stakes. Consequently, trust is considered one of the assessment principles (Liu, Chen and Lu, 2015). According to Liu, Chen and Lu (2015), perceived trust in the context of summative CBA is the extent to which the CBA is perceived to be trustworthy. If students lack faith in the CBA system, this will compromise their eligibility to take the examination ((Liu, Chen and Lu, 2015). Essentially, Ivanova et al. (2018) recognized that trust in CBA could be called at various levels: trust in the institution (Is the institution trustworthy?); trust in the e-authentication tools (Do the tools do what they claim to do?); trust in the

deployment of the tools (Are the tools used transparently or covertly?); trust in the use of the collected data (Will the data be used as agreed and intended?); and trust in the outcomes (Will cheating students be identified?). Accordingly, students' satisfaction and participation in computer-based examinations will be influenced by their perceptions of its trustworthiness.

Nevertheless, whether quality factors and trust in the CBA explain students' satisfaction with CBA in higher education is still not empirically clear (Vairamuthu and Anuncia, 2016; Dobre, 2015; Bahati et al., 2019; Binsaif Alhassan, and Singh, 2021). Hence, this issue requires further research. The CBA system is another type of e-learning (Lin, 2019), and its critical role in the e-learning process has not received proper attention in empirical e-learning research compared to massive open online courses (MOOCs) and computer-supported collaborative learning (CSCL) (Osang, 2014). Therefore, four specific research gaps are identified along this line of research.

First, user satisfaction is a significant component of IS success (DeLone and McLean, 1992). Several studies have described the effect of CBA quality factors on students' satisfaction with higher education. For instance, Vairamuthu and Anuncia's (2016) study shows how usability factors affect users' satisfaction with CBA in higher education. Dobre (2015) is concerned with the impact of the system's navigation, interface, interaction, and assessment, while the quality of formative CBA feedback in influencing CBA satisfaction was studied by Bahati et al. (2019). Binsaif, Alhassan and Singh (2021) examined students' performance perceptions of CBA satisfaction. A close look at the studies highlighted above shows that these previous studies were not based on theory, and CBA satisfaction has not been explored in a theory-based approach. Consequently, CBA satisfaction based on quality factors has not been theoretically established so far (Osang, 2014). Second, all the factors considered in the previous studies were based on system/technical qualities. However, none included service quality because all the CBAs examined in the studies were run and managed by the institutions concerned. Though, in some developing countries, some higher education institutions' CBA services and facilities are run and operated by trusted third parties (Fluck, Adebayo and Abdulhamid, 2017; Umar and Wilson, 2019; Adebayo, Abdulhamid and Fluck, 2013), hence, determining the quality of the services provided by the vendors is of paramount importance (Vairamuthu and Anuncia, 2016). Third, students' satisfaction with the services offered by the CBA vendors needs to be assessed to ascertain the level of service quality provided (Vairamuthu and Anuncia, 2016). Students' service satisfaction is a short-term attitude resulting from the cognitive evaluation of the services offered and facilities provided (Weerasinghe, Lalitha and Fernando, 2017), while overall satisfaction is "the IS end-user's overall affective and cognitive evaluation of the pleasurable level of consumption-related fulfilment experienced with the IS." (Au, Ngai and Cheng, 2002). Prior literature suggested that IS's quality factors impact service satisfaction. In other studies, service satisfaction has influenced users' overall satisfaction (Mihanović, Batinić and Pavić, 2016; Wang, So and Sparks, 2017; Eiamkanchanalai and Assarut, 2018). However, the mediating role of service satisfaction between perceived quality factors of CBA and overall satisfaction has not been explored in an integrated way so far. Thus, the specific mechanism through which the perceived quality factors of CBA affect overall CBA satisfaction has not been established yet. Fourth, trust is believed to be a fundamental prerequisite for the success of any educational technology, particularly in the higher education context (Edwards et al., 2018), because a student who trusts an institution's services expects satisfaction concerning the institutions that are likely to be confirmed (Kim et al., 2011). Hence, many studies have investigated the impact of perceived trust on user satisfaction and the successful implementation of educational technologies within the higher education context (Edwards et al., 2018; Nikou and Economides, 2017; Ivanova et al., 2018; Liu, Chen and Lu, 2015; Ismail, Celebi and Nadiri, 2019; Alkrajji and Ameen, 2021). Despite the increased popularity of CBA among higher education institutions, evaluating students' trust and satisfaction with the system was not fully undertaken.

In covering the gaps mentioned above, the study contributes to previous literature. First, the study extends the limited research on understanding CBA quality factors and their impact on satisfaction. Our study is one of the first to consider quality factors as essential antecedents of CBA satisfaction through a theoretical approach. Second, no previous research has empirically explored the effects of service quality on CBA satisfaction in higher education to the best of our knowledge and through searches in peer-reviewed databases. However, research has shown that service quality can increase users' satisfaction with educational technologies (Almarashdeh, 2016; Masrek and Gaskin, 2016; Al-Fraihat, Joy and Sinclair, 2020). Based on the reviewed literature, previous studies in higher education have not incorporated the identified mediator to explain the impact of perceived CBA quality factors and the effect of trust on CBA satisfaction. Consequently, there is still a limited understanding of the different routes that link the variables in this context.

Thus, the overall objective of this study is to explore and empirically test quality factors' influence on how well they predict how satisfied students will be with their CBA. This was followed by testing a mediator to comprehend better the connection between the CBA centers' facilities and services and their overall satisfaction and examining the role of perceived trust in CBA in influencing satisfaction. Therefore, this study seeks to answer the question, "How does the quality of the services and facilities provided at the CBA centers affect student satisfaction, and what impact does student's perceived trust in CBA have on the overall satisfaction with the CBA at higher education institutions of developing countries?".

This research provides some practical contributions. It offers insight to CBA center managers who wish to enhance the students' service satisfaction, which is a crucial factor in overall satisfaction. The findings indicated that CBA center managers should focus on quality factors to increase overall satisfaction. The organization of this paper is as follows. The first section lays out the background and identifies research gaps. Section 2 provides the theoretical background of the Delone and McLean model used in this study and the description of the proposed research model. Sections 3 and 4 elaborate on the methods and results of the study, while sections 5 and 6 consist of the research's discussion, conclusion, implications, and limitations.

2. Literature Review

2.1 Theoretical Background

This study was conceived under the updated information system success model (ISSM) (Delone and McLean, 2003), which links system quality, service quality, and information quality to overall user satisfaction and system use/intention, which in turn influences net benefits. Information quality, system quality, and service quality refer to features of both the system and the provider. This model is also flexible because other factors represented as the organizational and individual impact can be combined to make the model more adequate for describing various technologies. Figure 1 illustrates the model.

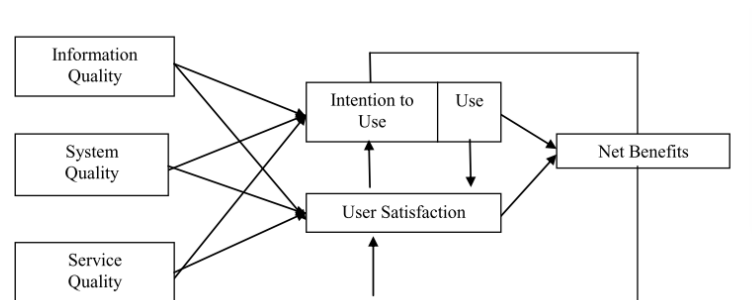


Figure 1: Delone and McLean Information System Success Model (Delone and McLean, 2003)

This study incorporates the Delone and McLean (2003) system success model with quality features relevant to CBA system. There is a need to distinguish the student's satisfaction with the CBA services provided at the CBA center from students' satisfaction with the overall student CBA usage experience (Wang, So and Sparks, 2017). Additionally, studies such as Ramayah, Nejati and Shafaei (2015), Cheng (2012), and Shin (2015) have replaced Delone and McLean's (2003) information quality variable with content in a content-oriented system (such as e-learning and web blogs). While previous research has validated the importance of cost-effectiveness and content as CBA quality requirements (Economides and Roupas, 2007). Nonetheless, little is known about how cost-effectiveness and content affect students' CBA satisfaction. In addition to quality factors, some studies extended the Delone and McLean (2003) with variables relevant to their research area. Hussein and Hilmi (2021) extended it with convenience in an e-learning study, and Al-Adwan et al. (2022) introduced self-regulated learning to the model in e-learning research, while Sharma and Sharma (2019) included trust in their model in a mobile banking study. Hence, this study extended the DeLone and McLean (2003) model with the construct of perceived trust in CBA.

2.1.1 System quality

A sound quality system quickly identifies functional IS groupings and navigational options through resources supplied by the IS (Cheng, 2012). Previous studies point to various criteria for determining system quality when assessing a system, including speed, time, accuracy, stability, functionality, and accessibility (Hamilton and Chervany, 1981; Bailey and Pearson, 1983). During the Covid-19 pandemic, internet connection and assessment

platform challenges were obstacles to CBA's success in Jordan. Also, login issues can delay starting the CBA, as previously proven by the study of Elsalem *et al.* (2020).

2.1.2 Service quality

Even though trusted third parties (TTP) in developing countries provide some CBA services and facilities, there are still delivery obstacles. There may be power outages, interruptions, untrained examination personnel, and poorly managed examination centers (Fluck, Adebayo and Abdulhamid, 2017; Sanni and Mohammad, 2015). Service quality examines the support or assistance provided by the service provider (Delone and McLean, 2003) or information system services, such as training and helpdesk services (Mohammadi, 2015). In light of this, the entire CBA center supports employees, and the institution's support staff is categorized as a service.

2.1.3 Questions' content

A CBA's question content and presentation are issues and obstacles higher education students cope with (Fluck, Adebayo and Abdulhamid, 2017; Sanni and Mohammad, 2015). Multiple studies have found that educational IS content (such as e-learning, e-training, and MOOCs) influences user satisfaction (Mohammadi, 2015; Seta *et al.*, 2018; Hassanzadeh, Kanaani and Elahi, 2012; Kim *et al.*, 2015). However, empirical research examining the influence of question content on CBA satisfaction is scarce. The CBA questions' content focuses on quantity and quality (Economides, 2005). In addition, students of the CBA examination anticipate that the items on the questions will be accurate, trustworthy, directly relevant, accurate, and reliable (Economides, 2005). Additional recommendations demonstrate that question format and presentation affect test quality (Kuikka, Kitola and Laakso, 2014). Figure 2 depicts a sample dummy CBA question for a college admission examination in Nigeria.

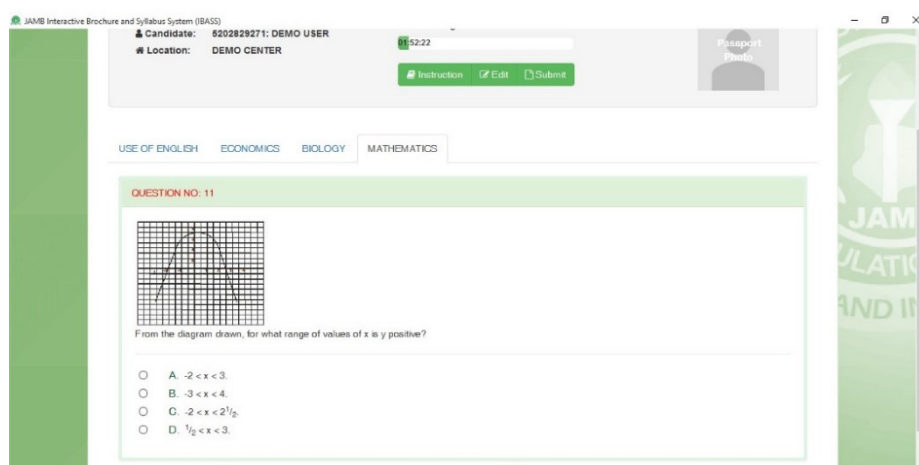


Figure 2: Sampled Higher education entrance Dummy CBA question in Nigeria. (JAMB, 2019)

2.1.4 CBA services cost-effectiveness

Cost-effective teaching and learning approaches are required to expand student numbers (Loewenberger and Bull, 2016). The cost-effectiveness of the CBA system is related to student-achieved satisfaction concerning the fees and costs of the CBA services (Economides, 2005). In other words, CBA services' cost-effectiveness is the students achieved satisfaction with using the CBA vs the fees the student pays (Economides and Roupas, 2007). Every student should be aware of all costs and fees for any CBA service (Economides, 2005). For instance, students of CBA in some Nigerian higher education institutions usually pay for some pre-examination or post-examination services or purchase scratch cards from the institutions before or after the exam (Economides and Roupas, 2007). CBA studies are lacking in exploring students' evaluation of the cost-effectiveness of CBA services.

2.1.5 CBA center service satisfaction

According to some studies, CBA centers in developing nations are unpleasant due to persistent network, power supply, and computer system failures (Adepoju, 2016). For instance, Elsalem *et al.* (2020) reported that most higher education institutions implemented on-campus CBA in response to the Coronavirus outbreak in Jordan, and students faced similar negative experiences when taking the on-campus CBA. Also, according to Salah, Ramadan and Ahmed (2021), a stress-free environment is required to encourage CBA adoption. Consequently, even though third parties provide certain CBA services and facilities, it is essential to evaluate student

satisfaction with the services offered by these vendors. Consequently, computer-based assessment centers are validated to ensure students' positive experiences (Nwankwo, Nwosu and Oputa, 2016). Figure 3 depicts a typical CBA center in Nigerian higher education institution.



Figure 3: A typical higher education institution CBA center in Nigeria. (*Premium Times*, 2017).

2.1.6 Overall satisfaction with CBA

According to previous research, "user satisfaction" and "overall user satisfaction" are frequently used interchangeably (Ibrahim, 2016). Overall satisfaction is "the IS user's affective and cognitive assessment of the level of consumption-related fulfillment achieved with the IS" (Au, Ngai and Cheng, 2002). Overall user satisfaction comprises both the systems and services provided (Petter, DeLone and McLean, 2008). Based on the reviewed literature, few studies investigated students' satisfaction with CBA. For example, Vairamuthu and Anuncia (2016) investigated the effect of usability issues on academic institution students' satisfaction with an online assessment. Dobre (2015) used the Intelligent Tutoring System to collect data on CBA satisfaction for a study conducted in Romania. Similarly, Bahati et al. (2019) surveyed the University of Rwanda students' involvement and the impact of feedback quality on formative CBA satisfaction.

2.1.7 Perceived trust with CBA

CBA uses technology to support online assessments of students' knowledge and skills. However, challenging problems must be addressed, such as trustworthiness among students and teachers in higher education settings (Ivanova *et al.*, 2018). In their contribution, Nikou and Economides (2017) define perceived trust in a CBA system as the student's perceptions of its reliability and trustworthiness. Perceived trust in CBA may depend on the reliability of the user authentication process, the ability to cheat prevention, the security of the information processing, and the perceived reliability of the evaluation outcome (Liu, Chen and Lu, 2015). The importance of trust in the satisfaction of users in some electronic-mediated environments was studied by several researchers like Shirazi et al. (2021) (e-commerce), Meng and Berger (2021) (organization), Giao, Vuong, and Quan (2020) (online shopping), and Romeike, Nienaber and Schewe (2016) (virtual teams) and all established significant correlations between trust and users' satisfaction.

2.2 Research Model and Hypotheses Development

This study identified system quality, service quality, question content, the cost-effectiveness of CBA services, and trust as the primary determinants of CBA satisfaction. The relationship between service and system quality is mediated by CBA center service satisfaction. Prior study indicates that quality factors influence user satisfaction with information systems (DeLone and McLean, 2003). This study examined the relationship between CBA center service satisfaction, quality factors, and overall satisfaction. Figure 4 shows the conceptual research model.

2.2.1 System quality and CBA center service satisfaction

With the widespread adoption of information technologies, new quality issues have emerged. There appear to be few studies on students' satisfaction with computer-based testing facilities. The relationship between system quality and service satisfaction is empirically supported (Shin, 2015; Alzabi et al., 2016; Noh and Chang, 2020).

Therefore, this study proposes:

H1: CBA system quality positively influences students' satisfaction with the CBA center services.

2.2.2 Service quality and CBA center service satisfaction

The cognitive evaluation of service quality emphasizes service efficiency and efficacy. The correlation between service quality and user satisfaction with services was established by (Wang, So and Sparks, 2017; Lee and Wu, 2011; Alzabi et al., 2016). Due to the positive impact of assessment service quality on students, the following hypothesis is presented:

H2: Service quality of CBA will positively influence students' CBA center service satisfaction.

2.2.3 CBA center service satisfaction and overall satisfaction

The impact of service satisfaction on overall user satisfaction with IS cannot be denied, as many studies have established (Mihanović, Batinić and Pavičić, 2016; Wang, So and Sparks, 2017; Eiamkanchanalai and Assarut, 2018). Previous studies have found that service satisfaction positively affects overall satisfaction (Mihanović, Batinić and Pavičić, 2016; Wang, So and Sparks, 2017). These studies demonstrated a correlation between service satisfaction and overall satisfaction. Those who are satisfied with the service provided at CBA centers may also be satisfied with their CBA usage experience. Consequently, this study proposed:

H3: Students' satisfaction with the CBA center's services will positively influence overall satisfaction.

2.2.4 System quality and overall satisfaction

User satisfaction is related to system quality (Delone and McLean, 2003; Fang, Chiu and Wang, 2011; Ramayah and Lee, 2012; Al-Mamary et al., 2015; Bello and Abdullah, 2021). The system's overall quality predicts an IS user's level of satisfaction. Therefore, it is hypothesized in this study that:

H4: CBA system quality positively influences overall satisfaction with the CBA.

2.2.5 Service quality and overall satisfaction

Several studies have proven a strong relationship between service quality and user satisfaction (Almarashdeh, 2016; Mohammadi, 2015). According to their findings, the quality of e-learning services has a significant and positive effect on learner satisfaction. The following hypothesis is developed to examine the impact of service quality on overall CBA satisfaction:

H5: CBA service quality positively influences the student's overall satisfaction.

2.2.6 Questions' content and overall satisfaction

Hassanzadeh, Kanaani and Elahi (2012) and Mohammadi (2015) investigated the correlation between the content of an e-learning system and learner satisfaction and discovered statistically significant correlations. Equivalently, CBA research should investigate the connection between CBA question content and student satisfaction. Hence,

H6: CBA question content positively influences overall satisfaction with the CBA system.

2.2.7 CBA services cost-effectiveness and overall satisfaction

Researchers analyzed the relationship between service cost-effectiveness and user satisfaction and found statistically significant correlations (Kumbhar, 2011; Atmojo et al., 2020). The cost-effectiveness and satisfaction of CBA services are understudied. It is necessary to examine these relationships to ensure a connection between the cost-effectiveness of CBA services and user satisfaction within the context of CBA. Therefore, the following hypothesis is proposed:

H7: CBA services cost-effectiveness positively influences overall satisfaction with the CBA system.

2.2.8 Perceived trust and CBA satisfaction

A student who trusts an institution's services expects satisfaction concerning the institution that is likely to be confirmed (Kim et al., 2011). Despite the increased popularity of student information systems (SIS) among universities, evaluating students' trust and satisfaction with the system was not fully undertaken. Hence, Ismail,

Celebi and Nadiri, (2019) sampled 634 students from a Cyprus university to examine their trust and satisfaction with the SIS. The findings from SEM analysis indicated a significant influence of trust on students' satisfaction with SIS based. Young citizens' loyalty to e-government services was investigated by Alkraihi and Ameen (2021). The study's key findings indicated a significant impact of trust in the system on students' satisfaction and loyalty to the services provided by the e-government services.

Contrary to many assumptions, trust was found not to influence satisfaction with services in an electronically mediated environment (EME) of how consumers and firms interact. Dai et al. (2015) conducted a study with 415 consumers and found that consumers' trust does not influence their satisfaction in EME. Therefore, the relationship between trust and overall satisfaction with CBA is with this proposed to be tested. Hence, H8: Perceived trust in the CBA positively influences students' CBA satisfaction.

2.2.9 The Mediating Role of CBA center service satisfaction

System and service quality are necessary conditions for satisfaction with information system services (Shin, 2015; (Wang, So and Sparks, 2017). It has also been proposed that system and service qualities directly affect information system satisfaction (Alzabi et al., 2016; Noh and Chang, 2020; Wang, So and Sparks, 2017; Subrahmanyam, 2017). Researchers also discovered a correlation between satisfaction with information system services and overall user satisfaction (Wang, So and Sparks, 2017; Eiamkanchanalai and Assarut, 2018). From an empirical standpoint, it is assumed that there is a relationship between system quality, service quality, and overall satisfaction via the service satisfaction effect. However, the indirect effects of CBA quality factors on overall CBA satisfaction have not yet been studied in the literature. Therefore, this study proposes:

H9: Students' satisfaction with the services provided at the CBA center mediates the relationship between system quality and overall CBA satisfaction.

H10: Students' satisfaction with the services provided at the CBA center mediates the relationship between service quality and overall CBA satisfaction.

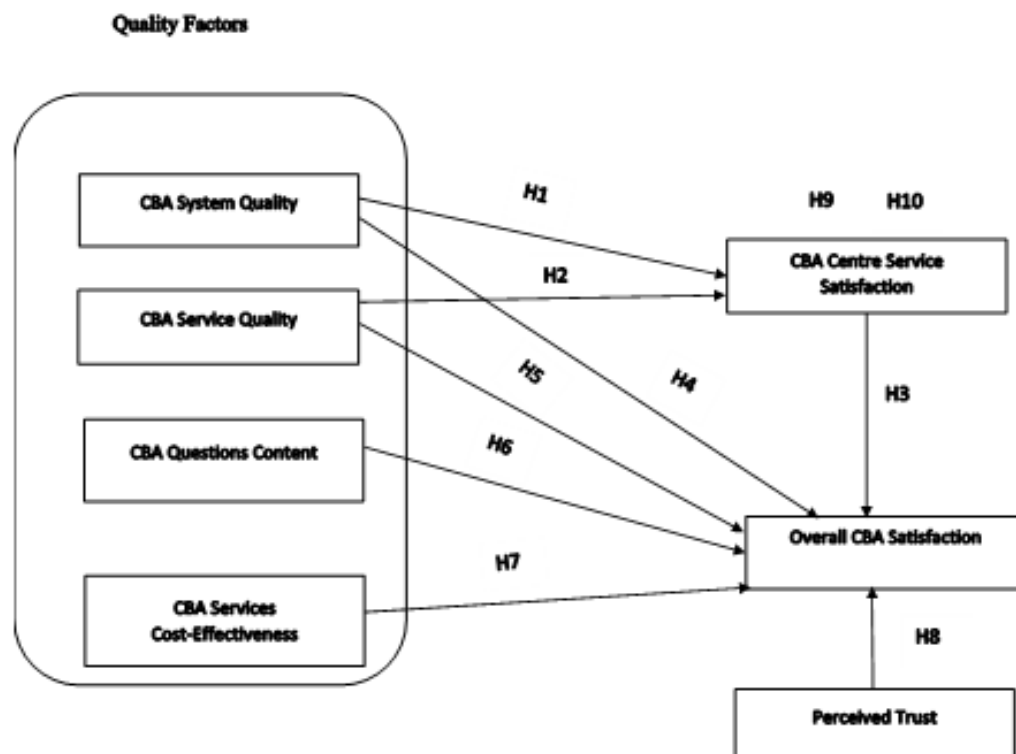


Figure 4: Students' CBA Satisfaction Model

3. Methodology

3.1 Instrument development

A research questionnaire was developed using previously employed, tested, and validated instruments. The questionnaire consisted of thirty questions organized into two sections. The first section requested demographic data and contained seven questions (see Table 1). The second section examined CBA quality, students' satisfaction with CBA center services, overall satisfaction, and perceived trust (see Appendix for more information about the items).

A five-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree, and 5 = strongly agree) was used to evaluate independent variables, whereas a seven-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = somewhat disagree; 4 = neutral; 5 = somewhat agree; 6 = agree, and 7 = strongly agree) was used to evaluate all items related to mediating and dependent variables. The Likert scales were employed as a procedural technique to reduce common method bias (CMB) (Podsakoff, MacKenzie and Podsakoff, 2012). Three items of the CBA services cost-effectiveness construct are adapted from Kim, Yoon and Han (2016), whereas three items of the question content variable are adopted from Nikou and Economides (2017). Five system quality measures and six service quality measures are adopted from Holsapple and Lee-Post (2006). In addition, three CBA center service satisfaction items and three overall CBA satisfaction items are adapted from Xu and Du (2018). The perceived trust measurement items are from Liu, Chen and Lu (2015). The research team interviewed three experts and conducted a pilot test with 100 students. Based on the test results, the questionnaire was modified to ensure the item meanings were not lost and no misunderstandings occurred.

3.2 Study Participants

This study sample consists of 459 undergraduate students from three public higher education institutions (a university, polytechnic, and college of education) in Kano state, North-West Nigeria. The three higher institutions selected for this study served as CBA centers for the annual matriculation computer-based examinations conducted by the Joint admission and matriculation board (JAMB). All the undergraduate students of these institutions have been admitted based on their participation in this examination. Male students outnumbered female students in this study, as shown in Table 1 (Male = 267; Female = 192). Regarding the type of institution of the students, the number of universities, polytechnics, and colleges of education students was 188, 162, and 109, respectively.

Table 1: Demography of the participants

Demographics	Items	Number	Percentage (%)
Gender	Male	267	58.2
	Female	192	41.8
Institution	University	188	41.0
	Polytechnic	162	35.3
	College of Education	109	23.7
Course	Science	342	74.5
	Art	97	21.1
	Others	20	4.4

3.3 Data Collection and Analysis

The data collection was conducted with the help of two trained research assistants. Six hundred questionnaires were administered at the selected institutions. Participation in this study was voluntary, and convenience sampling was adopted among current students enrolled in the academic year 2020/21 who were admitted via the CBA entrance matriculation examination as the minimum CBA experience. Lin and Lai (2019) and Okocha, Toluwani and Owolabi (2017) have typically employed non-probabilistic (convenience) sampling in CBA studies. To overcome the disadvantages of convenient sampling, students from various disciplines, including science, art, and others, were considered. The G*Power software (https://download.cnet.com/G-Power/3000-2054_4-10647044.html) was utilized to calculate the minimum sample size for the survey (Hair *et al.*, 2019). A minimum sample size of 146 was required for a power of 0.95. Four hundred fifty-nine valid records were obtained after data filtering and cleaning. Multivariate data analysis revealed that the scale data appeared to have a non-normal distribution; therefore, the data set was suitable for Partial Least Square Structural Equation Modelling (PLS-SEM) analysis (Hair *et al.*, 2017).

The hypothesized relationships were investigated using the technique of structural equation modelling (SEM) because of its statistical approach, which includes latent variable relations. SmartPLS 3.0 was utilized to evaluate and analyze the research model.

4. Results

The results of the hypotheses testing are obtained as follows: First, we assess the model's reliability and validity. Once the measurement model has been established, the subsequent step entails examining its paths and identifying model construct relationships.

4.1 Measurement Model Evaluation

The measurement model was evaluated using two types of validity: convergent validity and discriminant validity.

4.1.1 Convergent Validity

Fornell and Larcker (1981) proposed three criteria for assessing the convergent validity of reflective constructs. It is as follows: In particular: 1) indicator loadings must be statistically significant and greater than 0.70; 2) internal consistency (composite reliability/ Cronbach's Alpha) must be greater than 0.70; 3) the average variance extracted (AVE) for each construct must be greater than 0.50. However, indicator loadings between 0.5 and 0.7 are acceptable if the composite reliability (CR) and extracted average variance (AVE) values exceed the previously mentioned thresholds (Hair et al., 2017). These metrics are detailed in Table 2.

Table 2: Reliability and Validity Measurements

Construct	Items	Loadings	CR	AVE
CBA Services Cost-Effectiveness	CEF1	0.785	0.816	0.599
	CEF2	0.862		
	CEF3	0.661		
Overall CBA Satisfaction	OVER_SAT1	0.871	0.885	0.719
	OVER_SAT2	0.850		
	OVER_SAT3	0.822		
Perceived Trust	PTE1	0.790	0.841	0.571
	PTE2	0.833		
	PTE3	0.660		
	PTE5	0.729		
CBA Question Content	QCQ1	0.822	0.845	0.645
	QCQ2	0.817		
	QCQ3	0.769		
CBT Centre Service Satisfaction	SERV_SAT1	0.866	0.900	0.749
	SERV_SAT2	0.841		
	SERV_SAT3	0.890		
CBA Service Quality	SRQ1	0.819	0.894	0.628
	SRQ2	0.843		
	SRQ3	0.796		
	SRQ4	0.772		
	SRQ5	0.727		
CBA System Quality	SYQ1	0.792	0.883	0.557
	SYQ2	0.815		
	SYQ3	0.745		
	SYQ4	0.715		
	SYQ5	0.659		
	SYQ6	0.743		

NOTE: CR= Composite Reliability; AVE= Average Variance Extracted.

As shown in Table 2, all three conditions for convergent validity are met (Hair et al., 2017).

4.1.2 Discriminant Validity

To determine discriminant validity, Fornell and Larcker (1981) proposed that the square root of each construct's AVE should be greater than its highest correlation with any other construct. The square root of the AVE is expressed diagonally in Table 3. Compared to all other model constructs, the AVE value for each construct was greater than its correlation coefficient. In addition, Henseler, Ringle and Sarstedt (2015) recommended substituting the Heterotrait-Monotrait correlation ratio (HTMT) for measuring discriminant validity. The HTMT is calculated by dividing the average correlations between items across constructs by the geometric mean of the average correlations between items within the same construct. There are discriminant validity issues when HTMT values are increased. Therefore, Henseler, Ringle and Sarstedt (2015) proposed 0.90 as the cut-off value. As shown in Tables 3 and 4, the discriminant validity of the data is satisfactory.

Table 3: The Fornell-Larcker Discriminant validity correlation matrix

	SERV_SAT	QCQ	SRQ	CEF	SYQ	OVER_SAT	PTE
Construct							
SERV_SAT	0.866						
QCQ	0.462	0.803					
SRQ	0.536	0.624	0.792				
CEF	0.291	0.420	0.381	0.774			
SYQ	0.574	0.650	0.664	0.424	0.747		
OVER_SAT	0.674	0.476	0.511	0.373	0.647	0.848	
PTE	0.572	0.533	0.599	0.369	0.607	0.564	0.756

NOTE: SERV_SAT = CBA Centre Service Satisfaction; CEF= CBA services Cost-effectiveness. OVER_SAT= Overall CBA Satisfaction; QCQ = Question Content; SRQ= CBA Service Quality; SYQ= CBA System Quality; PTE=Perceived Trust

Table 4: The HTMT correlation matrix

	SERV_SAT	QCQ	SRQ	CEF	SYQ	OVER_SAT	PTE
Construct							
SERV_SAT							
QCQ	0.594						
SRQ	0.633	0.794					
CEF	0.370	0.590	0.491				
SYQ	0.675	0.830	0.787	0.548			
OVER_SAT	0.818	0.618	0.618	0.488	0.781		
PTE	0.718	0.716	0.745	0.509	0.769	0.720	

NOTE: SERV_SAT = CBA Centre Service Satisfaction; CEF= CBA services Cost-effectiveness. OVER_SAT= Overall CBA Satisfaction; QCQ = Question Content; SRQ= CBA Service Quality; SYQ= CBA System Quality; PTE= Perceived Trust.

4.1.3 Common method variance (CMV)

Kock (2015) proposed a comprehensive test for detecting common method variance in data using a model that passes standard convergent and discriminant validity tests via confirmatory factor analysis. Therefore, a comprehensive collinearity test was conducted to determine the PLS-common SEM method variance (CMV) (Kock, 2015). Collinearity Statistics (VIF) values should be less than 3.30 (Kock, 2015; Hair et al., 2017). As shown in Table 5, the VIF values for all factors were less than the 3.3 thresholds, indicating the absence of method bias in the model. Furthermore, Harman's single-factor test was employed to measure the common method bias problem using SPSS software (version 25), following the approach of previous studies to analyze CMV (Gu, Xu and Sun, 2021). The result from Harman's single-factor test conveyed that the single-factor contribution was 37.21 percent, which is less than 50 percent suggesting that CMV did not affect the results of this study (Verma, Chaurasia and Bhattacharyya, 2020).

Table 5: Collinearity (VIF) Statistics

	CBA Centre Service Satisfaction	Overall CBA Satisfaction
CBA Centre Service Satisfaction		1.736
CBA Question Content		2.045
CBA Service Quality	1.788	2.239
CBA Services Cost-Effectiveness		1.296
CBA System Quality	1.788	2.484

	CBA Centre Service Satisfaction	Overall CBA Satisfaction
Overall CBA Satisfaction		
Perceived Trust		1.979

4.2 Structural Model Evaluation

The structural model investigated the direct and indirect relationships of the proposed variables. The path coefficients (β) were computed to determine the magnitude of the inter-variable effects. The significance level of the path was determined using 5000 samples using a bootstrapping procedure (Hair et al., 2017). The evaluation results of the study's hypotheses are summarised in Table 6 and Figure 5. The results of the hypotheses testing validate the influence of system quality (SYQ) on CBA center service satisfaction (SERV_SAT) and overall CBA satisfaction (OVER_SAT) (H1 and H4). Also, the findings revealed a correlation between CBA service quality (SRQ) and CBA center service satisfaction (SERV_SAT) (H2). There is a statistically significant correlation between center service satisfaction (SERV_SAT) and overall satisfaction (OVER_SAT) (H3). Although the cost-effectiveness of CBA services (CEF) was found to have a positive direct effect on overall satisfaction with the CBA system (OVER_SAT) (H7), the results do not support the direct impact of CBA service quality (SRQ) and CBA question content (QCQ) on overall satisfaction with the CBA system (OVERALL_SAT) (H5 and H6). On the relationship between perceived trust (PTE) in CBA and overall satisfaction (H8), the result indicated a statistically significant influence of trust on students' overall satisfaction.

Table 6 also indicates that the effect of CBA service quality (SRQ) on overall CBA satisfaction (OVER_SAT) via CBA center service satisfaction (SERV_SAT) is significant (H9). Therefore, the results demonstrate that service satisfaction at CBA centers (SERV_SAT) acts as a mediator between service quality (SRQ) and overall satisfaction with CBA (OVER_SAT). In addition, the results confirm the significant indirect effect of System Quality (SYQ) on overall satisfaction (OVER_SAT) via CBA center service satisfaction (SERV_SAT) (H10), thereby validating the mediating role of CBA center service satisfaction (SERV_SAT) too.

Table 6: Results of the Structural Model Analysis (Hypotheses Testing)

Hypothesis	Relationship	Beta value	Std. Error	t-value	P-value	Decision	R ²	f ²	Q ²
H1	SYQ-> SERV_SAT	0.390	0.062	6.247	0.000	Supported	0.373	0.135	0.274
H2	SRQ-> SERV_SAT	0.278	0.066	4.239	0.000	Supported		0.069	
H3	SERV_SAT-> OVER_SAT	0.412	0.054	7.664	0.000	Supported	0.570	0.227	0.402
H4	SYQ-> OVER_SAT	0.324	0.064	5.029	0.000	Supported		0.098	
H5	SRQ-> OVER_SAT	-0.022	0.056	0.388	0.349	Not Supported		0.000	
H6	QCQ-> OVER_SAT	-0.010	0.047	0.219	0.413	Not Supported		0.000	
H7	CEF-> OVER_SAT	0.084	0.045	1.866	0.031	Supported		0.013	
H8	PTE-> OVER_SAT	0.119	0.049	2.442	0.007	Supported		0.017	
H9	SRQ-> SERV_SAT-> OVER_SAT	0.114	0.028	4.156	0.000	Supported			
H10	SYQ-> SERV_SAT-> OVER_SAT	0.160	0.034	4.763	0.000	Supported			

Note: $p < 0.05$ (one-tailed for direct effect, and two-tailed for specific indirect effect).

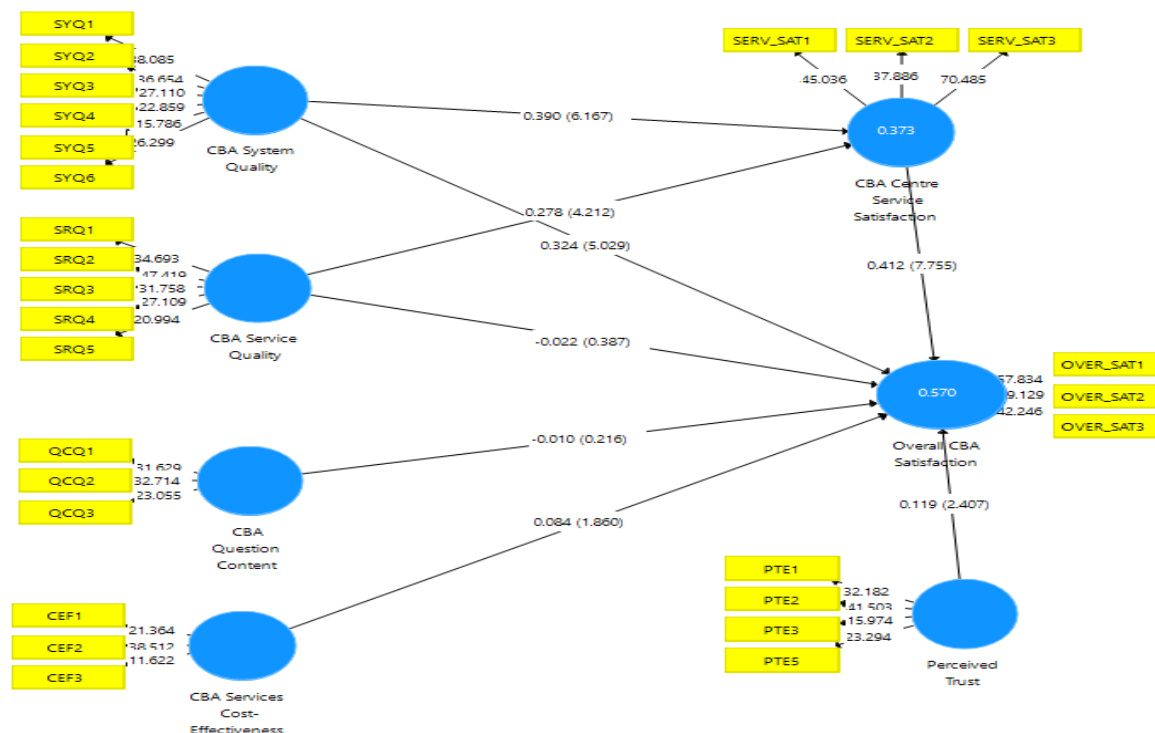


Figure 5: Results of evaluation of the structural model with R² values

R-square value (R²) and Stone-Q² Geisser's were used to validate the structural model in this study. Stone-Q² Geisser's is a method for determining predictive relevance that does not consider the magnitude of the value of R². Values of Q² greater than zero indicate the existence of predictive relevance between the independent and dependent constructs (Hair *et al.*, 2019). About R², the results show a strong fit of the model, as Cohen (1988) suggested, where R² values of .02, .13, and .26 are considered weak, medium, and strong, respectively. In addition, each independent construct's impact on its corresponding dependent construct represents the effect size (f²). Kenny (2016) also suggested using 0.005, 0.01, and 0.025 as a small, medium, and large effect sizes.

5. Discussion

CBA center service satisfaction had a significant impact on CBA overall satisfaction. Wang, So and Sparks (2017) and Hoyer, Herrmann and Huber (2002) found a correlation between service satisfaction and overall individual satisfaction with the specialized experience. This association is strongest according to the model's conclusion that student satisfaction with CBA center services is crucial. It is possible that during the CBA, students will pay more attention to the quality of services provided, particularly the technical assistance provided by CBA center employees. Consequently, a center must provide onsite student support. In addition, the study discovered a positive correlation between CBA system quality and CBA center satisfaction. This result is consistent with the findings of Shin (2015), Alzabi *et al.* (2016), Noh and Chang (2020), and Kim *et al.* (2015), who discovered that system quality influences user satisfaction. In addition, the study revealed that student satisfaction with CBA center services is proportional to the center's service quality. This study demonstrates that student satisfaction with the services affects their satisfaction with the service providers.

In line with Delone and McLean (2003), Al-Mamary *et al.* (2015), and Seta *et al.* (2018), this study demonstrates a direct relationship between CBA system quality and overall CBA satisfaction. As a result, the system's overall satisfaction is determined by its usability, ability to meet students' needs, interaction flexibility, speed and security, and other features and functions. Consistent with previous research by Seta *et al.* (2018), the results revealed no direct correlation between CBA service quality and students' overall satisfaction with the CBA experience. In conclusion, higher education institutions must establish a helpdesk and provide online services and explanations to assist future exam takers with the CBA. In addition, the SEM analysis revealed that the content of the CBA questions did not affect the student's overall satisfaction. This study confirms the findings of Ramayah, Ahmad and Hong (2012), who demonstrated that the content of e-training has no impact on user

satisfaction. The following explanations have been offered: The student profiles offer a plausible explanation for this. According to their profiles, the students' backgrounds are diverse, and their interpretations of the material may vary. The cost-effectiveness of CBA services had a significant impact on overall satisfaction. This result demonstrated that different CBA center fees led to a stronger correlation between the cost-effectiveness of CBA services and overall CBA satisfaction (Kumbhar, 2011).

One of the primary objectives of this study is to determine how student satisfaction with CBA center services affects the relationship between the system, service quality, and overall satisfaction with the CBA system. Improving system quality indirectly increases CBA satisfaction by enhancing the quality of services provided at CBA centers. Consequently, service quality indirectly influences overall satisfaction via CBA center service satisfaction, whereas its direct effect is negligible. Thus, as service quality improves, so does CBA center satisfaction, increasing overall satisfaction. In addition, the results revealed a significant indirect effect of system quality on CBA satisfaction and the mediating role of CBA center service satisfaction. System quality had a significant direct effect on CBA satisfaction, as opposed to an indirect effect. Thus, CBA center service satisfaction mediates the relationship between system quality and overall CBA satisfaction.

This study demonstrated that users' evaluations of overall satisfaction is influenced by their assessment of the various examination phases. The direct effect results from the established structural model, also indicate that hypothesis H10 is supported. In addition to information, system, and service quality, trust also positively influences student satisfaction. CBA satisfaction is determined by CBA center service satisfaction, which complements system quality, the cost-effectiveness of CBA services, perceived trust, and indirect service quality. As a result, our understanding of how students achieve satisfaction has increased.

6. Conclusion, Implications, and Limitations

This study investigated the effect of CBA center service satisfaction on the relationship between CBA quality factors (such as system quality and service quality) and overall CBA satisfaction. Prior research has examined the relationship between quality factors and CBA satisfaction. As far as we know, the role of CBA center service satisfaction as a mediator has not yet been examined. Few studies have compared quality factors' direct and indirect effects on overall satisfaction with CBA. Consequently, the mediating role of CBA center services satisfaction is a significant theoretical contribution to the study. CBA system quality has a more significant direct impact on overall satisfaction than CBA center service quality. The link between CBA center service satisfaction and the indirect effect of CBA service quality on overall CBA satisfaction makes the indirect impact of CBA service quality on overall CBA satisfaction stronger and more significant. The theoretical finding highlights the significance of quality factors' direct and indirect effects on overall satisfaction. In addition, this research was conducted in Nigeria, a developing nation that has been largely overlooked, especially in terms of CBA center service satisfaction. Thirdly, previous CBA researchers overlooked the effect of the cost-effectiveness of CBA services on overall satisfaction; therefore, this study made a second theoretical contribution by exploring this relationship. Fourthly, in CBA satisfaction studies, there is little concern about the effect of perceived CBA trust on students' satisfaction which this study theoretically contributed.

These results suggested some practical implications. The quality of the CBA system, directly and indirectly, influenced the overall satisfaction with the CBA. For the development of a successful computer-based assessment, satisfaction is crucial. Additionally, more resources must be invested in system quality, particularly in the hardware and infrastructure, and fees/charges must be standardized and subsidized. Also indicated by the CBA center service satisfaction mediator study, there were greater direct impacts of certain quality components (such as system quality) and greater indirect effects of certain quality aspects (e.g., service quality). This finding suggests that managers of CBA centers should focus on quality factors to increase overall satisfaction and that CBA center satisfaction influences other relationship dynamics. The study's findings highlighted the importance of CBA center satisfaction to overall CBA satisfaction. CBA centers should maximize student satisfaction by enhancing the environment and services required for CBA exercises to succeed.

In this context, the study is novel because it examines the relationship between overall satisfaction with CBA services and several quality aspects. Still, the research has its limits. This study began by looking at the effects of various qualities (for example, system quality and service quality), while other facets may be investigated in the future (e.g., support system quality, invigilator quality, and student quality). This study found that the relationship between CBA and CBA utilization is mediated by school CBA center satisfaction. Future studies

should be conducted across regions and educational institutions to generalize the findings. In order to avoid causation concerns, the CMB test was utilized in this study.

Nonetheless, future development of the hypothesized links will be aided by the model's application in various locations and contexts. Due to the study's non-probability sampling method, the generalizability of the findings should be approached with caution. In order to provide a longitudinal approach to CBA satisfaction research, future studies must evaluate the direct and indirect relationships across time. This approach mitigates the limitations of a cross-sectional design and the risk of self-selection bias (Podsakoff, MacKenzie and Podsakoff, 2012). Future researchers must conduct additional qualitative research to discover the causes of these unsupported relationships.

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Appendix: Questionnaire items

Questions	
	CBA services cost-effectiveness
CEF1	I find the overall prices of the CBA services inexpensive.
CEF2	The CBA services deserve the current price.
CEF3	I find the CBA services cost-effective.
	Overall CBA satisfaction
OVER_SAT1	Overall, taking the CBA make me feel very satisfied.
OVER_SAT2	Overall, taking the CBA make me feel very pleased.
OVER_SAT3	Overall, taking the CBA make me very delighted.
	Question content
QCQ1	The CBA's questions were clear and understandable.
QCQ2	The CBA's questions were relevant to the courses' syllabus.
QCQ3	The CBA's questions were useful for my course
	CBA centre service satisfaction
SERV_SAT1	I feel satisfied with the services provided by the school's CBA centre staff.
SERV_SAT2	I feel contented with the services provided by the school's CBA centre staff.
SERV_SAT3	I like the services provided by the school's CBA centre staff.
	Service quality
SRQ1	The CBA centre service staff promptly attend to our request.
SRQ2	The CBA centre service staff responds to our needs timely and satisfactorily.
SRQ3	The CBA centre service staff understands the specific needs of the students.
SRQ4	The CBA centre service staff know their work very well.
SRQ5	The CBA centre service staff are available and cooperative when facing an error with the CBA system.
	System quality

SYQ1	The CBA system is easy to use.
SYQ2	The CBA system is user-friendly.
SYQ3	The CBA system is stable.
SYQ4	The CBA system protects my information from unauthorized access by logging in only with my account and password account and password account and password
SYQ5	The CBA system runs very fast.
SYQ6	The CBA system responds quickly to my request.
	Perceived Trust
PTE1	I think that the CBA is reliable in identifying students' identities.
PTE2	I feel that the strategies used to prevent cheating behaviors in the CBA are trustworthy.
PTE3	I think that assessment of learning outcomes through the CBA is fair.
PTE5	Overall, I think that the CBA is trustworthy.

Mobile-Assisted Language Learning using Task-Based Approach and Gamification for Enhancing Writing Skills in EFL Students

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Abstract: The purposes of this research were 1) to study the user experience and needs of EFL students and teachers in learning English writing skills; 2) to design and develop a mobile-assisted language learning (MALL) application, teaching writing procedure, and writing activities; and 3) to implement a MALL application and, teaching writing procedure to students. The samples were 665 EFL lower secondary students in Thailand as the online survey respondents and five high school teachers as the interviewees. The experiment samples were 35 EFL lower secondary students. The research instruments consist of the MALL application, the learning process, English writing tasks, English writing tests, scoring writing rubrics, and a questionnaire on student satisfaction. The experimental period lasted for 8 weeks. The data were analysed by using frequency, mean, standard deviation, priority needs index, dependent t-test, and one-way ANOVA with repeated measure analysis. The research result indicated that 1) lower secondary students were able to use the internet on a regular basis. Students wanted to learn writing skills relevant to the student's experience through the study of writing errors, writing samples, writing styles, peer assessment, and constructive feedback from teachers. 2) The learning process of mobile-assisted language learning application using a task-based approach and gamification to enhance lower secondary students' English writing skills consisted of 3 components: pre-task, task process, and language focus. The 7 steps are as follows: selecting themes, exploring topics, drafting ideas, editing tasks, giving feedback, reviewing submissions, and concluding findings. 3) The experiment results indicated that the samples' English writing skills in the post-test were higher than in the pre-test at the .05 level of significance. 4) The difference in mean scores in the English writing tasks showed that there was a difference between English writing scores at the .05 level of significance ($F=1579.266$, $\text{sig}=.000$). 5) The result of satisfaction showed that the respondents were very satisfied with the learning process and MALL application.

Keywords: MALL Application, Task-Based Approach, Gamification, English Writing Skills

1. Introduction

The rapid changes of globalization in the 21st century and outbreak of the COVID-19 pandemic significantly affect every industrial sector to the new normal changes. Digital devices, especially mobile devices, have become more important for educational purposes to learn and seek in digital verse for learners (Papadakis and Kalogiannakis, 2017). Moreover, information and communications technology (ICT) and mobile learning have played important roles in language teaching and learning. They extend the opportunities to design various language teaching methods and promote learners' motivation and meaningful language learning experiences (Finardi, Leão and Amorim, 2016; Shi, Luo and He, 2017; Yundayani, Kardijan and Herawan, 2019). Then, learning resources can be accessed anywhere and anytime via mobile applications (Miao, et al. 2017). The Mobile-assisted language learning (MALL) application has also provided learners with spontaneous access, convenience, collaboration, and different learning contexts (Kukulska-Hulme and Shield, 2008; Mosavi Miangah and Nezarat, 2012). Some examples of MALL applications, both native and web applications, for mobile platforms are Duolingo, Memrise, and MALLO. They are used for facilitate English as a Foreign Language (EFL) students to learn English language inside and outside the classroom. (Lindaman and Nolan, 2015).

A survey of English Proficiency Index (EPI) assessment among students in 100 countries from the Education First Institute (EF) shows that Thai students were ranked 89th out of 100 consecutively in the Very Low Proficiency level during 2011 to 2020. (Education First, 2020). Even though English has been taught to Thai students for a long time. However, Thai learners of English still cannot write properly. One of the possible causes of the issue may be inappropriate teaching techniques. Due to instructors' continued adherence to a teaching-learning method that is instructor-centered, unable to integrated educational technology in classroom, and emphasizes

lecturing, learners lack involvement or instructional activities and are unable to use classroom knowledge in their everyday lives (Chaturanon, et al., 2015).

Then, to design the meaningful English writing learning applications and learning process to EFL learner, it is a complex process due language barrier, such as culture, interest, motivation, and other internal and external factors (Kharis, et al., 2020). Especially, writing skills is very challenging for EFL students to decode their native language and encode into the written comprehensible English language. To enhance writing skills, the task-based approach (TBA) can enable students to practice the English language skill via real-world and relevant tasks to enhance their writing skills (Yundayani, Kardijan and Herawan, 2019). Besides, gamification can be used in instruction and language learning environment to bolster learners' motivation and thinking which creates a competitive environment (Bicen and Kocakoyun, 2018). Gamification uses game elements, such as levels, points, and rewards, in non-game contexts (Kapp, 2012). Gamification can also increase students' interests and motivation while learning and accepting e-learning and m-learning contents (Ozcinar, et al., 2019; Yamani, 2021).

The present study therefore focuses on the development and implementation the MALL Application for lower secondary EFL students in Thai context. The purpose of this research is to investigate EFL students' and teachers' experiences and need in teaching and acquiring English writing skills. Then, design and develop a MALL Application that is applicable to learners on multiple platforms and can assist EFL students with their writing skills based on their individual needs and experiences. This app, which combines MALL, TBA, and gamification, will ease the EFL learning process and improve EFL learners' English writing abilities.

2. Purpose of the research and research questions

The present study is design-based research that attempts to design a learning prototype of mobile application, writing learning process, and learning activities that can be used either for hybrid or remote learning. This study not only aims to describe the designed mobile application and writing learning process but also examines the usefulness and useability of processes and the design principles before the real-world implementation. Hence, research questions can be stated as follows:

RQ1: What are the user experiences and needs for teaching and learning English writing skills?

RQ2: What are the design principles and elements based on the user experience and needs for designing and developing a mobile application, writing learning process, and learning activities for improving EFL writing skills?

RQ3: Can the mobile application and writing learning process support student to enhance their English writing skills?

According to the research questions, this aims study were to:

1. Study the user experience and needs of EFL students and teachers in learning English writing skills
2. Design and develop a mobile application, writing learning process, and learning activities
3. Implement the mobile application and writing learning process for students

3. Literature Review

3.1 Mobile-Assisted Language Learning

Mobile-assisted language learning (MALL) is the subset of Mobile learning (M-learning) and computer-assisted language learning (CALL) (Kim, 2012; Uwizeyimana, 2018). For MALL, mobile devices are used with support of the Internet network, Wi-Fi, 3G, 4G, or 5G to access learning anywhere and anytime, and learners are responsive to mobile display screens. The characteristics of MALL are time and space flexibility, portability, personalization, and interactivity (Persson and Nouri, 2018; Şad, et al., 2020). In education, MALL can be in forms of social networking websites and mobile applications (e.g., Facebook, Twitter, and YouTube); podcasts (e.g., Apple Podcast, Soundcloud, and Spotify); learning management systems (LMS) (e.g., Moodle, Schoology, Google Classroom, and Blackboard); and automatic speech recognitions (ASR) or voice recognition software (e.g., Siri, Google Assistant, and Alexa).

3.1.1 MALL and language teaching method

In addition, MALL offers students access to learning materials outside the classroom and various learning contexts (Shi, Luo and He, 2017). To effectively design a MALL application, educational uses of mobile technology must be included along with pedagogy that suits the learners' context. (Papadakis, 2021). Task-based approach

(TBA) is one of the strategies that may be utilized to improve writing abilities and English fluency (Xue, 2020). Moreover, on mobile devices, learners can learn through their learning styles based on their needs. They can also share information with other learners and teachers using mobile or web applications, contributing to collaboration between peers and teachers with digital experiences (Persson and Nouri, 2018, Papadakis, 2021). Moreover, Koraneekij and Khlaisang (2015) stated that there are four elements for designing of digital learning experience namely electronic content, learning management system, communication, and evaluation. All features emphasize a technique of instruction in which students have a more active role as learners in the learning process.

3.2 Task-Based Approach

Task-based approach (TBA) or task-based language learning (TBLL) is a subset of communicative language teaching (CLT) methods (Aliasin, et al., 2019). TBA activates learners' cognitive process by practicing the target language via meaningful and communicative language tasks, which indirectly enhance students' self-confidence and motivation (Ellis, 2003; Yundayani, Kardijan and Herawan, 2019). In TBA, Learners are provided a task to practice the target language while communicating. Learning English language is more than just commit structure, rules, phonology, and lexical terms. The language task should boost students' self-esteem and, as a result, keep them interested. Instructors have a critical role in selecting appropriate tasks that allow pupils to interact socially and develop mutual respect (Yundayani, Kardijan and Herawan, 2019). Then, Nunan (2004) stated the principles and procedures of TBA are as follows:

- Content selection depending on learner's needs.
- Concentrate on learning to communicate in the target language via interaction activities.
- Emphasis on both language and the learning process and personalize experiences are being added to instructions.
- Correlate between classroom language learning and real-life language use.
- Concern with the needs of students, their communicative and applied language abilities, as well as real and meaningful activities.

3.3 Gamification

In the educational context, gamification stimulates learning motivation and engagement with game elements, such as points, badges, rewards, and achievements (Kalogiannakis, Papadakis and Zourmpakis, 2021; Zourmpakis, Papadakis and Kalogiannakis, 2022). Dynamics, mechanics, and appropriate components are merged into learning to result in expected learning outcomes, including positive behaviour and increased learner motivation while learning (Bicen and Kocakoyun, 2018; Kapp, 2012). According to (Kalogiannakis, Papadakis and Zourmpakis, (2021), adopting gamification in the learning process may promote motivation and engagement, learning successes, and social interaction. Furthermore, gamification helps with learners' language skills, (Yavuz, Özdemir and Celik., 2020, Kayımbaşioğlu, Oktekin and Hacı, 2016), attitudes toward the English language (Phuong, 2020), motivation, and confidence (Zou, 2020).

3.3.1 Gamification in e-learning

To take advantage of gamification for implement in digital platform, Phuong (2020) has suggested that, to design gamification for e-learning, the main concept should emphasize goal-based activities, reward mechanisms, and progress tracking. Furthermore, Kapp (2012) using points and badges alone does not result in a completed gamification application, and game designers must design the game elements according to the main objectives and consider how the players' behaviour will change and their motivation while learning will increase.

3.4 English Writing Skills

The four language skills consist of listening, speaking, reading, and writing, with writing being the most difficult and requiring the most complicated language processing. Multiple areas of knowledge, such as vocabulary, grammar, and experiences, are considered for the success of writing skills and the construction of communicative language using encoded letters and structures (Mohamad, Ghazali and Hashim, 2018, Gabrielatos, 2002, Kharis, et al., 2020).

3.4.1 Designing teaching English Writing

To design teaching writing, Gabrielatos (2002) has proposed the framework for teaching writing, which involves four stages: awareness-raising, support, practice, and feedback. First, the awareness-raising stage explores ideas and identifies examples of writing and features from various text types that arise when learners become familiar

with the task (Kumar and Mohite, 2017; Williams, 2014). Second, in the support stage, the facilitator helps learners by guiding and clarifying writing topics as well as providing writing examples and guidelines for appropriate organization, layouts, and styles. Additionally, the teacher presents relevant vocabulary, grammar, and background information in a pre-writing activity. Third, in the following stage, students translate the information from previous pre-writing activities into English (Sasaki, 2000) in both controlled and free practice. Finally, in the feedback stage, the teacher and peers give comments and grades. This stage provides constructive feedback, gives discussions for writing improvement, and identifies strong and weak points of the learners' writing tasks.

Therefore, to improve the writing skills of young students, learning designers must construct the whole teaching process to be relevant to real-world tasks, scaffold activities with learners' prior background knowledge, and encourage students to detect writing patterns and language.

4. Research methodology and design

The research was divided into three phases based on the research questions.

Phase 1: This study adopted the mixed-method research design using a qualitative dataset with a secondary quantitative dataset. The quantitative data were collected using the online questionnaire, and the qualitative data were collected via semi-structured interviews. The 665 EFL lower secondary students in four regions, north-eastern, northern, central, and southern Thailand completed the online survey. The simple random sampling method was used to draw the samples for this study (see **Error! Reference source not found.**). The semi-structured interviews were conducted with five Thai teachers as the samples who have been teaching English writing to secondary students in Thai secondary schools.

The survey questionnaire was divided into three parts. Part 1 involved the demographic data of the sample including gender, educational levels, regions, and GPAX. Part 2 was related to learners' use and access of the Internet in their daily lives. Part 3 was about the user experience and needs for improving writing skills, use of gamification in English writing tasks, as well as challenges in games, rewards, and English writing learning.

The index of Item Objective Congruence (IOC) was used to evaluate the content validity of the questionnaire. The scores given by three experts were calculated to find the consistency index between items and their objectives. If the score was higher than or equal to 0.5, the item was considered appropriate. As a result, it was found that all items were appropriate. However, one of the experts suggested that another open-ended question on the opinions toward the English writing tasks should be added to the questionnaire. Therefore, the questionnaire was revised accordingly. Then, the survey was piloted with 30 lower secondary students. Using Cronbach's alpha or coefficient alpha, the results confirmed that the questionnaire exhibited high reliability, with a coefficient alpha of 0.872, exceeding or approaching the acceptable level of 0.70. The survey questionnaires were created with a web application as the online survey, making the survey form responsive to the screens of different computers and mobile devices. The data was collected for two months.

The semi-structured interviews topics are divided into three questions: the current content and method of English writing tasks, the teacher characteristics, and styles of teaching English writing in classroom, and the assessment method and techniques for English writing.

Table 1: Sample sizes in different regions in Thailand

Regions in Thailand	n	%
North-eastern region	148	22.26%
Northern region	100	15.04%
Central region	256	38.50%
Southern region	161	24.21%
Total	665	100%

The phase of study used content analysis method for the interview data analysis, descriptive statistics for the survey and interventions evaluation; including means, standard deviations, frequencies, and percentages, and priority needs index (PNI_{Modified}) (Wongwanich, 2015) calculation in the importance (I) and degree of success (D) for assessing and prioritizing the learners' needs in the first phase. The degree of success was achieved by comparing the current states and the expected states when importance was defined as needs prioritization (Koraneekij and Khlaisang, 2019).

$$PNI_{\text{Modified}} = \frac{(I - D)}{D}$$

Phase 2: We utilized the data from RQ1 together with the literature studies to generate the design principles for developing and designing the intervention. Then, we determined the initial design principles for designing and developing the mobile application for enhancing writing abilities based on a task-based approach and gamification to suit the needs of the users. The writers used data from phase 1 combined with literature studies and principles. The researchers then designed and developed the mobile application for improving writing abilities utilizing a task-based strategy and gamification. For pilot-testing and validating the interventions, five experts in the disciplines of mobile learning, gamification, and TBA in Thailand were purposefully selected to validate and endorse the interventions and to provide some recommendations. This is done through semi-structured interviews and the evaluating questionnaires (5-point Likert scale). The questionnaires consisted of overall characteristics of the interventions, design arguments, design principles, and components of the MALL application and writing learning process and activities. Afterward, the researchers used data that was collected from the experts and iterate the interventions.

Phase 3: The researchers used the interventions with 35 EFL lower secondary students from a private high school in Bangkok, Thailand. The research instruments consisted of the MALL application, the learning process, English writing tasks, English writing tests, scoring writing rubrics, and a questionnaire on student satisfaction. The study implemented the pre-experimental design method in the one-group pre-test and post-test time-series design method. This experiment took eight weeks (two hours per week) during semester 1 in 2022. The research instruments consisted of the MALL application, the learning process, six English writing tasks, two English writing tests, a writing score analytic rubric (total of 25 points including grammar, organization, mechanics, content, and vocabulary assessments), and a questionnaire on student satisfaction (5-point Likert scale).

The students were required to take the pre-test and post-test to measure their level of English writing skills. Moreover, the student had to complete the six English writing tasks during the eight weeks of the experiment. Afterward, students completed the questionnaire on student satisfaction. For the process of creating the tests and tasks, this research relied on three experts who are English language teachers. These experts were required to validate the content IOC at the average values of 0.868 for the tests and tasks and 0.812 for the questionnaire. The experimental data were analysed by using frequency, mean, standard deviation, dependent t-test, and one-way ANOVA with repeated measure analysis for measuring English writing skills in weeks 1, 3, 5, and 7 (Table 2).

Table 2: Pre-experimental designs method in this research

Sample	Pre-test (week 1)	Interventions	Evaluation No.1 (week 3)	Evaluation No.2 (week 5)	Evaluation No.3 (week 7)	Post-Test (week 8)
E	O ₁	X	O ₂	O ₃	O ₄	O ₅

X = Treatment of MALL application, writing learning process, English writing tasks

E = Experimental group

O₁ = Pre-test

O₂ = Writing evaluation No.1

O₃ = Writing evaluation No.2

O₄ = Writing evaluation No.3

O₅ = Post-test

The researchers followed the privacy, data protection, and confidentiality policy. Therefore, all research participants' identities and data remained unidentifiable and will be deleted immediately after the research is completed. The participants from both cohorts gave us consent to use their data for research purposes.

5. Result and Findings

5.1 User's data and interviews data

Survey respondents were 665 English language learners in lower secondary (Grade 7 to 9) all over Thailand. 310 (46.6%) were males, and 355 (53.4%) were female. Respondents were in different regions in Thailand: 256 (38.50%) in central Thailand, 148 (22.26%) in north-eastern Thailand, 100 (15.04%) in northern Thailand, and 161 (24.21%) in southern Thailand. The analysis of students' GPAX showed that the average of Grade 7 students was 3.50 (SD=0.49, MAX=4.00, MIN=1.84), the average of Grade 8 students was 3.39 (SD=0.54, MAX=4.00, MIN=1.80), and the average of Grade 9 students was 3.39 (SD=0.51, MAX=4.00, MIN=2.08).

The Internet usage behaviour showed that students used the Internet for various purposes, such as communication (f=514, 77.29%), downloading/uploading data (f=363, 54.59%), entertainment (f=573, 86.17%), information search (f=512, 76.99%), gaming (f=197, 29.62%), and education and learning (f=520, 78.20%). The students used the Internet 4-7 hours per day (f=268, 40.3%) during 18:01 – 22:00 (f=325, 48.9%). Most of them accessed the Internet from their house (f=627, 94.3%) via Android (f=473, 71.1%) smartphones (f=549, 82.6%).

Results indicated that learners thought that the three tasks that had improved their writing skills the most were designing a portfolio (f=137, 20.6%), describing a picture (f=135, 20.3%), and writing an essay (f=125, 18.8%). Furthermore, learners stated that competing with classmates (f=158, 23.8%), opportunity to develop themselves (f=136, 20.5%) and gathering rewards (f=111, 16.7%) could be the challenge that motivated them to do tasks and learn. Rewards (f=436, 65.56%), items (f=332, 49.92%), and points (f=379, 56.99%) were what students expected to get from game activities. Results also suggested that handing in the assignment on time (f=261, 39.50%), the number of completed tasks (f=229, 34.44%), and the interaction/participation with learners (f=206, 30.98%) should be rewarded.

The results from the questionnaire on the needs for practicing English writing indicated that the focus should be on (1) studying writing errors from examples (PNI_{Modified}=0.27), (2) brainstorming and exchanging writing ideas (PNI_{Modified}=0.26), and (3) studying examples of good writing (PNI_{Modified}=0.25). Moreover, the evaluation of students' writing should include (1) peer-rating (PNI_{Modified}=0.30), (2) voting (PNI_{Modified}=0.28), and automated writing scoring (PNI_{Modified}=0.27). In addition, the evaluation should be done by (1) learners from different classes (PNI_{Modified}=0.37), the public (PNI_{Modified}=0.36), and English teachers in the school (PNI_{Modified}=0.32).

The last item in the questionnaire was an open-ended question. The students were asked to give suggestions for developing the application. They suggested that:

- the writing tasks should be relevant and authentic.
- teachers should provide something that motivates students to write.
- tasks should be of different difficulty levels for learners to practice writing.
- the criteria should be designed to reflect different levels of proficiency.

According to the interview data, the teaching of English writing could be divided into three topics: the content of writing tasks, the characteristics of teaching English writing, and the assessment method. The results of the analysis are as follows:

- **Content of writing tasks:** Lower secondary pupils may be unfamiliar with formal and informal writing structures and vocabulary. These may vary from how they write in Thai, their native language. In addition, instructors should give students with feedback and direction to help them comprehend the overall quality of their writing and make adjustments. In addition, writing assignments should be authentic and relevant to students' everyday lives so that they are motivated and able to apply what they have learned in the real world.
- **Characteristics of English writing instruction:** To enhance writing abilities, students must constantly practice writing in English and use vocabulary and grammar. Before beginning to write, the instructor should familiarize students with writing issues and relevant language. In this procedure, a brainstorming session might be held. Then, the instructor may show students several writing styles or writing examples so that they could become familiar with writing patterns and forms.
- **Assessment method:** The evaluation of writing may involve both peer and instructor judgments. Teachers may allow students to examine each other's writing to assist learners to identify mistakes and

potential for advancement. Then, teachers might evaluate student work based on the criteria set cooperatively by the teacher and the students. Instructors might offer students with feedback in a variety of methods, including pointing out faults and discussing them with students.

5.2 Design and development of interventions

5.2.1 The initial design principles

From the user data and interview data, they could be grouped into four aspects: Internet usage, English writing tasks, English writing teaching, and gamification design before construct the design principles to meet the users experience and needs.

- **Internet usage:** Most students could access the Internet via their Android smartphones. Thus, a lightweight MALL application would be appropriate since it could be accessed through web browsers on their smartphones.
- **English writing tasks:** In order to familiarize students with English writing tasks, the tasks should be guided writing tasks are relevant to students' experience, such as self-introduction, an essay on daily life and describing pictures. Then, the teacher should provide ideas, guidelines, and additional resources for students to complete writing tasks.
- **English writing teaching:** English writing teaching should consist of studying errors in writing samples, brainstorming, and exchanging writing ideas and learning from good examples and using them as guidelines for students' own writing. Peer-rating and public evaluation could be applied in writing task assessments. The teacher should familiarize students with the writing format, grammar, and vocabulary. Moreover, teachers must assist students in completing writing tasks by giving feedback, suggesting writing ideas, and teaching useful language expressions.
- **Gamification design:** Students usually enjoy competing with their classmates, while developing their English writing skills. Considering this, points and achievements were used as rewards to encourage students to do the tasks on MALL applications.
- The design principles in **Table 3** based on the data from previous literature reviewed and as well as from the findings reported above. MALL, TBA and gamification were taken into consideration to establish the design principles combined with UX and needs which were categorized in to four aspects: Internet usage, English writing tasks, English writing teaching, and gamification design.

Table 3: Design principles used in this research

Design Principle	Description
DP1	Digital interactions between contents, peers, and teachers in a mobile language learning application
DP2	Learning process and activities focused on constructed knowledge from learners' experiences and interests
DP3	Students' engagement with game elements and peers
DP4	Facilitating learners to initiate ideas and produce written works

As stated above, they were the foundations of design principles for developing the interventions in this research. The objectives were to aid and enrich a mobile language learning environment, improve students' motivation to develop English writing skills and practice language tasks relevant to their experience with sufficient support.

In order to apply the design principles in Table 3 designing elements and constructing Sandoval (2014)'s conjecture map to plan and organize tools to design interventions (Wongwanich, 2020) for enhancing English writing skills, design elements (Embodiment) were initially identified. Eight English writing tasks were embedded in a lightweight and responsive MALL application with a hierarchical structure and writing learning process and activities. The task structure consisted of eight real-world writing tasks and activities relevant to students' experiences. Additional resources were also included to support students while completing the tasks. The structure tracked how learners took part in each learning phase in the activities. Then, students gathered points and achievements on the MALL application and shared experience and ideas concerning the writing topics as the discursive practices. For the next component in the conjecture map, mediating process referred to observable interactions and participant artifacts (Sandoval, 2014). Through such interactions, students were observed accessing learning contents, engaging in activities, writing tasks, sharing their ideas and experience with their peers, as well as editing and revising their writing tasks via the MALL application. Additionally, participant artifacts were considered evidence for learners' English writing evaluation. To assess their writing

skills, the completed writing tasks were evaluated. As a result, students earned digital badges and points, as well as comments and suggestions from their peers. The last component, intended outcomes, was English writing skills, which the researchers expected see after students have engaged in all the design elements and mediating process. Figure 1 portrays the relationship between the design principles for the research in Table 3 and the design elements in this research.

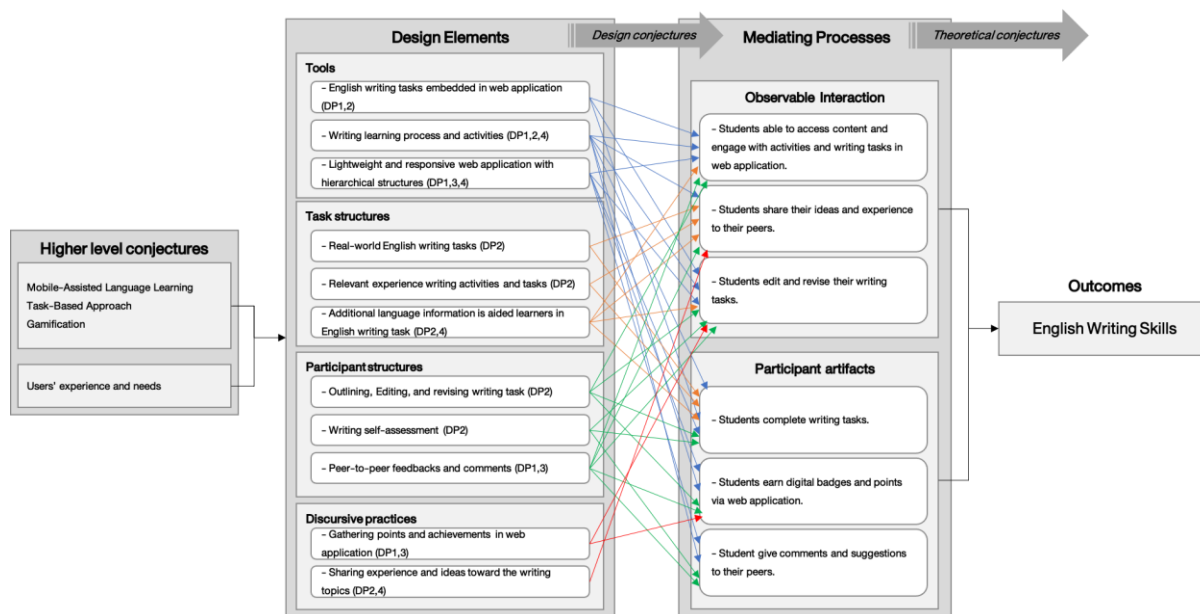


Figure 1: The initial conjecture map of the interventions used to enhance English writing skills

5.2.2 Interventions form the design principles

According to the conjecture map, the designed the writing learning process, as the writing teaching procedures, consisted of seven phases as follows: (see Figure 2).

1. **Selecting themes:** The teacher analyses contexts and learners' characteristics, sets learning objectives, and chooses a writing topic.
2. **Exploring topics:** Learners explore the topics, tasks, objectives of the lesson, and supportive information connected to their experiences and prepare to write by brainstorming, discussing, sharing information, and exchanging experiences.
3. **Drafting ideas:** Learners do the writing activities, examine writing samples/guidelines, and learn useful vocabulary, phrases, and language structures.
4. **Editing tasks:** Learner design and develop their writing product based on the information obtained in the previous phase, drafting ideas and submit the final product on the MALL application.
5. **Giving feedback:** Learners explore peers' tasks, rate them, and give comments.
6. **Reviewing submissions:** Learners edit their work according to the teacher's and peers' suggestions and recommendations and resubmit the writing task.
7. **Concluding findings:** Learners and their teacher summarize suggestions, errors, and language structures, and learn from them.



Figure 2: Seven steps of the learning process integrated with MALL, gamification, and TBA

For each the learning process, the researchers had designed the writing activities which were tools and guidelines for facilitating the writing learning process for enhancing English writing skills of learners. Then, writing activities for each phase were designed as shown in Table 4.

Table 4: Writing activities in different learning phases

Writing activities	Description
Pre-task: Exploring topics	
Sharing information	Discussing and exchanging information and prior knowledge related to the given topic
Introducing vocabulary	Presenting related vocabulary, phrases, and useful expressions about the topic
Designing the overview	Designing a mind map, diagram, flowchart, or outline on the topic
Determining the goal of writing	Selecting the purpose of writing, such as to reflect, to inform, to persuade, and to evaluate
Task process: Drafting ideas	
Exploring related words	Doing exercises that focus on finding vocabulary, phrases, and helpful expressions
Linking words	Adding linking words between sentences or paragraphs
Practicing language structures	Completing grammar exercises
Ordering sequence	Ordering a series of events or steps in a process
Writing guidelines	Examining the writing guidelines, layout, organization, and style
Task process: Editing tasks	
Participating in writing	Collaborative drafting, outlining, and editing writing product
Designing and developing writing products	Producing a draft using the information from the previous stages and editing it.
Task process: Giving feedback	
Rating writing products	Evaluating peers' writing products
Suggesting and commenting	Giving comments and suggestions on the peer-writing products
Task process: Reviewing submissions	
Revising	Improving own writing products according to suggestions from peers and teachers
Language focus: Concluding findings	
Discussing	Sharing opinions about writing products
Summarizing	Concluding what learners have learned from writing (issues, grammar, style, vocabulary, and main points of writing.)

In the conjecture map, the third design element for MALL application included lightweight, responsive displays (see Figure 4) and a hierarchical structure (see Figure 3) of the MALL application. This MALL application assisted

learners in accomplishing the writing task in digital language learning with game elements. The newly designed and developed MALL application; responsive web application; was called KidKian (<https://kidkian.edii.in.th>), which was transcribed from the Thai language. It is a combination of two Thai words: “Kid” meaning to think, and “Kian” meaning to write. WordPress and various plugins, such as wpDiscuz, WP User Frontend, and Ultimate Member, were used as web development tools. In this MALL application, the GamiPress plugin was used to place game elements on this application. Users could earn points, gems, and energy by doing specific tasks, such as giving comments, uploading completed tasks, and visiting the application. Furthermore, users could receive feedback in the forms of scores or comments from their friends and teacher. The wpDiscuz plugin was used to allow learners and teachers to give feedback and suggestions on each writing task.

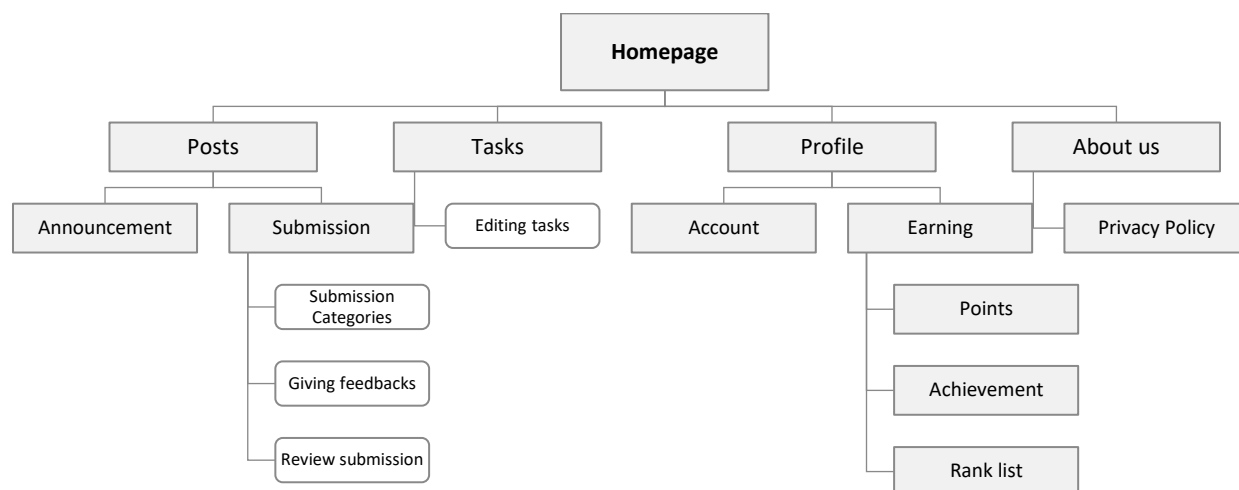


Figure 3: Hierarchical structure of MALL application

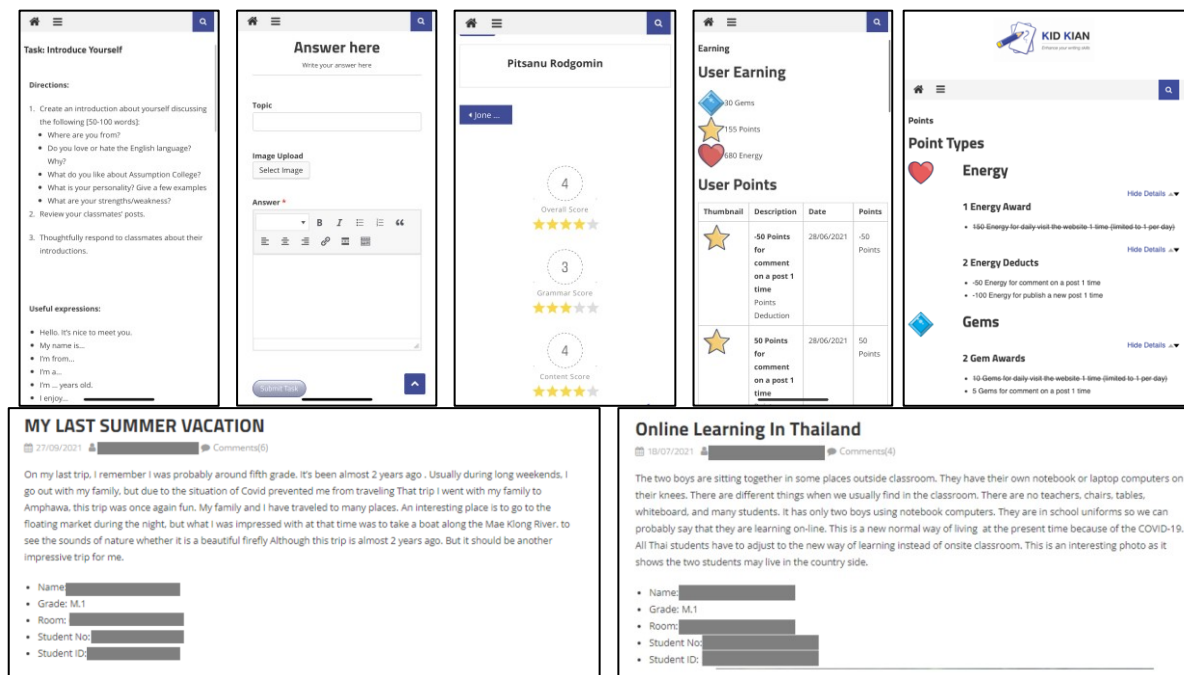


Figure 4: User interface of the MALL application a mobile device and desktop displays

5.2.3 Testing interventions

Five experts in mobile learning, gamification, and TBA validated the design principles behind the conjecture mapping, and interventions. They evaluated the characteristics of the interventions, design arguments, design principles, components of the MALL application, writing learning process and activities, and activity design. The results were calculated for means. Statements with a score of higher than 4 were endorsed and those with a score of lower than 4 were revised (see Table 5).

Table 5: Experts evaluation results

Topics	Mean (n=5)	Meaning
The characteristics of the interventions on the MALL application and writing learning process and activities	4.20	Endorsed
The design arguments of the MALL application and writing learning process and activities.	4.20	Endorsed
The design principles behind conjecture mapping to develop the MALL application and writing learning process and activities	4.60	Endorsed
The components of the MALL application and writing learning process and activities.	4.60	Endorsed
The design of writing learning activities	4.60	Endorsed
Overall	4.44	Endorsed

The average mean score for all the statements was 4.44, suggesting that the design principles and interventions could be implemented with lower secondary EFL students. However, three aspects needed to be revised and modified according to the experts' suggestions (see Table 6).

Table 6: Experts' suggestions and revisions

Suggestions	Revisions
Students should be encouraged to set a goal of writing during the pre-task stage. This will help them to orient themselves to the task and the appropriate level of language.	A goal setting activity was added to the pre-task writing activities.
It is unclear whether the students are to find sample writings themselves or the teacher provides them. Will 'searching skills' be the case here?	The researcher provided the additional resources which would help students to complete their writing tasks on the MALL application.
The user experience and user interface of the MALL application could be improved to be more attractive, and more game elements could be added	Side widget was added to display points, ranks, and achievements.

5.3 Implementing the interventions

The interventions aim to enhance the improvement of English writing skills for EFL lower secondary students. The experiment was applied to a sample of 35 EFL lower secondary students. The samples were EFL grade 7 students in a private all-male school in Bangkok, Thailand. In addition, all of them can use the internet from their accommodation and use their device to connect to the internet (Table 7).

This experiment occurred during the COVID-19 pandemic, whereupon the interventions were completed through online remote learning for an eight-week implementation.

Table 7: Demographic of the samples

Questionnaire items		frequency	%
Gender	male	35	100.00%
	female	0	0.00%
Internet usage for doing assignments (per week)	1-2 hour(s)	14	40.00%
	2-3 hours	13	37.14%
	3-4 hours	0	0.00%
	4-5 hours	2	5.71%
	6-7 hours	0	0.00%
	7-8 hours	0	0.00%
	more than 8 hours	2	5.71%
Do you have a personal computer?	Yes	35	100.00%
	No	0	0.00%
Can your personal computer connect the internet?	Yes	35	100.00%
	No	0	0.00%
Do you have a mobile phone?	Yes	34	97.14%
	No	1	2.86%
Can your mobile phone connect the internet?	Yes	34	97.14%
	No	1	2.86%
Do you have a tablet?	Yes	20	57.14%
	No	15	42.86%
Can your tablet connect the internet?	Yes	29	82.86%

Questionnaire items		frequency	%
	No	6	17.14%
Which device do you use for remote learning?	iPhone	6	17.14%
	Android phone	15	42.86%
	Android tablet	2	5.71%
	iPad	10	28.57%
	Personal computer	11	31.43%
	Laptop	24	68.57%

The findings show the significant differences in the pre-and post-test. Data from the tests were analysed using SPSS. Table 8 shows that the average of the pre-test was 18.08 (S.D.= 4.74), while the average of the post-test was 22.48 (S.D.= 3.07). Both of the tests showed that the post-test score was higher than the pre-test at the .05 level of significance.

Table 8: T-test results for the pre-and post-test by the samples

	Mean	n	S.D.	t	df	p
Pre-test	18.08	35	4.74	-6.96	34	.000
Post-test	22.48	35	3.07			

Notes: $p < 0.05$.

Table 9 shows the English writing skills result in weeks 1,3,5, and 7. Analysis of the difference in English writing skill average scores of the samples used the repeated measure. Overall, the sample continuously had better scores. The results of the week 1 and week 3 assessments were at the Good level (Mean = 17.611, 18.71), and the week 5 and week 7 assessments were at the Excellent level (Mean = 20.223, 21.066). The difference was statistically significant at the .05 level ($F=1579.266$, $\text{sig}=.000$) (**Table 10** and **Table 10**: Result of one-way ANOVA with repeated measure analysis for weeks 1,3,5, and 7

	Source	SS	df	Mean Square	F	sig
Writing skills	Intercept	52713.683	1	52713.683	1579.266	.000
	Error	1134.872	34	33.379		

Notes: $p < 0.05$.

Table 9: Descriptive analysis of the writing evaluations for weeks 1,3,5, and 7

	Evaluation											
	Week 1			Week 3			Week 5			Week 7		
	Mean	S.D.	Level	Mean	S.D.	Level	Mean	S.D.	Level	Mean	S.D.	Level
Writing skills	17.611	4.940	Good	18.710	3.48	Good	20.223	2.90	Excellent	21.066	3.598	Excellent

Table 10: Result of one-way ANOVA with repeated measure analysis for weeks 1,3,5, and 7

	Source	SS	df	Mean Square	F	sig
Writing skills	Intercept	52713.683	1	52713.683	1579.266	.000
	Error	1134.872	34	33.379		

Notes: $p < 0.05$.

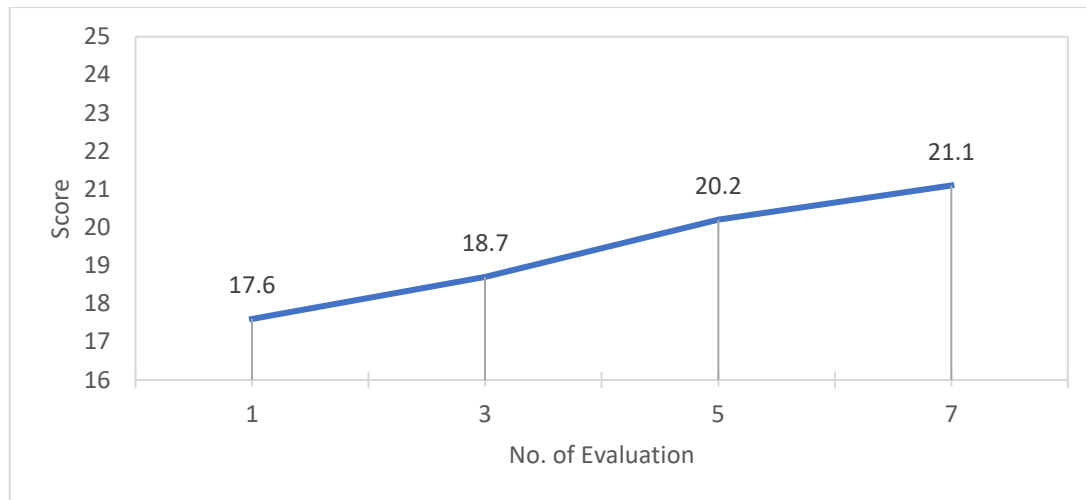


Figure 5: Average score of the English writing skills

After the experimental study using the intervention, the researchers conducted an opinion survey among the participants. It was found that overall opinion was at a high level (Mean=4.38, S.D.=0.13). As for the score for appropriateness and suitability for learning, the opinion towards the MALL application and learning process had the highest level (Mean=4.56, S.D.=0.10), while the acceptance and usability of the MALL application and learning process had the high level (Mean=4.49, S.D.=0.12) (Table 11).

Table 11: Descriptive analysis of the learners' satisfaction

Topics	Mean (n=35')	S.D.	Satisfaction level
Overall satisfaction for the MALL and writing learning process	4.56	0.12	High
The MALL writing learning process is appropriate and suitable for learning.	4.56	0.10	Very high
The MALL application and learning process are acceptable and usable for learning.	4.49	0.12	High

6. Discussions

6.1 Persona of Thai learners in internet use and learning writing skills

According to the survey results, the majority of Thai students can access the internet through any device, whether it is a smartphone or computer. The Thai government and Ministry of Education have formed a policy for remote learning in response to the pandemic situation caused by the Coronavirus 2019 or Covid-19 that has contributed to this significant increase in the number of digital devices and usages. Additionally, present learners are considered to be representatives of Generation Alpha with advanced technology skills who can use technology effectively (Nagy and Kölcsey, 2017). Al-Emran, Elsherif and Shaalan (2016) studied the acceptance of m-learning as significant assistive technology. Learners will be more willing to cooperate with m-learning as a tool for enhancing their learning if the adopted technology is known to them and corresponds to their requirements.

Moreover, the survey results show that the learners dramatically need proper English writing instruction, a variety of tasks, and relevance to their daily life. Some of Thailand's English teaching problems were caused by instructors such as the lack of the integration of language skills in teaching, less active and interactive language learning in the classroom, more grammar-based instruction, and conducting learning activities irrelevant to the learners' needs. (Mejang and Suksawas, 2021).

6.2 Design principles for MALL application and learning process for writing skills

Then, the interventions of the MALL application, learning process, and activities were based on users, learners, and the literature review. It was found that the MALL application that was accessible anywhere and anytime via the internet for self-practice could enhance writing skills and motivation. This is consistent with Yundayani, Kardijan and Herawan (2019)'s findings in that most students think that ICT integrated with task-based activities has a crucial influence on their motivation for learning English. These interventions' characteristics were real-world tasks, learners' interests in writing topics, peer-rating evaluations, responsive MALL applications, English

writing learning activities on MALL applications, and digital badges, points, and achievement as rewarding feedback. The responsive MALL application enables learners to learn, explore, collaborate, and exchange information through the internet on any mobile device (Mingsiritham and Koraneekij, 2020). However, these design principles are generated for Thai learners' contexts. These principles need more data for the iterating to be appropriate to other EFL learners from different backgrounds.

6.3 Result of implementation of the interventions

The score in English writing skills demonstrates that students' English writing skills improved. This might be related to learners' familiarity with the MALL application and writing pattern. Effective utilization of treatments has resulted in the development of skills and a positive attitude. Rewarding and providing feedback might motivate students to improve their writing skills. This is consistent with Pourdana, Behbahani and Safdari (2011) stating that utilizing a variety of tasks offers EFL learners the chance to engage in authentic interactions. According to this study's experimental findings, EFL learners find it pleasurable to perform differently on writing tasks with variety. Moreover, Al-Hamad, al-jamal and Bataineh. (2019) identified significant differences between the control and experimental groups in the use of mobile language learning-assisted mobile applications to improve English writing skills. The use of technology in learning also promotes interest in language acquisition (So, et al., 2017) interaction, emotion, motivation, feedback, and linguistic knowledge (Golanka, et al., 2014) as well as access to learning through a variety of displays at anytime, anywhere (Khlaissang, 2018). In addition, the application of gamification, makes learners enjoy learning a language where gamification is part of the variable that boosts the learner's motivation, and language learning efficiency (Elaish, et al., 2019) and can also be applied to mobile applications in language learning (Elaish, et al., 2017)

7. Conclusion and Recommendations

The use of mobile technology in education offers new opportunities to integrate onsite learning and online learning and learning at convenience. The initial design principles and the conjecture map for development in this research were based on the analysis of user experience and needs and literature review. Therefore, the design elements and mediating process that brought about the improvement in English writing skills as the desired outcomes were the MALL application and the writing learning process with activities. The MALL application features were chosen from the characteristics of technology that could enrich the second language learning environment, hierarchical structures, lightweight and responsive displays, and game elements. The writing learning process consisted of seven phases and writing activities, which supported learners to construct their language knowledge and experience to complete writing tasks. The finding from the implementation can be the evidence that EFL learner will achieve the highest level of language proficiency and communication ability in learning English via using responsive technology and communicative teaching method. This is a very useful innovation teaching English writing skill for EFL lower secondary students in Thailand. The suggestion for future research is to study the effect of this MALL application for other language skill and other group of learners.

7.1 Recommendations

Firstly, this research was confined to EFL lower secondary students and instructors. The viewpoints of EFL students at different educational levels about gamification and TBA might be investigated via further studies. The basic design principles and conjecture map may then be iterated and rebuilt in an attempt to generalize the design principles for this educational method.

Secondly, the teacher should also consider the Bring Your Own Device (BYOD) policy and the internet infrastructure required to access the MALL application when implementing these interventions in the classroom.

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Artificial Intelligence in Education: AIEd for Personalised Learning Pathways

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Abstract: Artificial intelligence is the driving force of change focusing on the needs and demands of the student. The research explores Artificial Intelligence in Education (AIEd) for building personalised learning systems for students. The research investigates and proposes a framework for AIEd: social networking sites and chatbots, expert systems for education, intelligent mentors and agents, machine learning, personalised educational systems and virtual educational environments. These technologies help educators to develop and introduce personalised approaches to master new knowledge and develop professional competencies. The research presents a case study of AIEd implementation in education. The scholars conducted the experiment in educational establishments using artificial intelligence in the curriculum. The scholars surveyed 184 second-year students of the Institute of Pedagogy and Psychology at the Abay Kazakh National Pedagogical University and the Kuban State Technological University to collect the data. The scholars considered the collective group discussions regarding the application of artificial intelligence in education to improve the effectiveness of learning. The research identified key advantages to creating personalised learning pathways such as access to training in 24/7 mode, training in virtual contexts, adaptation of educational content to personal needs of students, real-time and regular feedback, improvements in the educational process and mental stimulations. The proposed education paradigm reflects the increasing role of artificial intelligence in socio-economic life, the social and ethical concerns artificial intelligence may pose to humanity and its role in the digitalisation of education. The current article may be used as a theoretical framework for many educational institutions planning to exploit the capabilities of artificial intelligence in their adaptation to personalized learning.

Keywords: AIEd technologies; artificial intelligence; machine learning; personalised learning; prevalent behaviour patterns; sustainable development goals (SDGs).

1. Introduction

Digital transformation has become an important growth driver improving the quality of life. Digitalisation has an impact on global, innovative, inclusive and sustainable growth in different sectors (Dignum, 2021). Access to large volumes of data and the increasing role of digital technologies have inspired the development of computational science, led to the growth of different industries and facilitated a rapid transition to e-science on the national scale. With the development of intelligent computing in recent years, computer literacy has become the main skill that pushed industrial innovations. Moreover, it has been seen as a driver of economic growth within organisations (Tedre et al., 2021). The availability of cheap computing power and large data volumes have led to machine learning developments. Digital tools sparked commercial and research interest in artificial neural networks. Neural artificial intelligence and machine learning techniques are now being used for real-time language processing, translation, image analysis, self-driving cars, autonomous vehicles, automated customer service systems, fraud detection, process control, synthetic art, service robots and so forth (Tuomi, 2018; Shestak et al., 2020).

Artificial intelligence transforms all aspects of socio-economic life and integrates communication technology into virtual reality. Artificial intelligence in education has changed not only the education system but knowledge sharing approaches to learning, cognition and development of civilization (Kaur, 2021). The main challenge is that education has not accepted the educational value of technology, and for this reason, the launch of artificial intelligence in education has been postponed for many years. Nevertheless, applied sciences, industry, finance and medicine have undergone digital transformations (Luckin and Cukurova, 2019). The digital transformation of education has significantly influenced the adoption of technology by secondary and high educations around the world. It has also heated the interest in artificial intelligence in education (AIEd) in terms of research and its practical application in modern education.

On the other hand, on a worldwide scale, intensification of digital technology adoption in the learning process is uneven among educational institutions and remains a key issue in learning quality improvement for many developed countries (Fahimirad and Kotamjani, 2018). Thus, the use of artificial intelligence (AI) in the context of enhancing the sustainable development of society requires many institutions to work cohesively as a result of the interaction of multiple factors. For example, not every public education policy is internationally coherent, which comes with subjective efficiency and rationality of learning processes (Pedro et al., 2019). Although the scientific and technological advancement of civilisation in the form of an AI product can facilitate student access to education, collaborative environments, and intelligent learning systems to support teachers, the use of this tool is still a challenge rather than a fact (Flogie and Aberšek, 2022). As a consequence, research on the personalised learning establishment by means of AI implementation in the educational environment is quite relevant at this time.

The present research aims to investigate the possibilities of AIED to build personalised learning pathways. For this, the following objectives are set:

- - define a term, concepts, and subsets of artificial intelligence;
- - explore the possibilities of AIED and investigate the personalised approaches to knowledge acquisition and professional competencies development;
- - analyse the case studies that illustrate the implementation of AIED;
- - explore the benefits of AIED for personalised learning;
- - identify and describe the social and ethical concerns AI may pose to humanity and its role in the digitalisation of education.

The increased role of artificial intelligence has forced the modern generation of students to acquire knowledge and skills much faster. Nevertheless, addressing socio-economic problems, artificial intelligence has raised broad social concerns and may lead to unexpected outcomes (Zhang et al., 2021). AIED opens up new opportunities in educational practice. In its short history, AIED has undergone several periods, which are characterized by three paradigms in which AI methods are used in different ways to solve education and learning problems. In the first paradigm, AIED tools used to represent knowledge models and direct cognitive learning in which learners are recipients of educational services. In the second paradigm, AIED tools used to support learning while students work alongside AI. In the third paradigm, AIED tools used to enhance learning opportunities while students participate in learning. In general, the development trend of AIED has evolved to empower the learner and personalize learning process, allow learners to reflect on learning and inform AI systems to adapt accordingly, and lead to the iterative development of personalized, learner-centered, data-driven learning (Ouyang and Jiao, 2021). The concept of personalized learning is not something new in the field of education, but with the advent of artificial intelligence and big data analytics, new ways of implementing it are opening up (Magomadov, 2020). The digital learning environments offer the potential for personalised learning pathways. On the contrary, empirical evidence suggests that even if something is personalised, it does not automatically promote the learning experience. Adapting to learner characteristics that are not strongly related to learning processes (such as learning styles), or using static modelling as the basis for adaptation, can be seen as potential culprits for ineffective personalization attempts in teaching practice. In contrast, the use of dynamic modelling to assess and adapt to appropriate learner characteristics can lead to learning success that can only be rivalled by individual learning (Tetzlaff, Schmiedek, and Brod, 2021).

Intelligent Learning Systems (ITS) have a great potential for educators teaching distance learning courses. Digital tools forced the learning system to change drastically and move from face-to-face to distance modes of delivery. The AIED can foster collaborative learning by supporting the adaptive groups based on student personal profiles, facilitating online group interactions, or summarizing discussions (Zawacki-Richter et al., 2019). The main idea of intelligent learning systems is that the student interacts with an adaptive interface that personalises the learning process depending on the user's profile and academic achievements. On the other hand, the main strength of AI data-driven systems is that they can process very complex data streams in real-time. For the next generation of intelligent learning systems, it means that these systems will require user interfaces (UIs) that collect real-time student behaviour patterns, as well as historical data that can be used to develop the student's profile. Informally, it is known as the principle of "no AI without UI". Consequently, there will be significant commercial interest in promoting various types of sensor technologies and user interfaces in educational courses. They will help to access data from other sources related to learners behaviour patterns such as social networks and gaming platforms (Tuomi, 2018).

Artificial intelligence, available to teachers and students, help educators to craft courses that are customised to their needs. It creates growing awareness of new technological solutions that provide alternatives for students and promote new teaching and learning methods. The advances in artificial intelligence have led to the development of personalised pathways in education. AI simulates human listening (machine translation, speech recognition), speech (speech synthesis, human-computer dialogue), observation (computer vision, recognition images, text recognition), thinking (theorem proving), learning (machine learning, intelligent adaptive learning) and action (robotics) (Huang, Saleh, and Liu, 2021). Today, AI is one of the tools used in Learning Analytics to analyse students knowledge (as well as their learning engagement strategies) in order to restructure effective personalised learning pathways and develop supportive strategies in all stages of education. Learning analytics models are most commonly used in two spheres: decision support systems and personalised learning systems. Decision support systems use predictive analytics that proposes forecasts about future student outcomes and visualises information in graphs and tables. Teachers examine information on specific students achievements using AIED. Personalised learning systems help to analyse the mastery of the skills, provide students with the best educational activities and encourage students to learn at their own pace as they master skills and progress toward learning goals. Personalised learning leads to the building of customised learning pathways that make learning more effective and emphasise learner-specific goals related to the learning objective (Baker, 2021). Immersive technologies and artificial intelligence promote practical and innovative education through digital tools and virtual learning platforms (Klašnja-Milićević and Ivanović, 2021).

Education and business environment are interlinked, controlled and supported by information systems. The technological advances and the growing importance of artificial intelligence facilitate the research on the advantages of technological innovations and new strategies for education (Lam et al., 2021; Owoc, Sawicka, and Weichbroth, 2019). In recent years, artificial intelligence and robotics have generated great interest among the public, governments and prominent scientists. The role of digital tools in business and education is undeniable. The digitalisation of education has an important impact on the educational approaches and the role of teachers and students in the educational process. In this regard, the higher education system demands to teach individuals how to perform in a new economy and adapt society to a new way of life (Cox, 2021). Artificial intelligence creates new opportunities for education providers and bridges the gap between technological innovations and their implementation in education (Zhang and Aslan, 2021). Technological developments and pedagogy must go hand in hand. Effective collaboration between education professionals and artificial intelligence is extremely important because educational technologies cannot exist in a vacuum. Communication in educational establishments, the labour market and students who acquire professional skills and competencies are interlinked (González-Calatayud, Prendes-Espinosa, and Roig-Vila, 2021).

2. The Term, Concepts and Subsets of Artificial Intelligence

Artificial intelligence is defined as a wide-ranging branch of automated decision making without human involvement. It covers different areas from conditional logic to neural networks. Machine Learning (ML), a subset of AI, means decisions or predictions made by data-driven technology. Machine learning methods powered by AI include deep neural networks (DNN), also known as deep learning (DL) (Figure 1). Machine learning, artificial intelligence, and deep learning are widespread and integrated across data-driven industries that create AI-based products and services. The growing interaction between humans and AI has resulted in the development of human-centred machine learning (HCML) (Kaluarachchi, Reis, and Nanayakkara, 2021).

Artificial intelligence is based on algorithms, a set of rules and instructions that computers follow while performing problem-solving operations to complete the final goal. Algorithms provide instructions for AI and machine learning systems. Machine learning is based on statistical learning methods and uses data and algorithms to perform tasks that usually require human intelligence. Machine learning algorithms analyse data to identify the patterns and build a model and then calculate future values based on these models (Akgun and Greenhow, 2021). In general, the machine learning effectiveness depends on the data and its characteristics, as well as the performance of the learning algorithms. Machine learning algorithms include methods of classification analysis, regression, data clustering, feature design, dimension reduction, association rule learning and reinforcement learning to build data-driven systems. Choosing the correct learning algorithm for the application in a specific area can be a challenge. The final goal of different learning algorithms may differ. The outcomes of different learning algorithms in one subset may differ greatly because of the initial characteristics and input data (Sarker, 2021). Machine learning means the ability of systems to learn by the use of data and automate the process of building analytical models and solving related problems. The challenges in machine

learning include the data collection processes considered one of the most critical factors for learning. Machine learning requires time to analyse series data and explore its potential use in scenarios. The main functions are collecting, cleaning, analysing, visualising, and developing functions (Roh, Heo, and Whang, 2019). Deep learning is machine learning based on artificial neural networks. For many applications, deep learning models are superior to shallow machine learning models and traditional approaches used in data analysis (Janiesch, Zschech, and Heinrich, 2021).

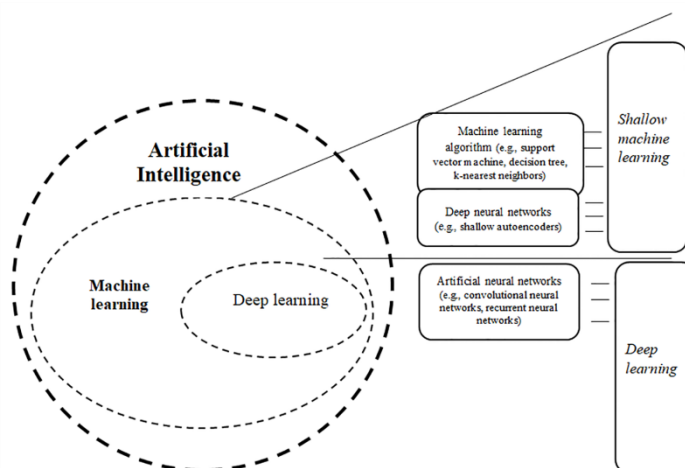


Figure 1: Artificial intelligence concepts and subsets

* Author's development (Goodfellow, Bengio, and Courville, 2016; Kaluarachchi, Reis, and Nanayakkara, 2021)

On the other hand, across-the-board popularity of machine learning has stemmed from agricultural training. Thus, for example, several European universities in the UK, Greece and Italy have proved a positive impact of machine learning due to its intensification of the use of data in the multidisciplinary agri-technologies domain (Liakos et al., 2018). Apart from this, there are also studies dedicated to identifying and distinguishing between sick and healthy wheat crops claiming using machine learning. More precisely, this technology has facilitated the development of a new system capable of identifying healthy winter wheat and having yellow rust disease based on a hierarchical self-organising classifier and hyperspectral reflectance data. The demonstrated application of this method contributed to a more effective application of fertilisers and fungicides according to specific plant's needs (Pantazi et al., 2017).

3. AIED for Building Personalised Learning Pathways, Acquiring Knowledge and Developing Professional Competencies

Learning is a natural human ability that starts in personal experience, cognitive awareness, personal biases, opinions, cultural background and environment. Learning is an individualised experience that expands knowledge, mind perspectives and practical skills (Shemshack and Spector, 2020). A significant disadvantage of traditional teaching is that all students have to follow the same learning sequences, but not all of them have the same knowledge, preferences, learning goals and needs. Traditional learning resources encourage learners to follow a set of learning sequences to improve their academic performance. Fixed learning pathways are not appropriate for all students. The designers of modern educational courses pay special attention to the development of personalised learning pathways taking into account the needs, motivation, interests, behaviour patterns and abilities of each student (Elshani and Nuçi, 2021).

At the same time, the specificity of the teacher's personality in the context of the implementation of personalised student learning should be noted. While under the traditional approach, the educator is more likely to make decisions on various aspects of the learning process, personalised learning transforms their role into "coordinator" or even "mentor". At the same time, the educator should have a fluent grasp of the tools for the digitalisation of scientific disciplines, i.e., complete appropriate professional development courses in the field of IT (Elfeky, 2018).

Personalised learning is a systematic learning design that adapts learning to the personal strengths, preferences, needs and goals of an individual learner. It leads to a comprehensive learning experience by ensuring a wide choice of new disciplines and skills development (Walkington and Bernacki, 2020). Personalised learning assigns a specific role to teachers that is to give the student the opportunity to manage the learning process, to be responsible for setting and implementing educational goals that correspond to his personal interests and needs (Aberbach et al., 2021). Personalised learning systems and approaches motivate students to learn and improve academic performance (Zlatarov et al., 2021).

Personalised learning emphasises the importance of personal growth and the learning environment. A personalised learning environment includes a variety of services, learning tools and applications tailored to the individual students' needs. They use technologies such as Web 2.0 or Web 3.0 to develop cheaper training, enhance user experience, and create personalised student profiles. Adaptive systems can be customised to individual learners' needs, focusing more on specific topics, repeating learning materials that have not been mastered properly (Klašnja-Milićević and Ivanović, 2021).

The use of artificial intelligence offers students of different age groups, academic levels and socioeconomic backgrounds opportunities to enhance learning experiences and improve academic achievements. Artificial intelligence technologies play a pivotal role in the development of personalised learning pathways. AI allows the use of different teaching methods effective for each student, taking into account the strengths, weaknesses, talents and academic problems of each learner. Advanced analytics and machine learning present a potential for developing social and emotional learning skills. New technologies enable educators to develop personalised learning pathways and analyse both qualitative and quantitative data. Artificial intelligence, data, analytics and machine learning help educators to deliver educational programmes to students via an immersive virtual environment. This approach helps to ensure the quality of distance learning and effective teaching (Duggan, 2020).

In recent years, advances in artificial intelligence, machine learning and big data analytics have opened up new opportunities for personalised learning. *Personalised learning* is one of the innovations that help educators to customise learning and respond to new educational perspectives. The new paradigm influences the quality of education based on the characteristics and expectations of each student, such as personality, talent, and individual goals and backgrounds. Continuing education promotes the educational process, as well as help student to acquire new skills and competencies important for the future (Maghsudi et al., 2021). Personalised learning systems, automated assessment systems, facial recognition systems, chatbots (social networking sites) and predictive analytics tools that run on machine learning systems and algorithms are increasingly adopted in educational establishments to ensure effective teaching. Intelligent learning systems are one of the most widespread and valuable artificial intelligence applications for students and teachers to access a variety of learning materials depending on their individual learning needs (Akgun and Greenhow, 2021). Intelligent Learning Systems (ITS) are able to teach students using computing systems and provide immediate and personalised feedback (Kokku et al., 2018).

The introduction of artificial intelligence to improve the optimality of learning processes has been actualised strongly in the context of the coronavirus pandemic. Medical education was the domain most affected by such learning format adjustments. As noted by researchers from the University of the West Indies (Gaur et al., 2020), the COVID-19 pandemic has posed several challenges to premedical education, among which suspension of face-to-face teaching and lack of cadaveric dissections and hands-on/lab sessions. However, at the same time, it has provided an impetus for many innovative initiatives that include but are not limited to AI-based education. As a result, AI was confirmed to be a sound solution for adaptive learning due to its broad virtual simulation capabilities.

Each student has unique learning needs and the AIED goal is to provide students with a personalised learning experience within the intelligent learning environment that facilitates knowledge acquisition and provides personalised feedback. AI can significantly automate and track the student's progress. AI helps educators to apply the most effective teaching methods, taking into account the learning contexts and academic achievements (Chaudhry and Kazim, 2022). For students, the AIED opens up new opportunities to learn online and enrich their learning environments with adaptive learning materials and metacognitive cues. AIED increases engagement and improves learning outcomes. For educators and school administration, AIED helps to record academic achievements, develop personalised learning materials, provide reviews and analyse data. The use of

AIEd provides the most immediate benefits of automating simple tasks such as assessments, digital asset classification or scheduling. AIEd helps teachers to save time usually spent on routine tasks and devote more time to communicate with students. Student needs and curriculum are changing as educators identify which skills the world needs for the future. AI-based analytics is required to identify the key trends in the subject area and help the teacher to generate learning content. In addition, the AI solutions can be integrated with other IT initiatives such as smart technology and a managed IoT network ensuing effective learning solutions for students (Joshi, Rambola, and Churi, 2021). AI learning environment can improve LMS for both teachers and students with the help of expert systems, visual feedback and learning process based on visualization and immersive technologies (Zhang and Aslan, 2021). The quality of learning can be improved by developing new pedagogical approaches and introducing technological innovations. Personalised learning helps students to take responsibility for their personal, professional and academic development and use the acquired knowledge and skills at the workplace (Whalley et al., 2021).

The artificial intelligence tools help educators to build a complex educational environment. Learning can be more personalised and flexible, and education management more inclusive. New learning contexts can help students to develop knowledge and skills that are in demand in society (Pokrivčáková, 2019). Educational technologies interlinked to other forms of innovative pedagogical practices make personalised learning the cornerstone for the effective achievement of the set goals (Cheung et al., 2021). Figure 2 presents the possibilities of AIEd technologies for personalised approaches in education.

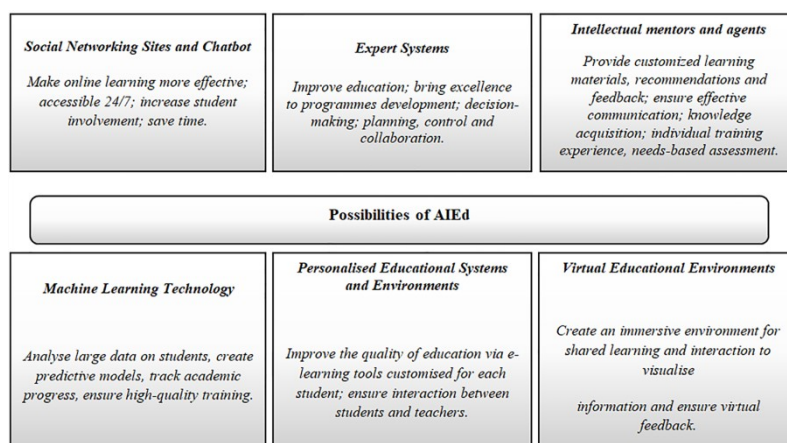


Figure 2: AIEd technologies in personalised approaches to learning

* Author's development

AIEd technologies are effective tools used for the students' competencies development. The new approaches help students to acquire skills and knowledge important for tomorrow's challenges. Students use and develop new competencies when they face unfamiliar or challenging situations. For example, Nanyang Technological University in Singapore has performed research on the application of virtual reality in medical education. Virtual reality technology helps to improve the understanding of medical subjects (Larchenko and Barynikova, 2021). Another research on digital education examined the problem of online gamification for the development of entrepreneurship skills. The developed special online game had a positive effect on the acquisition of entrepreneurial skills among students (Holmes et al., 2021).

The developments in natural language processing resulted in the deep and network learning progress, as well as the growth of technological capabilities for large data analysis. Today, AI can analyse the psychological characteristics, selecting an algorithm for raw data analysis, detection of stress, anxiety and depression using technology (Tapalova and Kuatbekov, 2021). Artificial intelligence in language learning resulted in the development of the Intelligent Computer-Assisted Language Learning (ICALL system). The system involves personalised teaching materials, machine translation tools, chatbots, platforms and applications for learning languages based on artificial intelligence, intelligent learning systems, adaptive and intelligent systems for collaborative learning, and intelligent virtual reality (Pokrivčáková, 2019).

However, the theoretical basis for determining AI as a digital tool in an educational environment is individual for each region or educational institution (Zhang, Basham, and Yang, 2020). Even though there are several publications describing the key features of AI implementation in education, this issue has not yet been sufficiently explored in the context of personalised student learning, which is taking on a more traditional form under today's global challenges.

4. The Case Study on the AIED Implementation in Education

Artificial intelligence tools are popular in education offering opportunities for student-centred learning. The possibilities of using artificial intelligence to develop a personalised pathway in psychological disciplines including "Zoopsychology", "Cognitive and affective foundations of human behaviour", as well as special disciplines such as "Speech therapy", "Subject-practical training in children with impairments", The sample included 184 second-year students of the Institute of Pedagogy and Psychology at the Abay Kazakh National Pedagogical University and the Kuban State Technological University to collect the data. The vast majority of them were females (112), while the number of males was notably fewer (72). Research participants' mean age constituted 19.6 years. The selection of students was made with reference to their field of study. The scholars analysed the benefits of artificial intelligence in teaching university students. The training was carried out in a distance format for 3 months from September to November 2021. Following the instructions of the course moderator, students tested educational tools adapted to the educational content. All moderators (20 people) were IT instructors in the university under study. As concerns the ethical side of the research, all the ethical principles were met in the course of the investigation. Each person involved consented to personal data processing, while achievements made were agreed with the university administration.

In the course of the educational experiment, educational digital tools powered by artificial intelligence were used, such as Altitude Learning (2021). It is a professional learning platform that encourages students to self-study and helps teachers to meet the needs of every student in the entire learning cycle, from the course planning to assess student progress. With the support and guidance of a teacher or mentor, students gain independent learning experiences by completing assignments and interacting with peers in groups.

Gradescope (2021) is a platform that combines expertise with the latest machine learning and artificial intelligence technologies to help the teacher assess student progress. The platform is effective because it allows teachers to save time usually spent on academic reviews and assessments. Gradescope provides statistics and identifies classroom trends and student needs. Knewton's Alta (2021) is an artificial intelligence platform designed to improve learning and help teachers to assess assignments. KnewtonAlta is responsive learning software that provides a hands-on learning experience with detailed explanations and timely instructions. At Knewton Alta, students use the personalised pathway based on their individual achievements and needs. The platform monitors student progress and adapts it in real-time to maximize learning outcomes.

The other learning platform, Knowji (2021) is a research-based audiovisual application that tracks student progress. It reflects cognitive category typologies and structures academic knowledge. It helps to research the connection of gestalts with the basic level concepts, analyses quick reasoning based on figurative-schematic structures and explores clip thinking (mental and visual images), visual images (high-quality memorization, productive building of their logical relationship). The system develops the student's psychological portrait.

Knowji's vocabulary applications combine the best techniques to provide fun for students and effective learning at the same time. Duolingo (2021) is a chatbot platform integrated with artificial intelligence algorithms that allow educators to understand the user's context and respond to individual students' needs.

The interest of foreign researchers in machine learning algorithms (Machine Learning, ML) was heated by the digitalization of education. Big data means digital traces that students generated on a daily basis in social networks. The research hypothesis state that there was a link between students' characteristics (for example, creativity or academic performance) and behaviour patterns in social networks.

During the learning process, the moderators of the training course structured the possibilities of AIED technology in educational activities for students, teachers and educational institutions (Figure 3).

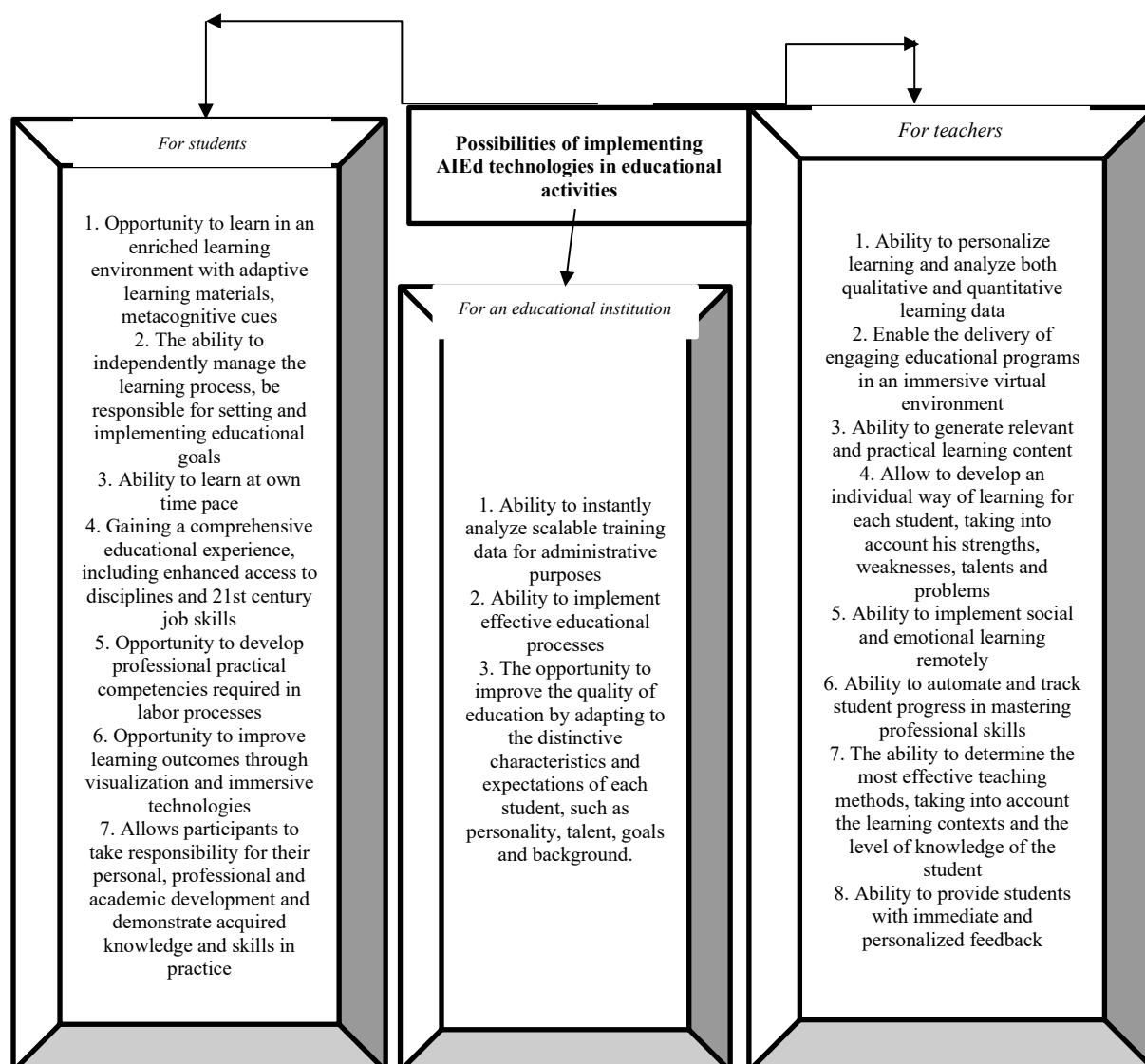


Figure 3: Possibilities of AIEd technology in educational activities for students, teachers and educational institutions

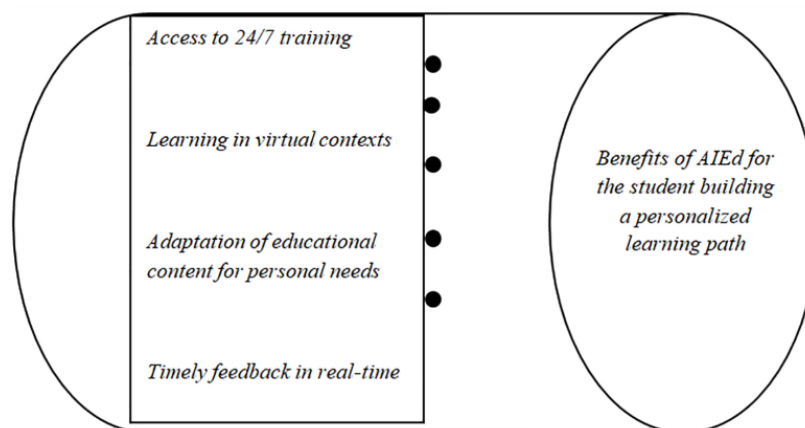
* Author's development

At the end of the training, in the online survey mode on the Zoom communication platform, students asked to answer the following question: "In your opinion, to what extent the possibilities of AIEd technologies in educational practices affect the implementation of the principles of personalized learning. The results of the survey are presented in Table 1.

The training sessions provided students with personalised learning pathways and demonstrated that educational tools based on artificial intelligence were important for educational purposes. The digital tools turned out to be a valuable and rewarding educational experience for most students. The students identified key advantages for building personalized educational pathways based on artificial intelligence technologies (Figure 4).

Table 1: The results of the student survey

<i>Innovative capabilities of AIED technologies</i>	The degree of influence on the implementation of the principles of personalized learning		
	No effect	Not significant	Significant
Opportunity to learn in an enriched learning environment with adaptive learning materials, metacognitive cues		14%	86%
The ability to independently manage the learning process, be responsible for setting and implementing educational goals		2%	98%
The opportunity to gain a comprehensive educational experience, including expanded access to disciplines and 21st century work skills		20%	80%
Opportunity to develop professional practical competencies required in labor processes		32%	68%
Ability to instantly analyze scalable training data		22%	78%
The ability of curricula to adapt to the distinctive characteristics and expectations of each student, such as personality, talent, goals and background			100%
Opportunity to learn in an exciting virtual environment with the effect of presence		14%	86%
The ability to generate relevant and practical learning content in an online environment		8%	92%
Ability to implement social and emotional learning remotely		12%	82%
Ability to automate and track learning progress		4%	96%
The ability to determine the most effective teaching methods, taking into account learning contexts and knowledge levels		2%	98%
Ability to receive immediate and personalized feedback and access to training 24/7			100%

**Figure 4:** Benefits of AIED for the student building personalized learning pathways

* Author's development

The majority of participants responded that the implementation of AIED technologies in education increased their involvement and interest in learning, helped to adapt educational content to personal needs, accelerated the educational process and stimulated mental activity. Therefore, it provided an opportunity to learn disciplines in virtual contexts by providing access to training in 24/7 mode and ensured timely feedback.

On the other hand, the use of AI technology in personalised learning opens up broad professional development opportunities for educators, which may significantly impact the quality of education. Hence, for example, the research carried out on the basis of several universities in Russia proves the need for practical and dynamic training of teachers of the Russian Federation to work in the electronic information and educational environment (EIEE), which is continuously and intensively enriched with AI technologies. At the same time, it is shown that the use of new types of educational activities in the conditions of a digital educational environment

enriched with AI elements contributes to the innovative professional training of a modern educator (Vlasova et al., 2019).

5. The Social and Ethical Concerns AI May Pose to Humanity and Its Role in the Digitalisation of Education

The social and ethical concerns of artificial intelligence are apparent. Artificial intelligence is at the centre of controversy, for example, in the automation of workplaces and public services. The algorithms lead to bias and discrimination, inequality and disadvantages for individual users. The scholars admit that the main challenges connected with artificial intelligence include ignoring data protection and confidentiality, political and commercial micro-targeting, and the inability of technology corporations to control the economy. Numerous ethical frameworks and professional codes of conduct have been developed to try to reduce the potential dangers and risks of artificial intelligence in society (Williamson and Eynon, 2020). In the educational context, the ethical issues related to artificial intelligence include privacy, security, use of personal data, and the impact of virtual assistants on assessments. Potential social and ethical risks arise as artificial intelligence become more intelligent and sophisticated (Dignum, 2021). Several European Commission initiatives have addressed ethics as a means to protect people from the risks posed by new technologies and as a way to govern and regulate areas of innovation. The spread of references to “ethics” and “ethical principles/values” in legal and political discourse, as well as the growing importance of ethical expertise, ethical committees, ethical advisory groups and councils, ethical guidelines are called the phenomenon of “ethification” (Dijk and Casiraghi, 2020).

The scope of AI ethics covers immediate, topical issues such as data privacy and bias in existing AI systems, the impact of AI and robotics on the workplace, and concerns about techno replacing human capabilities. Ethical concerns about AI have sparked a huge number of national and international initiatives from non-governmental organizations, academic and industrial groups, professional organizations and governments. These initiatives vary greatly in their goals, amount of investment, and their commitment to developing an ethical framework. These initiatives have resulted in the publication of a large number of sets of ethical principles for robotics and AI (EPRS, 2020).

In European countries, artificial intelligence technologies are considered by citizens as a positive addition to the socio-economic life. The general trends in public perception obtained during a special Eurobarometer survey on the attitudes of citizens of the European Union (EU) towards the digitalization of their daily lives revealed the main concerns in digitalization trends: the risk of job cuts, the lack of special knowledge and skills for effective and thorough technology management, concerns about access and protection of their data and online information, privacy (European Commission, 2020).

In 2019, the European Commission published the Ethical Guidelines for Trusted AI to instruct the public on their expectations for the proper development and use of AI. The guiding principles included: strength and security, privacy and data governance, transparency, diversity, non-discrimination and fairness, social and environmental well-being, accountability (Mitchell et al., 2020). In 2021, the European Commission presented its proposal for a Law on Artificial Intelligence, called “the world’s first regulation on AI”. While many declarations have been made about the ethics of AI over the past few years, the novelty and complexity of AI, combined with concerns about stifling innovation, have limited the translation of these ethical principles into concrete regulatory measures (INQ LAW, 2021).

The European Commission provides a common framework for the development of AI in the EU, but Member States are also required to develop their own national strategies. For example, Finland was the first Member State to develop a national program on artificial intelligence (Ministry of Economic Affairs and Employment of Finland, 2018) aimed at promoting the good governance and efficient use of information, taking into account the principles of fair data management, including recommendations on the use of information and ethical values. . The UK National Artificial Intelligence (AI) Strategy 2021 is a vision of innovation and opportunity, underpinned by a system of trust that puts innovation and opportunity first. While strategy sends important signals for innovation, achieving ethical innovation is more challenging and will require a carefully crafted framework built with relevant expertise (Kazim et al., 2021). The focus of the Danish National Strategy for Artificial Intelligence is to ensure that the development and use of artificial intelligence is based on democratic values. The use of artificial intelligence should help analyze, understand and make decisions and complement people, and algorithms should ensure equality, being objective, based on facts and independent of personal

circumstances (Denmark, 2019). In Germany, with the aim of integrating AI into society in ethical, legal, cultural and institutional terms, the Strategy for Artificial Intelligence of the German Federal Government was adopted (Die Bundesregierung, 2020). France launched the AI for Humanity program in 2018, which is committed to supporting French talent, making better use of data, and setting an ethical framework for AI (AI For Humanity, 2018). Digital ethics is now a major issue in a global world where data, information and knowledge play such an important role in our daily lives and in our society. In 2019, the French National Committee for Digital Ethics (FNCDE) was created with the task of helping to organize reflections on digital ethics in France in close coordination with European and international institutions and initiatives (Kirchner, 2020). In May 2019, a group of experts led by the Ministry of Economic Affairs and Communications (MKM) and the Government Office submitted proposals to promote the implementation of artificial intelligence (AI) in Estonia, also known as the Estonian National AI Strategy. The Estonian National AI Strategy has been developed in the context of the European Union's coordinated action plan on artificial intelligence, synchronized with relevant activities at the EU level. The strategy takes into account the ethical implications of AI, and proposes practical economic incentives and pilot programs (OECD.AI, 2021).

Currently, there is no regulatory regime and no federal regulation of AI in North America. In the US, concerns about the possible misuse or unintended consequences of AI have spurred efforts to study and develop standards, such as the US National Institute of Standards and Technology (NIST) initiative, which includes workshops and discussions with the public and private sectors around the development of federal standards for reliable artificial intelligence systems (NCSL, 2022). Although Canada was the first country in the world to launch a national AI strategy in 2017, AI systems in Canada are governed by general privacy, technology and human rights laws and efforts are being made to develop a more flexible framework for regulating AI. In 2020, the Office of the Privacy Commissioner of Canada (OPC) released PIPEDA reform recommendations to help you reap the benefits of AI while respecting people's basic right to privacy (INQ LAW, 2021).

In the Middle East, the United Arab Emirates was the first country to develop a strategy for AI in 2017, with a focus on improving government performance and financial sustainability. The Dubai AI Ethics Guidelines have identified key principles that make AI systems fair, accountable, transparent and explicable. A self-assessment tool has also been developed to help AI technology developers assess the ethics of their system (EPRS, 2020).

Israel launched the National Department of Synchronization of Research Center Operations (IDSI or Israel Data Science Initiative) program in 2020. The goals of the program are to promote high-level research and create an ecosystem that will ensure the further development and competitiveness of industry, academia and the public sector in the field of high technologies. The program also aims to develop mission-critical applications for the Israeli security system and master the use of AI in industry, the service sector, and government ministries (Xinhua, 2020).

Asian countries have experience in complying with the EU General Data Protection Regulation (GDPR). The wide extraterritorial scope of the GDPR has prompted many countries to model their own legislation along similar lines (Harjani, 2021). In 2019, the Japanese Cabinet released a document titled "Social Principles for Human-Centered AI". The document includes the following principles: human focus, education, confidentiality, security, fair competition, fairness, accountability, transparency and innovation (Mitchell et al., 2020). In 2019, Singapore presented its AI Governance Model Framework at the World Economic Forum (WEF) in Davos. The two guiding principles of the system are: decisions made by AI must be "explainable, transparent and fair"; and AI systems must be human-centred (i.e., the development and deployment of AI must protect the interests of people, including their safety and well-being) (Choudhury, 2021). For 2021, the Chinese government has released a number of policy papers and public statements that seem to reinforce the country's AI governance regime. These initiatives show the emergence of three different approaches to managing AI, each championed by a different branch of the Chinese bureaucracy and at different levels of maturity: 1) rules for online algorithms with an emphasis on public opinion (Internet Information Service Algorithmic Recommendation Management Provisions; Guiding Opinions on Strengthening Overall Governance of Internet Information Service Algorithms); 2) tools for testing and certification of "reliable AI" systems (Trustworthy AI white paper; Trustworthy Facial Recognition Applications and Protections Plan); 3) establishing AI ethics principles and creating technical ethics councils in companies and research institutions (Guiding Opinions on Strengthening Ethical Governance of Science and Technology; Ethical Norms for New Generation Artificial Intelligence) (Sheehan, 2022).

AI will increasingly shape the global response to the world's most complex problems, especially in the field of social development. To minimize the risks associated with the implementation of AI systems in educational processes and maximize their benefits, human rights principles must be embedded in the development stages, from the earliest stages of conception to implementation and follow-up. In addition, it is important to put in place mechanisms that guarantee an adequate level of both technical and organizational transparency. For any educational project, it is necessary to ensure the use of high quality data and adherence to best practices for data protection and confidentiality. For AI tools to contribute to human progress, educational organizations must be active and inclusive in developing tools, policies and accountability mechanisms that protect human rights (Pizzi, Romanoff, and Engelhardt, 2020).

Active implementation of personalised learning is a challenge to the traditional system of any educational establishment (Murphy, 2019). Therefore, each higher education institution must develop personal adaptive student-instructor interaction program to ensure effective cooperation and use AI capabilities in modern conditions.

6. Conclusions

Personalised learning is a trend in the modern educational system related to the global digital transformations of all aspects of socio-economic life. The introduction of artificial intelligence technologies makes it possible to increase the efficiency and quality of education focused on the needs and demands of students. The use of social networking sites and chatbots in education allows teachers to make training more effective, accessible 24/7, increase student engagement, and save time. Expert systems improve the efficiency of education, ensure excellence in curriculum development, decision-making, planning, control and collaboration. Intelligent mentors and agents promote individualised learning pathways based on students needs, preferences and previous academic knowledge. Machine learning technologies allow teachers to analyse large amounts of student data, create predictive models, track educational progress and adjust learning to students needs and ensure high-quality learning. Personalised educational pathways improve the quality of e-learning and provide students with personalised learning materials and resources. Moreover, they facilitate interaction between students and educators. Virtual learning environments provide an immersive environment for collaborative learning, interaction, information visualisation and real-time virtual feedback.

The findings suggest that the key advantages of AIED technologies allow educators to build personalised educational pathways to meet individual learners' needs. The majority of participants admitted that the implementation of AIED technologies in education increased their involvement and interest in learning, helped them to adapt educational content to personal needs, accelerated the educational process and stimulated mental activity. Moreover, AIED provided an opportunity to research psychological aspects in virtual contexts, accessed academic progress in 24/7 mode and ensured timely feedback. The educational paradigm proposed within the current study depicts the growing role of AI in socio-economic life, the social and ethical problems that AI can cause for humanity, as well as the role of AI in the digitalisation of education, especially personalised.

6.1 Research Limitations

The research is theoretical and descriptive by its nature. It lacked the quantitative data assessment related to the effectiveness of AIED technologies in education. Future research is still needed. The research provides evidence for changes in the future. The recommendations may be pertinent to other universities on how to use the specifically designed programme based on AI-powered tools.

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