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Technology Enhanced Language Learning Research Trends and Practices: A Systematic Review (2020-2022)

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Abstract: In recent years, the role of technology in language classrooms has grown in importance. Due to recent developments in the education sector, technology-enhanced language learning (TELL) has come into the spotlight. Previous studies have shown that technology encourages both instructors and students to take an active role in the language learning process. In light of the widespread adoption and enabling power of immersive technologies and the potential applications of TELL, it is imperative that the literature be continuously investigated to identify the types and tendencies of recent studies in order to understand current practises and guide future research in the field with two research questions; RQ1: What are the trends and practices of TELL in language teaching and learning? and RQ2: What are the research methodologies employed in TELL studies? This review carefully examines the overall research trends and practises in language education in order to chart the development of TELL during the past few years. Out of 87 publications found in 2020–2022, 17 were selected using exclusion and inclusion criteria from Web of Science (WoS) and Scopus. Using five codes obtained from previous systematic reviews, we performed an analysis and synthesis of these publications. The codes are: 1) aim, 2) methodology, 3) sample, 4) country, and 5) outcomes. The bulk of the studies used a quantitative research technique to look into TELL trends and practises in language teaching and learning, and the systematic review found that TELL was more widespread in universities than in other types of schools, with the lowest occurrence seen in primary schools. In light of these findings, suggestions for more investigation were made. Academicians are urged to broaden the scope of future study and include students from all levels of education in future TELL practises in order to better understand TELL's usage in language teaching and learning.

Keywords: Technology enhanced language learning, Systematic review, Language teaching and learning, Trends, Practice

1. Introduction

Over the past few decades, the exponential growth of technology has held promise as a tool for improving language instruction. The fast development of technology has allowed for the testing of several potential approaches to teaching and learning languages. It has been proven that the usage of technology may help people learn a new language. Teachers of foreign languages have used a variety of technological tools to help their pupils learn the language and culture more effectively through exposure to real-world applications. As a result, certain technological resources allow educators to modify lesson plans, tasks, and projects for the benefit of their language learners. It also helps teachers of foreign languages facilitate and mediate their students' language acquisition. Teachers of languages who are also adept at managing and facilitating technology-enhanced language learning environments are critical to the success of any initiative to integrate such tools into the classroom.

The benefits of TELL have been highlighted by Carr et al. (2011), Chirimbu and Tafazoli (2013), Patel (2014) and Yeşilel (2016). Hence, the field has received a great deal of attention. TELL gives people the chance to link together many sources of knowledge and educational resources. Teens and young adults nowadays have unrestricted access to state-of-the-art technologies that are rapidly evolving and improving their capacity for communication and education. As a result, it is efficient to employ technology that is relevant to their daily lives.

Societies nowadays impose harsh expectations on people in many facets of life. All of these requirements point to fundamental skills that people must develop. Competency goes beyond merely having the right information and abilities. Ability to draw from and mobilise one's psychosocial resources, such as one's talents and attitudes, to successfully fulfil complicated demands in a given setting (Sumter et al., 2021; Kipper et al., 2021). One example of a competency is the capacity to communicate effectively, which might call upon a person's linguistic prowess, their experience with actual communication situations, and their perspective on the people with whom they are conversing.

Phonetics, grammar, vocabulary, reading, writing, translation, auditory comprehension, literature appreciation, and assessment are all areas where Tseng (2019) believes technology may make a significant impact on language acquisition. Vocabulary learning using technology, according to Asllani and Paçarizi (2021), may be adaptable and efficient. With the steady improvement of Internet-based technology over the past several years, more and more people are turning to it to increase their English vocabulary.

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2. Literature Review

2.1 Technology-Enhanced Language Learning (TELL)

Taking a broad view of technology and its effects on language instruction, TELL is the research of its application in education (Yeşilel, 2016). Park (2022) stated that TELL is "the use of computers as a technical innovation to show multimedia as a means of supplementing teaching [methods]" (Patel, 2014, pp.1). The primary objective of this field of study is to advance and enhance language learning by the application of various forms of technology (Golshan and Tafazoli, 2014; Hubbard, 2013; Yeşilel, 2016). The use of technology in teaching a new language is multifaceted. It has several applications, including as a teaching tool, a means of distribution, and a means of boosting efficiency (Ghanizadeh, Razavi and Jahedizadeh, 2015). Students with diverse learning styles, backgrounds, and interests can benefit greatly from the scaffolding provided by technology (Fuente, 2021). Technology Enhanced Language Learning (TELL) promotes computer-mediated communication (CMC) to improve students' linguistic competence in a targeted foreign language (Kranthi, 2017).

There are benefits and drawbacks of using TELL. The benefits of language education and learning are numerous (Carr et al., 2011; Chirimbu and Tafazoli, 2013; Patel, 2014; Yang and Chen, 2007). It caters to a wider variety of learning methods and student demands than traditional textbooks do, and it gives a far more in-depth experience overall. Through TELL, students are able to set their own learning goals, determine their own pace, and choose their own content, all of which contributes to a greater sense of freedom and autonomy. Technology-related activities become more analogous to real-world circumstances, which in turn boosts student engagement and motivation. This makes it much simpler for students to immerse themselves in the target language and culture, allowing them to widen their understanding of the world, acquire new languages, and appreciate other cultures.

There are benefits to deploying TELL, but there are also drawbacks to think about (Penado Abilleira et al., 2021; Ghory and Ghafory, 2021; Kulikowski, Przytuła and Sułkowski, 2022). Before implementing TELL in the classroom, both educators and students need a foundational understanding of technological concepts. The ability to lead students in the use of technology in language learning depends on teacher's familiarity with the usage of technology. Second, it might be difficult to work online materials into an effective language course. Third, students tend to pay more attention to the tools and resources available to them than they do to the material being taught. Therefore, the results of student's use of technology run counter to what would be desired by the educator. Finally, problems with technology might interrupt the flow of language classes. Unfortunately, digital technology is not backed up, so its use might be compromised in the event of a power outage or other emergency.

Previous studies have shown that technology creates a level playing field for students (Shomirzayev, 2021; Hermanto and Srimulyani, 2021; Fung et al., 2022). In the case of language study, for instance, online discussion threads may inspire students to share their thoughts and receive constructive criticism (Sandoval-Cruz, 2022). In a nutshell, TELL encourages both instructors and students to take an active role in the language learning process. Students of all ages have a natural curiosity and excitement for the possibilities presented by modern learning tools. Teachers of foreign languages would do well to make strategic use of such materials and to make available more realistic materials. The use of technology allows for the creation of more realistic settings for language study.

In light of the widespread adoption and enabling power of immersive technologies and the potential applications of TELL, it is imperative that the literature be continuously investigated to identify the types and tendencies of recent studies in order to understand current practises and guide future research in the field with two research questions as follow:

RQ1: What are the trends and practices of TELL in language teaching and learning?

RQ2: What are the research methodologies employed in TELL studies?

Hence this study examines TELL from a variety of perspectives, including the distribution of research themes, the range of devices, and the methodological elements of the TELL studies, and include thorough summaries and annotated references on the issue. It gives a more all-encompassing picture of TELL by additionally carefully analysing the variety of research subjects, the purpose, and the methodological elements of TELL investigations.

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3. Methodology

Methodologically, this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist, which consists of four steps (described in Figure 1): identification; screening; eligibility; and included. PRISMA's comprehensiveness and flexibility have made it a popular tool among researchers. As a result, the following describes the purpose of this research and how the systematic review will be conducted.

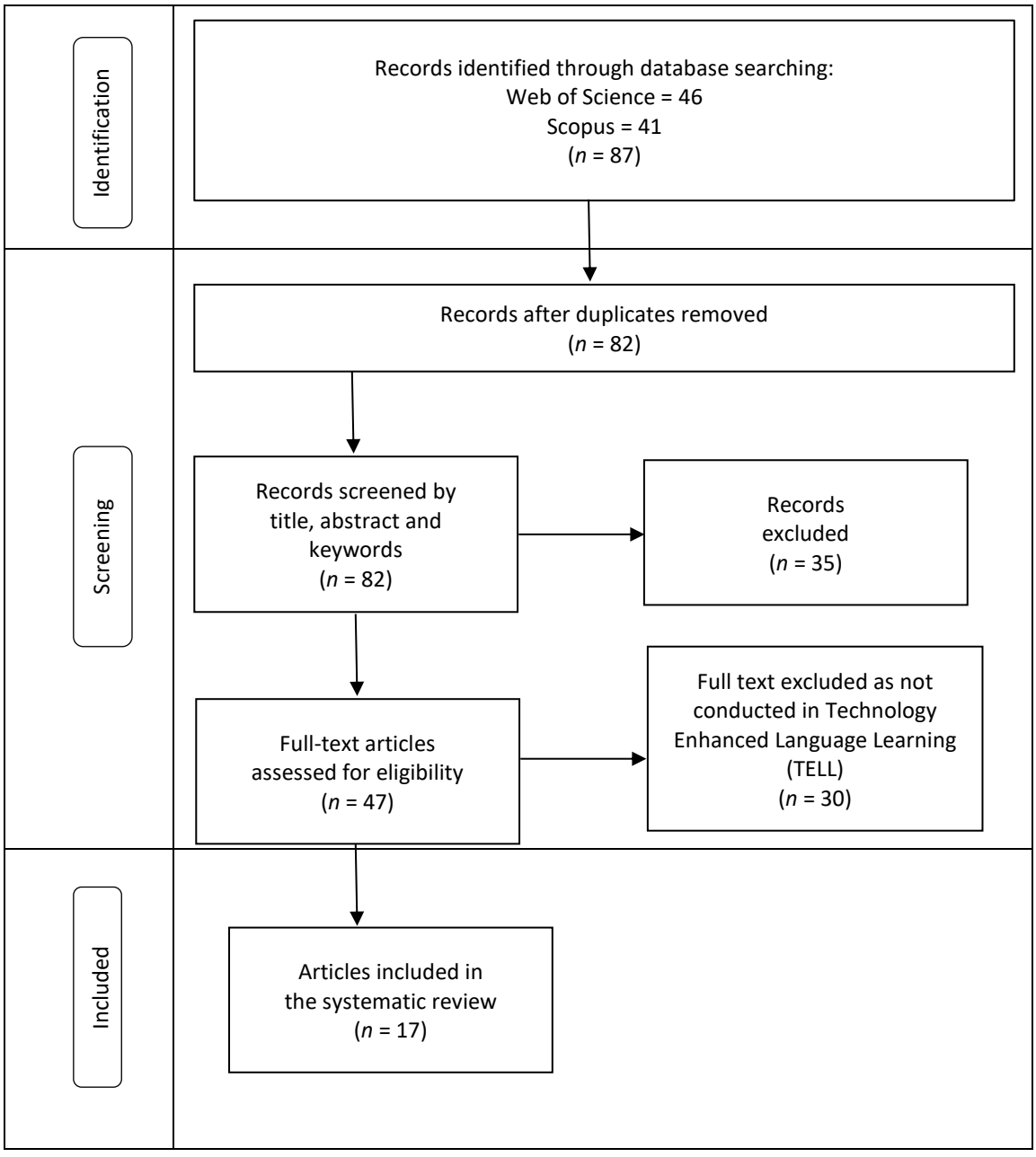

Figure 1: The PRISMA Systematic Review (Page et al., 2021).

3.1 Identification

The PRISMA guidelines outline the Identification procedure that must be followed as the first stage of any systematic review. For the purposes of this research, two databases—Web of Science (WoS) and Scopus—were selected. The review's primary phrases were developed with care to accurately capture the concepts that were to be examined. Several terms associated with TELL (Technology Enhanced Language Learning) were included. The search strings that were utilised in this research are shown in Table 1.

Table 1: Search String Used in This Study

Database	Search String
Web of Science (WoS)	TS=(("technology") AND ("enhanced") AND ("language learn*" OR "language teach*" OR "teaching language*" OR "language teaching and learning" OR "language pedagogy" OR "language teaching and learning"))
Scopus	TITLE-ABS-KEY (("technology") AND ("enhanced") AND ("language learn*" OR "language teach*" OR "teaching language*" OR "language teaching and learning" OR "language pedagogy" OR "language teaching and learning"))

*: Search String.

3.2 Screening

After articles are identified, they are screened, with the first step being the elimination of duplicates found in more than one database. After removing 5 duplicate articles from the initial screening, 82 articles remained. The titles, abstracts, and keywords of these 82 papers were examined for their relevance to the topic of "Technology-Enhanced Language Learning" (TELL). The screening approach resulted in the elimination of 35 papers that were deemed insignificant to the objectives of the study. Table 2 displays the results of the inclusion/exclusion screening applied to the remaining 47 publications.

Table 2: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies conducted between 2020 and 2022	Studies conducted before 2020
Articles from journals	Conference proceedings, review articles, book
The text was written in English	Text not written in English
Related to TELL	Not related to TELL

Inclusion in this systematic review was contingent upon the evaluation of 17 publications, which were initially screened for eligibility using predetermined inclusion and exclusion criteria. We did review, but we did not include book chapters or conference proceedings because they are not quite as complete (González-Albo and Bordons, 2011).

3.3 Included

This review of the literature centred on TELL. The included research studies are listed in Table 3. Seven articles were selected from WoS and ten from Scopus using the data in the table above. The databases were selected because of the excellent quality of the educational content they include. Each investigation zeroed emphasis on a certain facet of the TELL environment. The majority of the investigations were undertaken in academic settings, with just five studies focused on students in the classroom, and only one examined parental influence on their children's English proficiency.

Table 3: Summary of the Selected Studies

Study	Database	Study	Database
Bin-Hady and Al-Tamimi (2021)	WoS, Scopus	Marden and Herrington (2022)	Scopus
Jung (2021)	WoS, Scopus	Duong, Tran and Nguyen (2021)	Scopus
Lawrence et al. (2020)	WoS, Scopus	Poonpon (2021)	Scopus
Van der Merwe (2020)	WoS, Scopus	Kurt (2020)	Scopus
Faramarzi, Tabrizi and Chalak (2021)	WoS	Wang and Hsu (2020)	Scopus
Choi, Kang and Sheo (2020)	WoS	Halim, Hashim and Yunus (2020)	Scopus
Dalte (2021)	WoS	Syukur Saud et al. (2020)	Scopus
Park (2022)	Scopus	Pokrovska et al. (2020)	Scopus

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Study	Database	Study	Database
Mohammed (2022)	Scopus		

3.4 Data Analysis Procedure

All chosen articles were transferred to Mendeley, a citation manager. The following research problems were addressed using thematic analyses.

4. Findings and Discussion

4.1 RQ1: What are the Trends and Practices of TELL in Language Teaching and Learning?

The increasing number of articles between 2020-2022 confirms that interest in this area has been growing over the past three years especially during COVID-19 pandemic. The trends and practices of TELL in language teaching and learning were divided into six codes pertinent to RQ 1. The codes are: 1) aim 2) methodology 3) sample 4) country and 5) outcomes as shown in Table 4.

Table 4: Trends of TELL in Language Teaching and Learning

Study	Aim	Methodology	Sample	Country	Outcomes
Bin-Hady and Al-Tamimi (2021)	To explore the use of technology-based strategies develop their English as a foreign language skill in informal learning settings.	Mixed Method	Undergraduate EFL students.	Yemen	The approaches, according to the students, improved their vocabulary over grammar and pronunciation while also assisting them in the development of their speaking, listening, and reading abilities.
Jung (2021)	To explore the perceptions of post-secondary English as a Foreign Language (EFL) students on how their collaborative experiences of creating video projects influence their motivation to learn English.	Qualitative	Freshman student enrolled in a task-based EFL course.	South Korea	New knowledge about how technology-enhanced learning methods improve learner motivation in post-secondary EFL students.
Lawrence et al. (2020)	To discuss government-funded research documenting the largely undefined use of technologies in post-secondary North American English for Academic Purposes (EAP) programmes.	Mixed Method	EAP teachers and administrators.	Canada and United States	Integration of technology into EAP programmes requires a strong foundation in theory-informed techno-pedagogy.
Van der Merwe (2020)	To gather reflective feedback from an online dictionary project undertaken in a faculty of education at a university in the Western Cape.	Qualitative	Afrikaans intermediate phase students.	South Africa	The students' ability to expand their subject vocabulary in their native language improved as a result of their collaborative efforts and the usage of technology.

Study	Aim	Methodology	Sample	Country	Outcomes
Faramarzi, Tabrizi and Chalak (2021)	To investigate the major potentials and challenges of vodcasting technology in improving major language skills from EFL learners' perspectives.	Qualitative	Graduate students of Translation Studies.	Iran	Vodcasting helped people become more open-minded about other cultures and bolstered the communication quality of their conversations.
Choi, Kang and Sheo (2020)	To examine the effect of parent-child interactions and digital pen use in learning English.	Quantitative	Mothers of three-to-five year old preschool Children.	South Korea	Young children's interest in learning English was sparked when they were introduced to digital pens and encouraged to participate in regular conversations with their parents while reading English picture books.
Dalte (2021)	To present a SWOT analysis of the use of Edmodo and some other applications for the teaching and learning foreign languages for schools.	Quantitative	First grade students major in Teaching Chinese as a second language.	Ukraine	This paradigm places the learner at the centre of the classroom, allowing teachers to support an unlimited number of students while reducing the time and money spent on classroom administration.
Park (2022)	To investigate how TELL affected pre-service teachers' perceived competencies in teacher education.	Quantitative	Pre-service teachers at a medium-sized university.	Korea	Pre-service teachers benefited greatly from TELL training.
Mohammed (2022)	To present a fully online course model for teaching speaking and listening skills for students learning Arabic as a foreign language.	Quantitative	Arabic as a foreign language student in South Africa.	Africa	The methodology and framework used in this study can be adapted to a variety of settings where language is being taught.
Marden and Herrington (2022)	To examine the nature and extent of students' contributions to computer mediated communication tools provided in an online Italian as a foreign language learning environment.	Quantitative	Intermediate and advanced level students of Italian language course at.	Australia	Two distinct versions of the digital classroom have been developed, there was a significant improvement in how students used various discussion boards.
Duong, Tran and Nguyen (2021)	To unravel the employment of TELL tool based English vocabulary learning strategies (VLS)	Mixed Method	First year and second year non-English majored	Vietnam	Participants made extensive use of the English VLS based on the TELL tool.

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Study	Aim	Methodology	Sample	Country	Outcomes
	among non-English majored students.		students at Ho Chi Minh City University of Technology .		
Poonpon (2021)	To explore how self-generated online projects were integrated into an English language teaching (ELT) at a Thai university and their impact on pre-service teachers' experience during COVID-19.	Qualitative	Pre-service English language teachers who took the linguistics and language teaching course.	Thailand	The future educators of English language found that participating in online projects boosted their confidence, motivation, problem-solving abilities, and teamwork skills.
Kurt (2020)	To investigate whether the completion of technology-mediated tasks would improve young EFL learners' achievement in listening, reading and writing tests.	Quantitative	The students in Grade 4 at a private primary school are split evenly between two classrooms.	Turkey	Students in the experimental group who participated in technology-mediated tasks reported higher levels of confidence in their ability to use technology and a more favourable outlook on the medium.
Wang and Hsu (2020)	To investigate students' perceptions of using mobile-assisted language learning to learn business English.	Quantitative	Undergraduate and graduate students majoring in engineering , electrical engineering and computer science.	Taiwan	The students were enthusiastic about using the programme to improve their business English skills.
Halim, Hashim and Yunus (2020)	To examine pupils' motivation and perceptions of ESL lessons through online quiz games.	Quantitative	Pupils from a primary school.	Malaysia	The incorporation of online quiz-games into English classes was seen favourably by these students, who reported feeling more motivated and having more optimistic attitudes.
Syukur Saud et al. (2020)	To explore students' perceptions of strategies, impact, and challenges using online resources for foreign language learning.	Qualitative	Students from foreign language department in one Indonesian	Indonesia	In addition to improving their material and language knowledge, students also gained valuable experience with modern technological tools.

Study	Aim	Methodology	Sample	Country	Outcomes
			public university.		
Pokrovska et al. (2020)	To enhance the educational process and training skills of independent long term professional upgrade of students through MS Office 365 cloud services.	Quantitative	2nd and 3rd year undergraduate students from Vadym Hetman Kyiv National Economic University and the Kyiv National University of Trade and Economics.	Ukraine	To meet the challenges of today's classrooms, schools must invest in their students' ability to think logically (critically), creatively approach problems, and retain information.

4.2 RQ2: What Methodologies are Employed in TELL Studies?

There were three distinct types of research procedures employed across all 17 papers that were included in the systematic review. Most studies of language-teaching and learning trends and practises employed a quantitative research strategy. Only three studies employed a mixed research design (see Table 4). Nine quantitative investigations were conducted, with two using a quasi-experimental design and seven using a survey approach with questionnaires. The findings of this review corroborate the claims of Mohammed (2022), Choi, Kang and Sheo (2020), and Park (2022) that quantitative research methods are increasingly common among educational academics.

One possible explanation for this situation is that academics would rather use quantitative methods to investigate the rising popularity of TELL as a tool for facilitating language instruction. According to Creswell (2012) and Babbie (2020), the application of well-established computational approaches that enable research generalisations makes statistical analysis more dependable, objective, and accurate than traditional methods of data collection and interpretation. Five out of the total of seventeen studies (50%), used a qualitative approach to data collection. Case studies were employed in the research by Jung (2021), Van der Merwe (2020), and Faramarzi, Tabrizi and Chalak (2021) to investigate how TELL is being implemented in language classrooms and how it is being perceived, its impact, and the difficulties that arise from doing so.

Lack of qualitative research in TELL suggests that scholars are more interested in developing a surface-level understanding of the TELL phenomena than doing in-depth studies on the topic. The results of qualitative research are often criticised for being unreliable because of its small sample sizes, anecdotal character, lack of rigour, reliability and validity difficulties, hard to generalise, uncontrolled bias, and subjectivities (Anderson, 2010; Luo, 2011; Lenger, 2019).

Analysing qualitative data may be very difficult, iterative, complex, confusing, and time-consuming, despite the fact that it provides well-founded, detailed, and long narrations of individuals' experiences and reasonings in relation to the issues at hand (Hilal and Alabri, 2013; Miles, Huberman and Saldaña, 2018). Even with well-established qualitative data analysis software, researchers often struggle to elucidate the implicit meanings that people associate with their actions and responses to a phenomenon. This is due to the researcher's own presumptions, opinions, and personal opinions, which can be a bias to the findings (Hilal and Alabri, 2013; Erlingsson and Brysiewicz, 2017). Many researchers still shy away from qualitative research due to the external criticism and analytical difficulty associated with it, despite the fact that more qualitative research is needed in the TELL field due to the diversity, quality, and authority it can aid in the development of a more nuanced understanding of educational problems.

Of the seventeen studies completed on TELL in language education between 2020 and 2022, only three used a mixed-method technique. Three separate researchers combined questionnaires with open-ended questions or semi-structured interviews. The relevance of exploring and understanding TELL activities in language teaching

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and learning through a range of lenses is highlighted by the use of a mixed-method approach. The systematic review's findings corroborate the opinions of other researchers, who have been saying for years that mixed-method research designs are becoming more and more commonplace in the social sciences (Seyfried and Reith, 2019; Timans, Wouters and Heilbron, 2019).

By combining quantitative and qualitative approaches, researchers in the area of education hope to get a more complete understanding of their research questions and the phenomena they seek to examine than each approach could on its own (Creswell and Clark, 2017; Molina-Azorin, 2016). In addition, the mixed-method approach is laudable because it allows researchers to gain triangulated data that improves the validity and completeness of evidence supporting TELL methods in language teaching and learning (Creswell and Clark, 2017; Gibson, 2017).

5. Conclusion

This study's systematic literature review, which looked at seventeen publications published between 2020 and January 2022, provided an answer to the study's overall research question about the state of TELL research trends and practises in language education. This review's conclusions have synthesised the state of the art in TELL research on language instruction with respect to study purpose, technique, sample size, country of origin, and findings. The analysis found that research on TELL and its use in language teaching and learning is still in its preliminary phases, despite the enormous expansion and promise of technology. In order to deploy TELL across all educational levels in a way that satisfies the demands of Education 4.0, extensive research is needed to fill the gaps shown by the current review.

This study, like many studies, has its flaws, but those flaws all serve as excellent jumping-off points for more research. To begin with, the scope of this review is bounded by the journals that were consulted. The rising volume of articles in TELL makes it harder than ever to do a thorough and exhaustive search. This is why this study developed clear criteria for choosing which journals to include in our analysis. Due to their greater influence in the area, the journals included in WoS and Scopus were chosen as the sole sources for this analysis, despite the wide quality gap between them. Recent TELL studies have shown the advantages of publishing in high-impact journals, but this preference recognises the drawbacks of ignoring equally outstanding contributions published in other high-impact journals. Therefore, future research may want to examine into TELL studies in other publications, conference proceedings, project reports, and academic dissertations to better understand its development and current condition. The study is limited in its breadth because of the precision of the keywords employed, the nature of the questions posed, and the time span covered by the articles. Although the focus on 2020–2022, and diverse research questions, did ensure that the review covered almost the entire corpus of recent research in detail, an examination of articles produced within a larger date range, or of articles with different areas of research focus, would reflect even wider trends of development and changes in TELL studies over time. It is possible that future studies will give light on whether or not TELL is mostly employed as a stand-alone modality or as part of well-established courses or programmes based on great pedagogy, both of which would provide valuable insights.

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Creative Problem Solving Process Instructional Design in the Context of Blended Learning in Higher Education

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Abstract: The Creative Problem Solving (CPS) process is a conceptual model that focuses on using higher-order thinking skills in order to overcome authentic problems during learning. The CPS process offers a structured methodology to enhance every learner's solid critical, creative, and innovative thinking skill. The application of the CPS method has been growing, including its implementation in the blended learning environment in universities. However, its application still requires a strategic framework that is by the blended learning conceptual model to facilitate the CPS process. Properly organized instructional design is an important element in maintaining the success of the CPS process in blended learning to encourage and promote learner creativity to solve problems. The application of the CPS method in the context of blended learning is integrated through synchronous and asynchronous patterns facilitated by the Moodle LMS-based e-Learning facility. This research aims to produce a CPS process instructional design in a blended learning context that is valid, practical, and effective and can systematically guide instructors or lecturers in facilitating students to be skilled in critical thinking and creative thinking in problem-solving processes. This development process is based on the incorporation of ideas related to the conceptual model of blended learning with the principles of the CPS process design strategy that has been developed. Instructional design was developed by applying the Research and Development (R&D) method, which implements several stages between Analysis, Design, Development, Implementation, and Evaluation. The validity of the resulting model product was measured using a validation sheet of learning design experts, learning technology, media, materials, and linguists with the title of professor. Questionnaire responses from lecturers and students measured the product's practicality, and the product's effectiveness was measured by conducting testing of critical and creative thinking skills. The research data were analyzed using descriptive statistics to provide a quality score on the resulting instructional design. Based on the results of the study, it can be concluded that this learning design is valid, practical, and effective in improving the thinking skills of prospective teacher students. This proves that the instructional design developed has the feasibility to be used in learning, which can effectively improve the creative problem-solving process in the context of blended learning.

Keywords: Instructional design, Blended learning, Creative problem-solving process

1. Introduction

Higher-order thinking skills are very important to be developed in the learning process, especially in higher education. This is to encourage students to be able to face complex problem-solving situations in their careers. Higher-order thinking skills have been popularized for the process of achieving learning goals. One of them is as a practical solution for the problem-solving process in the learning activities of prospective teacher students. However, this thinking skill cannot be utilized optimally to influence the way of learning. Thus is due to the fact that the quality of instructional learning in higher education still prioritizes content achievement rather than choosing a problem-solving-centered learning approach as a predictive power to improve learning effectiveness (Ssemugenyi, 2022).

Under these conditions, the learning process is less in favor of the creative problem-solving process. The active role of lecturers is needed to facilitate the student learning process by providing authentic or real problems as a learning experience (Monita and Fitria, 2021). Thus, the role of creative thinking will be increasingly facilitated in the problem-solving process (Laisema and Wannapiroon, 2014). In organizing the thinking processes of student teachers who are more productive, the Creative Problem Solving (CPS) learning method can be used as a conceptual model to promote the use of thinking skills in improving students' learning in solving problems (Kashefi, Ismail and Yusof, 2012). The CPS process can help students engage in the integration of critical and creative thinking skills as well as several other metacognitive skills (Treffinger, 1995).

The application of CPS as a structured methodology for students' thinking skills has become an interesting study in this era, especially regarding its application regarding blended learning environments in universities. In the last decade, the application of blended learning in higher education institutions has been growing (Bazelais and

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Doleck, 2018). This is due to universities being at the academic levels that are most ready to implement information technology comprehensively (Prasetya *et al.*, 2020). The research results (Kashefi *et al.*, 2011; Kashefi, Ismail and Yusof, 2012; Lim and Han, 2020; Wahyuningsih *et al.*, 2020) reported that the CPS process through a blended learning context could increase active student involvement in the learning process. The results of this study illustrate that the CPS method in the context of blended learning can be a learning model that lecturers can use to promote student learning outcomes for prospective teachers.

But unfortunately, this conceptual learning model is still rarely used by lecturers in learning. Because the latest knowledge about strategic frameworks for designing blended learning that can facilitate creative problem-solving processes is still very minimal and is difficult for lecturers to build the success of the CPS process in blended learning events appropriately. In addition to that, in learning that involves technology, the attention of lecturers is often focused only on the implementation of the technology, while the contribution of the instructional model is less concerned about its function. In this regard, good instructional design is an important element in supporting the implementation of the CPS process in the context of blended learning as instructional design can produce methods that help instructors determine the best way to teach content to students both in practical and contextual conditions (Reigeluth and An, 2021). This is in line with (Kilbane and Milman, 2014), who states that instructional design is a special method that contributes to facilitating learning.

Thus, the main objective of this study is how to develop and produce the stages (syntax) of the CPS process in the context of blended learning in accordance with the context of learning for prospective teacher students, the expected learning context framework is that it can affect the high-level thinking skills of prospective teacher students such as critical and creative thinking in the problem-solving process. Critical thinking ability is a systematic and directed skill in forming and building trust to carry out activities in an organized manner (Sholikh, Sulisworo and Maruto, 2019). Meanwhile, according to (Zhuang *et al.*, 2021), the ability to think creatively is a feature of cognition in humans, which makes it possible to generate useful new ideas. The use of these two thinking skills can encourage students to be able to face problem-solving situations that are in accordance with their world of work.

Based on the description above, critical and creative thinking skills are needed by prospective teacher students to be able to face various and complex problems in the future, especially to respond to the world of work and changes in the growing educational transformation. However, this thinking ability has yet to be considered and appropriately facilitated in learning activities. Therefore, this study offers the CPS learning method in the context of blended learning as a conceptual model to improve critical and creative thinking skills in prospective teacher students. So, investigations related to these two thinking abilities need to be investigated further. Thus, the ability to think critically and creatively becomes the target of the results of developing the instructional design. The resulting learning design products can provide useful guidance for lecturers in implementing creative problem-solving processes in mixed learning contexts.

In achieving this learning context, (Lim, Park and Hong, 2010) recommend the basic principles of developing CPS process instructional design in a blended learning environment, namely; 1) the environment in which learning occurs, including the classroom environment (onsite) and virtual environment (online), 2) the learning instruction process, and 3) the components of the CPS process. Based on this principle, the blended learning approach functions as an environment that creates learning that integrates various learning resources and appropriate activities (Littlejohn and Pegler, 2007). Meanwhile, the instruction process and the components of the CPS process act as an integrated form of learning resources and activities to create a learning experience for students. Thus, the blended learning environment becomes an important determinant for shaping the CPS process. Therefore, selecting the right blended learning conceptual model can help students' learning process (Fazal, Panzano and Luk, 2020).

The application of blended learning does not only combine face-to-face (offline) with online learning but requires the most appropriate combination (Chaeruman, Wibawa and Syahrial, 2020). This mix can be managed well by deeply understanding the conceptual model and practice of effective blended learning settings. Recommendations for blended learning arrangements can be seen from the perspective of space and time (synchronicity) (Chaeruman, Wibawa and Syahrial, 2018) as well as from the source of the learning process in formal or informal conditions and individually or collaboratively (Ulfa, Surahman and Octaviani, 2020). This blended learning conceptual model aims to form a stronger community to interact, discuss, and share ideas and can stimulate the speed of independent learning of students both synchronously and asynchronously (Lin and Gao, 2020). A blended learning environment must facilitate involvement and experience and encourage student participation in learning (Armellini, Teixeira Antunes and Howe, 2021). According to (Fatawi *et al.*, 2020),

engagement is one of the indicators of the success of blended learning. Meanwhile, the level of student involvement can be measured from the aspect of participation during the learning process (Hui *et al.*, 2019). Blended learning designs that are planned and facilitated by technology appropriately can change students' attitudes, behavior, and learning outcomes (Hung, Tan and Koh, 2006). On the other hand, when the blended learning environment is not managed properly, it does not guarantee the realization of the level of satisfaction for students (Taghizadeh and Hajhosseini, 2021).

Thus, the CPS process in the context of blended learning should have an instructional design that is properly organized as a guide to help the learning process for prospective teacher students. Responding to this, this research focuses on developing blended learning instructional designs from the point of view of synchronicity patterns to be able to facilitate students' higher-order thinking processes in the problem-solving process.

2. Literature Review

2.1 Blended Learning

Blended learning, in a more specific sense, combines synchronous learning strategies and asynchronous learning (Khan, 2005). The two combinations create class-based synchronous communicative activities and asynchronous communicative activities supported by conventional technology (Littlejohn and Pegler, 2007). In essence, blended learning requires the right activities to integrate synchronous and asynchronous components (Garrison and Vaughan, 2008). So, the most appropriate combination is needed in order to influence the optimal learning experience (Chaeruman, Wibawa and Syahrial, 2020). This combination can be based on the source of the learning process in formal or informal conditions, in the classroom or outside the classroom, individually or socially, digital and non-digital media, as well as the physical or virtual environment (Ulfa, Surahman and Octaviani, 2020). This is in line with (Cubric, 2007), who states that a learning activity can be developed in the classroom ("face to face") or outside the classroom ("online"), and individually or in groups.

Formal and informal learning processes are interesting learning conditions to be applied in today's digital era. Because according to (Mills, Knezek and Khaddage, 2014), formal learning is a learning activity that occurs in the classroom, but access to learning technology causes a shift in learning outside the classroom as an informal condition. (Furlong and Davies, 2012), state that the use of ICT can create informal learning practices. So this shift supports the semiotic relationship between formal and informal learning (Lai, Khaddage and Knezek, 2013) because what is learned outside the classroom can support the learning process in the classroom and vice versa. According to (Allen, 2007), informal learning can complement or assist more formal efforts.

In addition to formal and informal learning processes, blended learning environments can consider a combination of individual learning processes and collaborative learning (social learning). Individual learning can occur in one individual who can change some of the features learned based on his own experience, whereas social learning requires more individuals to change the features that one person can learn based on the experiences of others (Heinerman, Rango and Eiben, 2015). According to (Lin, Huang and Ko, 2020), social learning is an activity in order to acquire new concepts and strategies through interaction with more knowledgeable individuals, and then the individual applies what is learned to other contexts. This process can occur through software-based media interaction to support learning (Tavangarian *et al.*, 2004). Blended learning is a medium that provides comfortable learning through team collaboration activities (Lin, Huang and Ko, 2020) to be skilled in problem-solving (Lin *et al.*, 2018). This condition can occur in social contexts such as online discussions to find references and work ideas to be produced (Cheng and Chau, 2014; Hui *et al.*, 2019).

Thus, the learning process in formal and informal conditions and individual and social conditions can form a blend of learning events in a blended learning environment. Moreover, offer complementary learning experiences in a digital environment (Ubah, Spangenberg and Ramdhany, 2020). Referring to this concept, the researcher defines the blended learning model as a synchronicity learning strategy that combines various learning conditions. The conceptual structure of this blended learning model can be explained in Figure 1.

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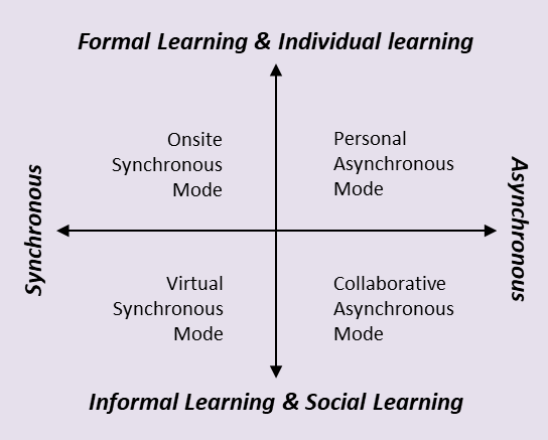

Figure 1: Conceptual Framework of Blended Learning Model

The conceptual framework of the blended learning model above forms a synchronicity pattern that places two groups of categories in the learning process, namely formal and individual conditions with informal and social conditions (Ulfa, Surahman and Octaviani, 2020). Both are in one context, which is presented through a blended learning setting blended (Chaeruman, Wibawa and Syahrial, 2020) which is modified through synchronous and asynchronous modes. As for the arrangement of the blended learning model, it can be divided into four subcategories of synchronicity patterns as follows.

- Onsite Synchronous Mode (OSM); is learning in a place that applies a formal situation in the classroom conditions between teachers and students who must be physically present. According to (Adarkwah, 2021), onsite learning occurs in school buildings with a teacher-centered teaching mode (providing comments) and student-centered (listening, taking notes, and also asking questions). Such learning conditions occur in direct synchrony between those who learn and teach at the same place and time (Chaeruman, Wibawa and Syahrial, 2018).
- Personal Asynchronous Mode (PAM); is individualized learning that allows students to learn at their own pace through online instructor direction. These learning events occur anytime and anywhere independently under their own pace and control (self-directed learning) (Chaeruman, Wibawa and Syahrial, 2020).
- Virtual Synchronous Mode (VSM); is a learning activity that occurs informally outside the classroom and simultaneously. This learning activity can occur through virtual meeting tools such as Google Meet or Zoom Cloud meetings. This mode of learning occurs in virtual synchrony at the same time but in different places (Chaeruman, Wibawa and Syahrial, 2020).
- Collaborative Asynchronous Mode (CAM); is a learning activity that applies social interaction through online learning technology. The learning experience that occurs in this mode directs the learner and learning resources to interact at any time or place and with anyone (Chaeruman, Wibawa and Syahrial, 2018).

2.2 Characteristics of *Creative Problem Solving* (CPS)

The initial idea of creative problem solving (CPS) was first initiated by (Osborn, 1953) with three main procedures: fact-finding, idea discovery, and finding solutions. CPS underwent several changes in its development, one of which was proposed by (Treffinger, Isaksen and Dorval, 2010). CPS Version 6.1™ includes a management component consisting of two stages: assessing tasks and designing processes. Assessing a task is the stage of guiding individuals or groups in examining sources, content, context, and methods to assess the suitability of the CPS for a particular task. While designing the process is the stage when CPS is considered the right choice, it then guides the selection of certain components, stages, and tools to be applied in the CPS process (Treffinger; and Isaksen;, 2013). The two stages act as an operational system for implementing the three components of the CPS process (understanding challenges, generating ideas, and preparing for action) and the six stages of implementing the CPS process, namely building opportunities, exploring data, and framing problems, generating ideas, developing solutions, and building acceptance.

The purpose of CPS is to enable students to face challenges in real life (Hajiyakhchali, 2013), which is supported by divergent and convergent thinking skills to find creative solutions (Lim and Han, 2020). The implementation of this model illustrates flexibility and creativity, which tend to function in a more cyclical pattern (Wood and

Bilsborow, 2014). This means that CPS has a gradual problem-solving pattern with the help of a systematic framework (Kapoor, Bansal and Jain, 2020). The systemic pattern (Kajzer Mitchell and Walinga, 2017) proposes that CPS can be combined with holistic problem framing and unlocks the quality of problem-solving through insight into finding solutions that are more effective. Therefore, the role of a systemic approach to CPS allows individuals or groups to recognize and act on opportunities, respond to challenges, balance creative and critical thinking, build collaboration and teamwork, and overcome problems (Treffinger and Isaksen, 2005).

2.3 Instructional Design of CPS Learning Methods in the Context of Blended Learning

Designing an effective CPS process in a blended learning context requires organized and systematic planning. According to (Kuo, Chen and Hwang, 2014), learning strategies and problem-solving instruction strategies are important issues that can be considered for designing learning performance in a digital environment. In addition, the intended strategy must be able to meet the principles of implementing the CPS process as proposed (Lim, Park and Hong, 2010), namely, the environment in which learning occurs, the learning instruction process, and the components of the CPS method.

2.3.1 Learning environment

In this study, the blended learning environment is the center of the occurrence of learning events from the point of view of the synchronous learning process. The principle of this learning refers to the alignment of indicators that affect the CPS process in the context of blended learning (Sophonhiranrak, Suwannatthachote and Ngudgratoke, 2015) with a modification of the conceptual model of blended learning synchronicity patterns (Chaeruman, Wibawa and Syahrial, 2018), which can be explained in table 1 below.

Table 1: Learning Activities in a Blended Learning Environment (Synchronicity)

Blended learning indicators for the CPS process	Blended Learning Strategy			
	Formal Learning & Individual learning		Informal Learning & Social Learning	
	OSM	PAM	VSM	CAM
Learning activities	Lectures Discussions Practice Workshops Seminars Lab practices Individual or group projects	Reading Watching (Video, webcast) Listening (audio, audio cast) Online studies Simulations or practice Exercises Roleplay Tests Journal publications	Virtual classes Audio conferences Video conferencing Web-based seminars (webinars)	Participation in discussions via online discussion forums Doing individual or group assignments through online assignments Individual or group publications
Learning resources	-	Texts Audio Visual Video Animations Simulations	Virtual Conference Zoom cloud meeting Google meeting Webex meeting	-
Feedback	Live sync face to face in class	Peer feedback via audio, Video, or text	In real-time via video call or video conference	Online discussion forum
interaction	Learning at the same time and location	Learn anytime, anywhere, about anything, without anyone	Learn at the same time but in different places	Learn anytime, anywhere, about anything, with anyone

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Blended learning indicators for the CPS process	Blended Learning Strategy			
	Formal Learning & Individual learning		Informal Learning & Social Learning	
	OSM	PAM	VSM	CAM
Evaluations	Individual or group project	Online tests	Virtual presentations and seminars	Online assignments

2.3.2 Learning instruction process

The CPS method instruction process in the context of blended learning can be developed with four stages recommended by (Lim and Han, 2020), namely: a) Course preparation, b) Preparation of CPS activities, c) CPS implementation, and d) Evaluation. In this study, one of the instructional processes is added, namely the activity of deepening the material. This stage is intended to provide reinforcement of the basic concepts of the study material before students perform the creative problem-solving process.

2.3.3 CPS process components

This stage contains three main phases: understanding the problem, generating ideas, and preparing for action (Treffinger, Isaksen and Dorval, 2010). The implementation process of the three phases can be described in Figure 2 below.

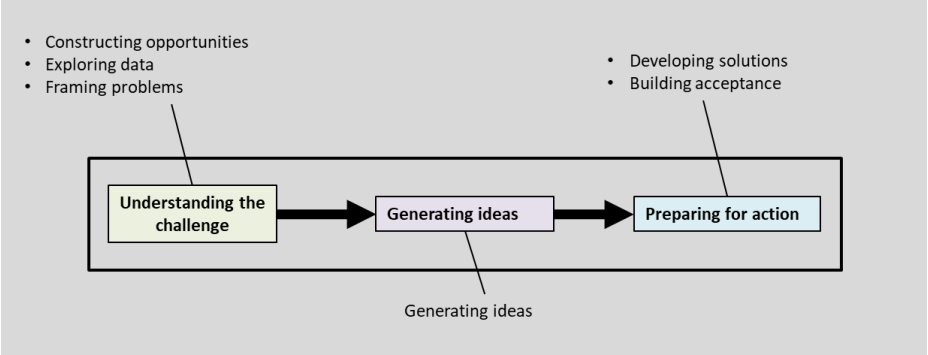

Figure 2: Stages of Implementing the Creative Problem-Solving Process

Of the three phases, (Lim and Han, 2020) outline the six steps of CPS: a) Building opportunities; identifying broad goals, challenges and opportunities; setting a direction for problem-solving; and focusing on possible opportunities and challenges. b) Explore the data, scrutinize the task carefully, and decide on the main focus of the CPS. c) Framing the problem; develop various problem statements and select specific problem statements. d) Generating ideas; generating new and diverse ideas related to the problem statement. e) Developing solutions; turning ideas into potential solutions. f) Build acceptance; explore potential solutions, and identify their supports and barriers to find workable solutions.

3. Methods

3.1 Research Design

This research is a Research and Development (R&D) which aims to produce a CPS process instructional design in a blended learning context that is valid, practical, and effective in learning strategy courses. This development research procedure refers to the ADDIE development model, which includes the Analysis, Design, Development, Implementation, and Evaluation stages. This model was considered in order to develop a learning model that is accurate, effective, efficient, and useful in developing learning for lecturers.

3.2 Research Sample

The population in this study were 6th-semester students of the Biology Education Study Program, Faculty of Mathematics and Natural Sciences, State University of Gorontalo, consisting of 64 students in learning strategies. The sample in this study was 30 students. The sampling technique used in this study was randomized sampling for limited product testing.

3.3 Data Collection Techniques and Instruments

Data collection techniques were used in this study, using instruments in the form of validation assessment sheets, product practicality assessment questionnaires, and effectiveness tests. The validation assessment sheet was used to obtain product validity data according to experts with the title of professor. The experts who validated this learning design were three validators with expertise in instructional design and learning technology experts. As for the other three experts, they were media experts, material experts, and linguists. The type of instrument used to validate the instructional design was an instrument with closed questions in the form of a 5-point Likert Scale which is based on the adaptation of a comprehensive rubric (Debattista, 2018) and (Perris and Mohee, 2020) as well as the CPS process design strategy in a blended learning environment (Lim and Han, 2020) and recommended design principles for CPS support systems by oleh (Lim, Lim and Hong, 2013). Meanwhile, the open-ended question instrument was used to explore information sourced from suggestions and input from experts regarding the design product being developed.

In a limited trial, practicality questionnaire sheets were used to obtain product practicality data according to user responses from lecturers and students. Tests of critical thinking and creative thinking were used to obtain data on the product's effectiveness in improving prospective teacher students' thinking skills. The indicators used to test the critical thinking skills of prospective teacher students adapt the critical thinking aspects proposed by (Ennis, 1989). Meanwhile, the indicators for the creative thinking ability test were adapted from (Treffinger *et al.*, 2002). All instruments were deemed valid and reliable before use.

3.4 Data Analysis Techniques

The data was collected in the form of quantitative data and analyzed descriptively, equipped with triangulation of methods and data sources. The resulting product validity data were analyzed and adjusted to the validity category based on the decision-making criteria using the conversion of score scores on a 5-point scale of the Likert Scale (from 1 = very poor and 5 = very good) (Widoyoko, 2013) as presented in table 2 below.

Table 2: Conversion of Five Actual Scale Scores

Score		Category
Formula	**Average**	
$X > \bar{X}_i + 1.8sd_i$	X > 4.2	Very good
$\bar{X}_i + 0.6sd_i < X \leq \bar{X}_i + 1.8sd_i$	3.4 < X ≤ 4.2	Good
$\bar{X}_i - 0.6sd_i < X \leq \bar{X}_i + 0.6sd_i$	2.6 < X ≤ 3.4	Satisfactory
$\bar{X}_i - 1.8sd_i < X \leq \bar{X}_i - 0.6sd_i$	1.8 < X ≤ 2.6	Not enough
$X > \bar{X}_i - 1.8sd_i$	X ≤ 1.8	Very poor

Where:

$\bar{X}_i$ (The mean ideal) = 1/2 (maximum score + minimum score)

sd_i (Standard deviation ideal) = 1/6 (maximum score - minimum score)

Maximum score = 5

Minimum score = 1

X = Actual Score

$\bar{X}_i$ = 1/2 (5+1) = 3

sb_i = 1/6 (5-1) = 0.67

The product's practicality is in the form of questionnaire data from lecturers and students who were analyzed quantitatively (percentage). The analysis to calculate the percentage of positive responses from lecturers and students was adapted from (Arikunto, 2010), which is very practical (84%-100%), practical (68%-83%), quite practical (52%-67%), less practical (36%-51%), and impractical (less than 35%). The instructional design of the CPS process in the context of blended learning can be declared practical if the responses of lecturers and students reach a minimum of 68% or are in the practical category. The product's effectiveness was analyzed by

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quantitative descriptive analysis using the N-gain test. The test results were then interpreted using a modified Normalized Gain index criterion (Hake, 1998) which is presented in Table 3 below.

Table 3: N-Gain Index Criteria

Normalized Gain Index	Classification/Category
g > 70	High / Very Effective
30 < g > 70	Moderate / Effective
g < 30	Low / Less Effective

The final conclusion of product feasibility was determined by using the criteria for the level of validity, practicality, and effectiveness adapted from (Akbar, 2013) in Table 4.

Table 4: Product Eligibility Criteria

No.	Achievement Criteria	Eligibility Level
1	81% - 100%	very valid, very practical, very effective, feasible to use without improvement
2	61% - 80%	quite valid, quite practical, quite effective, feasible to use but needs a little improvement
3	41% - 60%	less valid, less practical, less effective, needs major improvement, not feasible to use
4	21% - 40%	invalid, impractical, ineffective, should not be used
5	0% - 20%	very invalid, very impractical, very ineffective, absolutely not allowed

4. Results

4.1 Pre-Analysis

4.1.1 Characteristics analysis

Prospective teacher students in the Biology Education Study Program at the State University of Gorontalo have learning characteristics that have been facilitated by technology such as smartphones and PCs or laptops. Through this technology, students feel the ease of learning, including getting various learning information that suits their needs. Based on the results of initial observations, it is known that students' experiences, learning styles, learning preferences, and learning behaviors are highly dependent on learning activities that utilize computer-based digital media, such as interactive tools and interacting with others. Regarding the aspect of the maturity level of thinking, student teacher candidates are more fun in the form of personal activities to access and interact with widely available learning resources and are motivated in the form of collaborative social interaction activities. From this initial information, describing the source of the learning process among student teacher candidates, it was found that there really is a need for a more varied learning space, not only in formal study rooms and not individually.

4.1.2 Analysis of learning objects

The curriculum studies carried out focused on the objectives and characteristics of the learning content of the learning strategy courses in the Biology Education Study Program. The expected learning objectives are generally regarding the mastery of educational and academic competencies in the field of study and the ability to connect teaching and learning concepts. In particular, the learning strategy course has learning objectives to be able to understand, know, appreciate, animate, and have the ability to develop constructivism knowledge, problem-solving abilities, and skills, as well as critical thinking and creative thinking skills for their profession.

With such learning objectives, the ability of high creativity becomes the main goal for every student-teacher candidate because student-teacher candidates will be encouraged to be able to overcome practical problems in the real world by using higher-order thinking skills so, the ability of Creative Problem Solving (CPS) can be used as a method to influence students to use thinking skills in improving their way of learning.

4.1.3 Analysis of the blended learning environment

This analysis looked at the opportunities and constraints for teacher candidates implementing a student learning environment. The results of the initial analysis found that the depth of material that students must achieve had a wide scope with conceptual, procedural, and theoretical structures, as well as learning characteristics that focus on problem-solving abilities that are discovered. This consideration, of course, requires the provision of a more dynamic time to adjust learning activities. The time allotted for each course is equivalent to 170 minutes per credit each week. Thus the time is certainly not enough to be able to meet the expected learning achievements. Thus, to support the implementation of maximum learning, the State University of Gorontalo provides an infrastructure of e-learning facilities for learning in a Moodle-based LMS network. This infrastructure can provide convenience for lecturers and prospective teacher students to facilitate learning and teaching activities both synchronously and asynchronously. The use of e-learning media can facilitate the delivery and management of learning that is easier to support learning achievement. Thus, both lecturers and prospective teachers have good abilities to use e-learning media as a blended learning environment.

4.2 Design

This stage is the process of overcoming the problems encountered based on the results of the analysis that was conducted by designing a learning scenario. Activities in this process focus on developing the CPS process's learning syntax in the context of blended learning. The form of the learning steps can be explained in Figure 3 below.

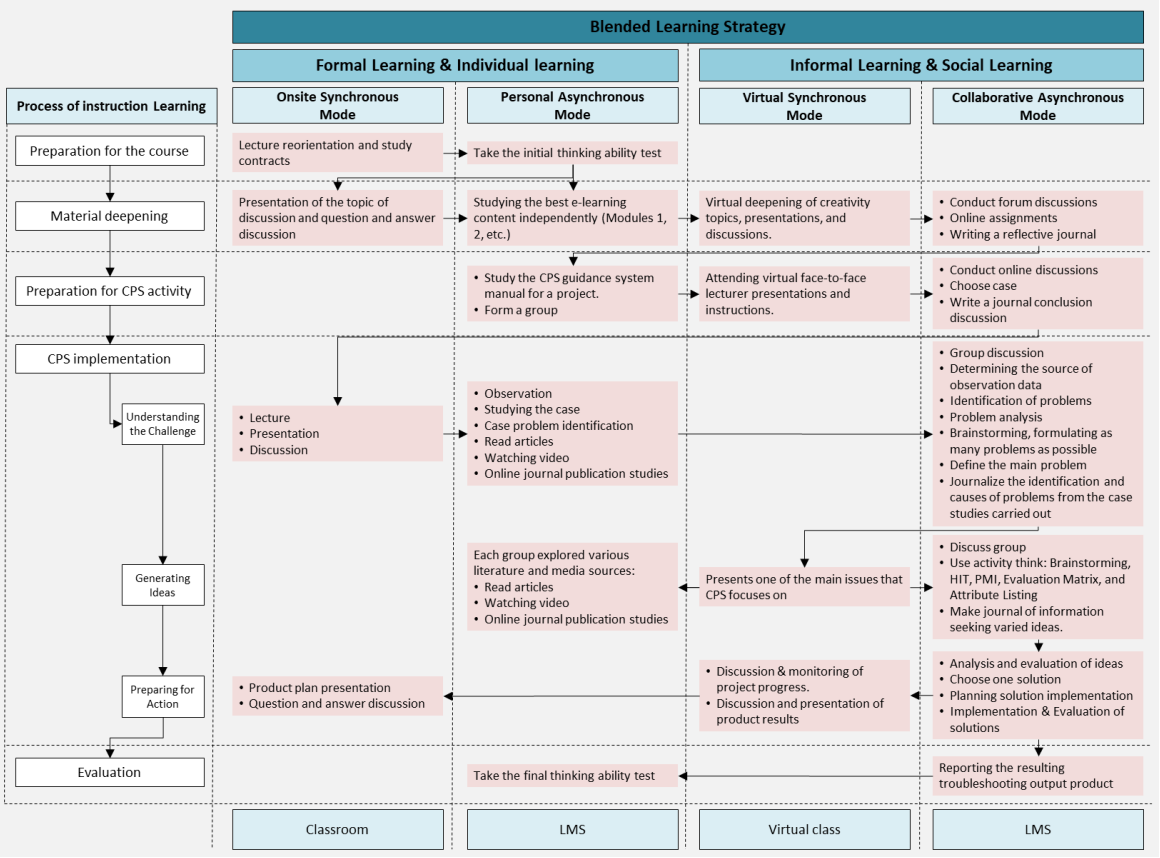

Figure 3: Design of the CPS Process Instructional Model in the Context of Blended Learning

This learning syntax can be started from;

- Preparation for early learning. Lecturers apply creative learning by introducing the study topic and explaining the focus of project problems to the team.
- The process of deepening the material. Students will study and explore the best material that has been presented by the lecturer through e-learning content independently.
- Preparation of CPS activities. Focuses on organizing the learning team and delivering the CPS process support system.

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- Implementation of CPS. Students work on team projects by utilizing the CPS process stage (understanding problems, generating ideas, and preparing actions) supported by divergent and convergent thinking tools available in the Moodle-based e-learning system.
- Evaluation activities. Directing students to present the results of team projects and evaluated by lecturers and colleagues as a form of participation.

4.3 Development

The product produced in this development is the syntax of the CPS learning method in the context of blended learning and e-learning for Moodle-based learning strategy courses that can be accessed via https://spada.ung.ac.id/. The e-learning class feature in this course provides 16 blended meetings. Each week of learning is equipped with learning resources and learning activities that provide 120 minutes for independent study and 120 minutes for collaboratively structured assignments.

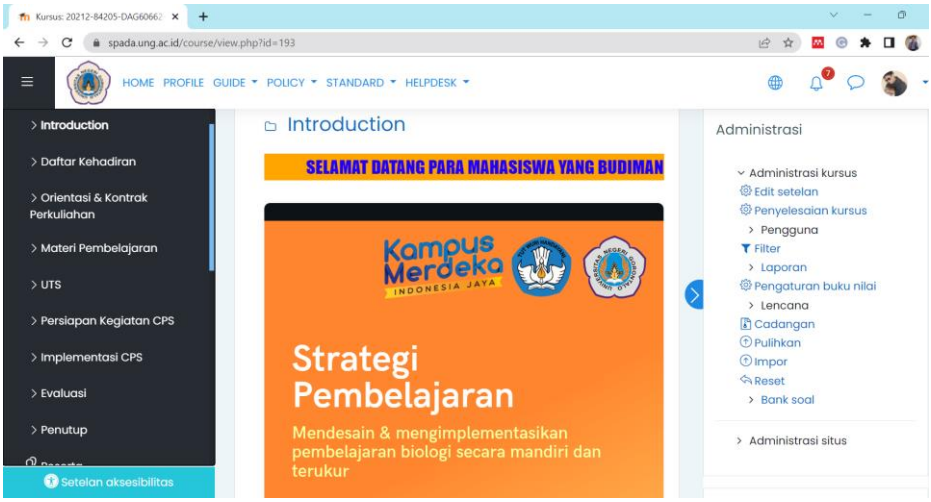

Figure 4: Integration of Learning Strategy Courses Into the Moodle Platform

Experts then validate the products that have been developed by reviewing the criteria for the resulting product indicators. The results of the assessment can be presented in table 5 below.

Table 5: The Results of the Validation of the CPS Process Instructional Design in the Context of Blended Learning

No.	Aspects assessed	Score			Average	Category
		Validator 1	Validator 2	Validator 3		
1	Instructional design	5.00	4.50	4.75	4.75	Very good
2	Learning structure	4.00	4.00	4.50	4.17	Good
3	Learning preparation	4.80	4.20	4.60	4.53	Very Good
4	Learning process	4.78	4.78	4.56	4.70	Very good
5	Learning assessment	4.67	4.50	4.67	4.61	Very good
6	Communication and interaction	4.90	4.60	4.70	4.73	Very good
7	Sources of instructional materials	4.57	4.29	4.86	4.57	Very good
8	Technology design	4.83	4.50	4.67	4.67	Very Good
9	Learning closure	4.00	4.67	4.67	4.44	Very good
Overall average					**4.58**	**Very Good**

Table 5 shows that the average value of the overall assessment aspect is 4.58, which is categorized as "Very Good". Thus the instructional design that has been developed is declared valid and can be implemented in the practicality test stage.

4.4 Implementation

This phase includes product practicality tests which are implemented through Moodle-based e-learning. The questionnaire consisted of responses from 3 lecturers who are lecturers of learning strategy courses and 30 students. The following are the results of practicality tests assessed by lecturers, which can be seen in table 6 below.

Table 6: Results of Lecturer User Responses

No.	Aspects assessed	Average	Category
1	Instructional design	95	Very practical
2	Learning structure	80	Practical
3	Learning preparation	92	Very practical
4	Learning process	87.41	Very practical
5	Learning assessment	85.56	Very practical
6	Communication and interaction	86.67	Very practical
7	Sources of instructional materials	88.57	Very practical
8	Technology design	87.78	Very practical
9	Learning closure	86.67	Very practical
10	Language appropriateness	93.33	Very practical
Overall average		**88.30**	**Very practical**

The results of student assessments of the practicality of product application in the lecture process can be seen in table 7 below.

Table 7: Student User Response Results

No.	Aspects assessed	Average	Category
1	Attractive learning environment	87.11	Very practical
2	Learning experience	82.67	Practical
3	Learning activities	82.89	Practical
4	Learning process	85.56	Very practical
5	Material relevance	89.56	Very practical
6	Language eligibility	89	Very practical
Overall average		**86.13**	**Very practical**

The results of user and student responses show that instructional design products implemented through Moodle-based e-learning facilities are very practical and do not need to be revised.

4.5 Evaluation

This stage is a limited testing process of the product that has been developed. The N-gain test measures the effectiveness of the product. The test instrument is an essay test of critical and creative thinking skills. The test results can be seen in Figure 5.

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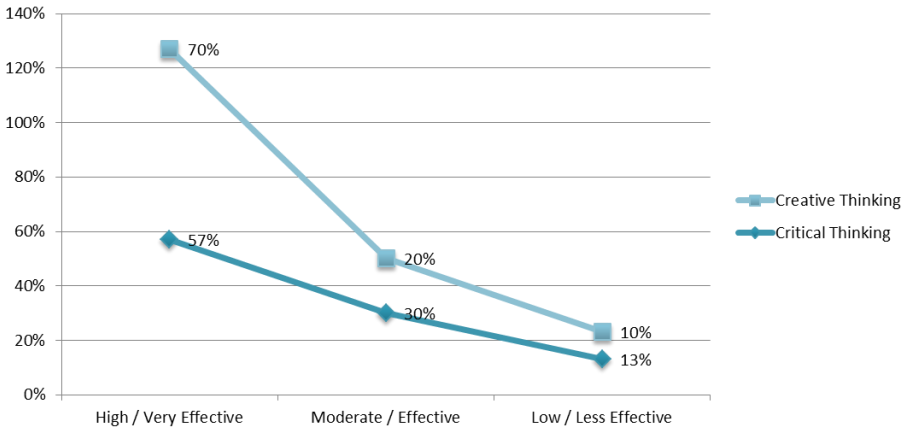

Figure 5: Diagram of N-Gain Test Results for Critical and Creative Thinking Skills

The N-gain value of the product's success is very effective; it can improve critical thinking skills by 71.20% and creative thinking by 72.04%. This success can be seen in Figure 6.

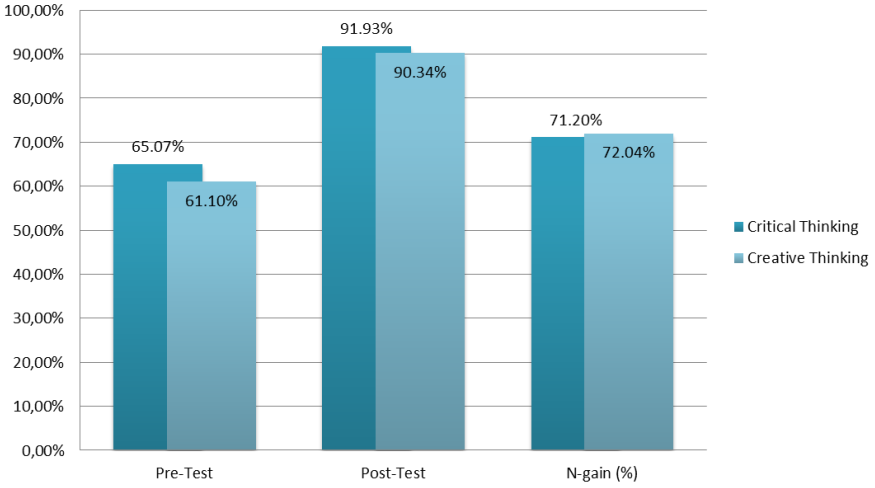

Figure 6: Diagram of the Average Product Effectiveness Test Results

In order to ensure the level of product feasibility, the researchers then carried out a Focus Group Discussion (FGD) activity which reviewed the results of the product tests that had been carried out. This activity involved media, materials, and language experts to complete the product assessment process. The results of the assessment can be seen in table 8.

Table 8: The Results of the Assessment of Media, Material, and Linguistic Experts

No.	Aspects assessed	Average Score	Category
A	Aspects of e-learning media		
1	Have a design interface display interesting to use.	3	Enough
2	Navigation on e-learning media is quite simple, easy, and very conducive.	3	Enough
3	The e-learning media provides a two-way interaction process, namely synchronous and asynchronous.	5	Very good
4	The e-learning media used can facilitate multi-way interactions.	4	Good
5	E-learning media provides various learning resources such as; audio, Video, text, graphic representations of the subject matter, etc.	4	Good

No.	Aspects assessed	Average Score	Category
6	The e-learning media used can promote the engagement of creative problem-solving process learners.	5	Very good
7	The e-learning media used can support a learner-centered learning approach.	3	Enough
8	Learners get clear and detailed instructions intuitively regarding the ease of use of e-learning media.	5	Very good
9	The e-learning media can be accessed through various software platforms, browsers, and computing devices.	5	Very good
10	The use of online e-learning media systems in learning provides time efficiency.	4	Good
Average		4.18	Good
B	Material aspect		
1	The material is given coherently.	5	Very good
2	The suitability of the material with the expected final achievement.	4	Good
3	The material is free from conceptual errors.	3	Enough
4	Clarity of presentation of material.	5	Very good
5	The material presented is easy to understand coverage.	4	Good
6	The course content is accurate, contextual and contemporary, and relevant to the needs of the professional world of work.	4	Good
6	The presentation of the material is more practical and can be studied repeatedly.	4	Good
Average		4.14	Good
C	Language aspect		
1	The language description is straightforward, easy to understand, and simple.	3	Enough
2	Instructions/descriptions of the description of learning materials using communicative language.	5	Very good
3	The suitability of using clear and precise sentences in communication with students.	5	Very good
Average		4.33	Very good

Based on the results of the tests that have been carried out, it can be recommended that the level of feasibility of learning to design products is described in Figure 7 below**.**

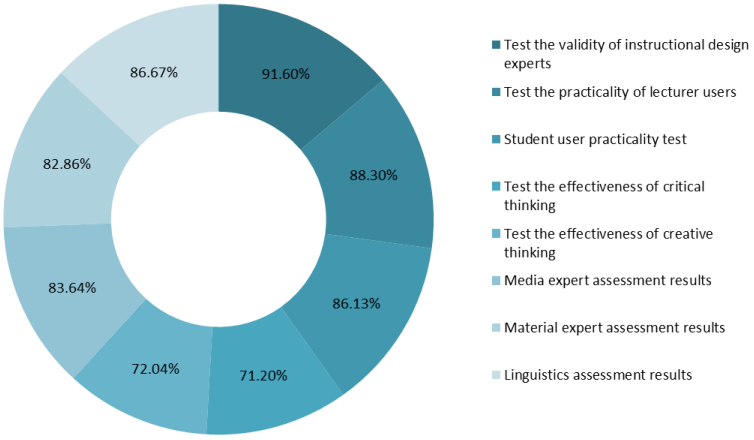

Figure 7: Recapitulation Diagram of Product Feasibility Test Results

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Based on the table above, it is known that the product developed has an average product feasibility value of 81.85%, which means that the resulting product is very valid, very practical, very effective, and feasible to use without repair. In addition, the results of expert assessments in FGD activities have ensured that the products produced are more suitable for implementation in the lecture process, with several recommendations for improving the product. The suggestion is that in the implementation of the learning design that is produced, it must be obeyed according to the design and attention must be paid to the learning structure of students so that it is not excessive.

5. Discussion

This study suggests an appropriate CPS process learning syntax to be applied to blended learning. The resulting learning syntax has the flexibility to be presented in a Moodle-based e-learning manner through various software platforms, browsers, and computing devices.

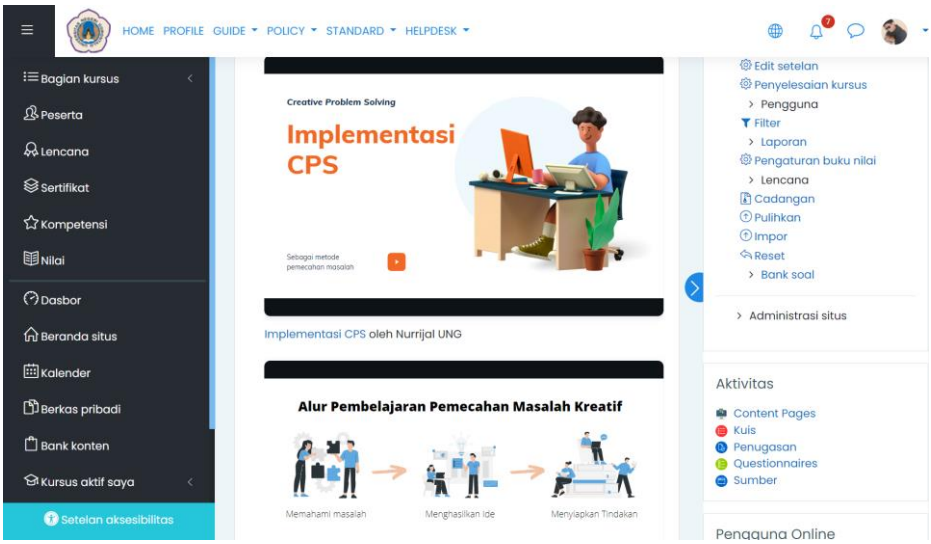

Figure 8: Integration of the CPS Process Into the Moodle Platform

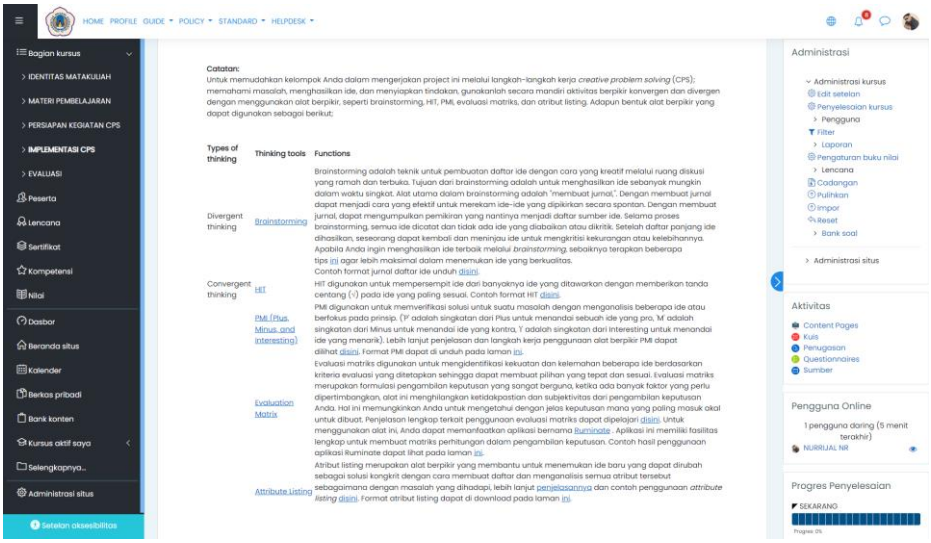

Figure 9: Online Support in the Form of Divergent and Convergent Thinking Tools

During the CPS process, e-learning facilities provide online support features in the form of divergent and convergent thinking tools. These thinking tools include; brainstorming, HIT, PMI, evaluation matrix, and attribute listing. This feature makes it easier for students to work on problem-solving projects and can balance divergent and convergent thinking throughout the CPS process.

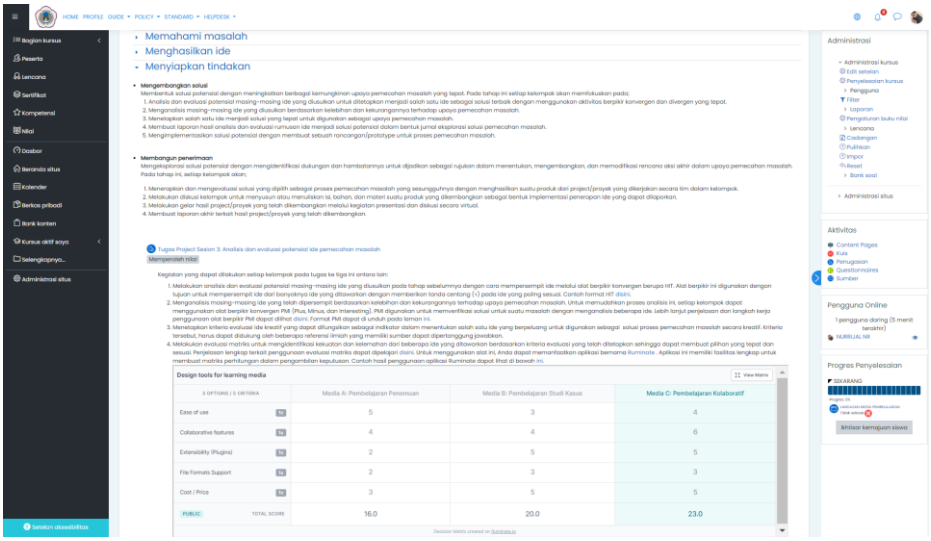

Figure 10: Examples of the Implementation of Online Thinking Tools

In addition, e-learning facilities have facilities that can present a combination of text, images, videos, and animations, as learning resources and various activities such as quizzes, chats, assignments, and discussion forums that can motivate students to be more active. This facility can support innovative learning anytime and anywhere that can be accessed and studied repeatedly.

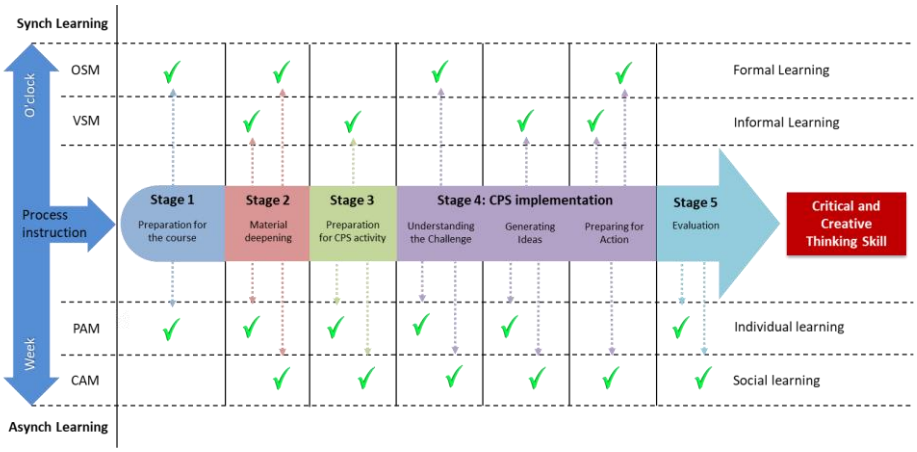

Figure 11: The Process of Implementing the CPS Method in the Context of Blended Learning

The conceptual model of blended learning built in this study offers a pattern of synchronicity as a learning environment for prospective teacher students. This conceptual form has explained the important elements of blended learning (Carman, 2002), namely; 1) Occurs synchronously, educators and all students participate at the same time informally in a "virtual classroom" or directly in a formal classroom; 2) Self-directed learning, a learning experience that is completed individually at asynchronous pace and in its own time; and 3) Collaboration (social learning), a learning experience that comes from the ability of individual students to communicate with other individuals, such as online discussions to facilitate project completion or authentic student assignments.

The expert validity test results indicate that the product developed is categorized as valid. This is in line with the practicality test, which shows a positive response from users to the implementation of very practical learning design products embedded in e-learning. A very good response means that students or lecturers support its use, and students are motivated to follow the whole series of lectures. Meanwhile, the product effectiveness test results show that prospective teacher students' critical and creative thinking skills have increased. This study's findings align with (Yustina, Syafii and Vebrianto, 2020; Bahtiar, 2021), who use an effective blended learning strategy to improve students' critical and creative thinking skills. In addition, the results of studies conducted (Kashefi *et al.*, 2011; Kashefi, Ismail and Yusof, 2012; Munafiah and Rochmad, 2021) also inform the same thing that combining blended learning strategies with e-learning assisted CPS methods can support students in critical thinking and creative thinking.

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Thus the CPS process in the context of blended learning has a strong potential to help students to develop their metacognitive thinking skills. This is because the blended learning mode with the CPS method is able to increase the learning potential of students in online interactions (Kanchanachaya and Shinasharkey, 2015), this mode utilizes a combination of computer technology to support students' communication, teamwork, and problem-solving skills (Kashefi *et al.*, 2011). This pattern increasingly directs individuals to think critically and creatively in dealing with complex problems and can play a role in promoting cognitive development (Treffinger, 2016).

6. Conclusion

The instructional design product produced in this study has a more structured and systematic learning syntax to support students' critical and creative thinking skills. With good thinking skills, students can be responsible for regulating the involvement of their learning process during problem-solving. In addition, this learning design can help students become independent learners and synergize collaboratively in teams.

Based on the results of expert validation tests, practicality tests, and product effectiveness tests, as well as the results of media, material, and language expert assessments in FGD activities, it can be concluded that the development of CPS instructional design in the context of blended learning is stated to be very valid, very practical, very effective, and feasible to be implemented in learning. In this study, it was found that the CPS process learning design was very suitable to be applied through the support of Moodle-based e-learning facilities. This is due to the fact that it can optimize and facilitate the balance of divergent and convergent thinking during the problem-solving process. Thus, it can improve students' thinking skills more optimally; however, further investigation is still needed to reveal the effectiveness of its influence on the learning process and learning outcomes of prospective teacher students, as well as its effect on higher order thinking skills in larger classes. So future work should involve experimental studies using control groups to observe or examine the performance and effects extensively of the resulting instructional design products.

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E-Learning Software: Comparing the use Behavior Among Academicians and Schoolteachers

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Abstract: The COVID-19 pandemic has caused an increase in the use of e-learning software. From the perspective of the decision-makers (school/university administration), it is crucial to understand what characteristics of the software are perceived by the users (teachers) as necessary for a task (e-learning). A popular method of determining these characteristics is a technology acceptance model. In this paper, the authors aim to understand the technology acceptance of Microsoft (MS) Teams by applying the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The authors also analyze acceptance in two distinctive groups of teachers: schoolteachers and academic teachers, to better understand differences in e-learning software acceptance and implementation. The results show that MS Teams is a well-accepted software and the users' intention to use MS Teams in e-learning is the same regardless of the teacher's group. There are significant differences in the perception of software characteristics between different groups. The authors analyze the potential causes of these differences and suggest practical implications for improving the quality of e-learning. The intent is not to validate UTAUT as a general technology acceptance model but to understand its practical importance in explaining use behavior in e-learning.

Keywords: e-Learning, Technology acceptance, MS Teams, Use behavior, Structural equation modeling

1. Introduction

The COVID-19 pandemic has forced teachers worldwide to switch from stationary learning to e-learning (Mulla et al., 2020). One of the essential choices they faced was selecting the computer program they wanted to use to carry out e-learning activities. However, the teacher or the person in charge of the institution made the final decision. The question arises about the criteria that were used in making this decision. A technology acceptance theory provides an answer to this question. In the framework of this theory, a set of beliefs and expectations towards a technology influences users' intention to use it. The stronger the intention, the more efficient the realization of a task for which this technology is used. A good understanding of technology acceptance can also help explain teachers' perception of used software, its strengths and weaknesses, the necessary IT competencies required to use it, and external variables, like work experience, that drive its acceptance.

There are many computer programs in the market for e-learning. These include MS Teams, Zoom, and Google Meet. The authors focused on MS Team as it is the most widely used e-learning software according to several researchers (Gauthier and Husain, 2021). The authors' goal is not only to show technology acceptance but also to conduct an analysis in which schoolteachers with academic teachers were compared and investigate the differences in beliefs and expectations towards technology.

The authors believe that teachers are essential in studying technology acceptance because they decide how the curriculum will be implemented in online classes. The teacher's beliefs and expectations determine which e-learning program will be used.

2. Theoretical Background and Related Research

Technology acceptance fundamentally concerns how people adapt certain technologies for a given use. The level of user acceptance is considered crucial when it comes to the design and development of new technology. Finding the determinants of the technology use and identifying the motivations of its users is vital in finding methods to design the technology better and predict its reception among users (Taherdoost, 2018). Various models and frameworks have been developed to study technology adoption among users. Some of the most widely used models include the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), which was the basis for one of the most important acceptance models, the Technology Acceptance Model (TAM) (Davis, Bagozzi, and Warshaw, 1989).

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Research on the acceptance of a particular educational technology is still in its nascent stage. Studies on the intensity of e-learning meeting platform use and level of acceptance have begun to gain popularity in the new era of distance learning. They typically focus on examining the acceptance level of a single e-learning online video meeting platform like Google Classroom (Fauzi et al., 2021; Bervell et al., 2022) or Zoom (Wijaya, Solikhatin and Tahyudin, 2021). One of the objectives of this research is to determine and explain the behavioral intention to use MS Teams software as e-learning software. It was decided to use the Unified Theory of Acceptance and Use of Technology (UTAUT) model proposed by Venkatesh et al. (2003) for this task. UTAUT is based on the theoretical framework of the previously mentioned models, and its multi-theoretical approach is conducive to achieving a broader understanding of the issue of technology adaptation that has been unattainable individually by previous models (Khecine, Lakhal, and Ndjambou, 2016).

UTAUT model was selected for this study due to its high explanatory power, high reliability, and ability to correctly predict user behavior (Schaper and Pervan, 2007; Khecine, Lakhal, and Ndjambou, 2016). The UTAUT model conceptually incorporates four constructs that determine Use Behavior, which measures the level of acceptance of technology among users. The predictors of this acceptance are the following latent variables: (1) Performance expectancy (PE), (2) Effort expectancy (EE), (3) Facilitating conditions (FC), and (4) Social influence (SI) (Venkatesh et al. 2003). Each construct defines a different technology dimension from the user's perspective. Performance expectancy (PE) is the user's belief about the usefulness and effectiveness of a given tool in his/her work; PE describes the degree to which the user perceives the potential to gain benefits for the task at hand by using the technology. Effort expectancy (EE) refers to the ease of use of a given tool and the user's belief that there is no need for specialized knowledge and that the technology can be mastered intuitively and easily. Social influence (SI) determines the level to which users perceive the influence of their social circle regarding their use of a given technology. Finally, Facilitating conditions (FC) measure the impact of technical and organizational infrastructure on the user's perception of its helpfulness in using a given technology (Venkatesh et al., 2003).

In the context of this study, within each construct, the level of agreement with the given items concerning MS Teams is measured. The constructs respectively measure the perception of MS Teams as making e-learning more effective and better (PE) or being an easy-to-use software (EE). The recommendation to use MS Teams by school authorities, colleagues/colleagues, or the overall prevalence of software use and its impact on users is measured as SI. Lastly, in this study, FC are defined as coaching and training offered by school authorities or help from colleagues or students regarding MS Teams.

Empirical applications of the UTAUT model over the past 20 years have been prevalent. Worth mentioning is the development of a subsequent version of the model, UTAUT 2 (Venkatesh, Thong, and Xu, 2012), which incorporates an additional three variables measuring technology acceptance: Hedonic motives, Price value, and Habit. It was further developed when Farooq, et al. proposed the so-called UTAUT 3 (2017), which expanded the previous model iteration to include a new construct, Personal innovativeness. The authors do not think these additional UTAUT variables are helpful in the context of online education software, so the classical UTAUT model was chosen. The extended UTAUT models and their variants were also used as a framework theory to analyze the acceptance of e-learning platforms. Alshammari (2021) modified the UTAUT model to investigate the determinants of virtual classroom use among university teachers. The model was augmented with the construct Mobility, but only PE and EE significantly affected BI. A study by Gunasinghe, et al. (2019) further tested the effectiveness of the UTAUT3 model in measuring and interpreting the level of online learning adoption among Sri-Lankan academics. However, the model proved to be inappropriate for research in this context. The UTAUT3 used by the researchers explained only 38% variance of BI and 19% of Use Behavior, implying an overall structural model as a weak tool to predict academic teacher acceptance of e-learning. This is why the UTAUT3 model was not selected as the theoretical framework in our study. At the same time, UTAUT2 was not chosen due to its inclusion of a price variable, which is not fully applicable in the context of our study. Other studies using the UTAUT model or parts of it have not always focused on platforms like Zoom or Microsoft Teams but often on other educational ICT platforms like Moodle (Saleem, Al-Saqri and Ahmad, 2016; Abbad, 2021), Massive Open Online Courses (MOOCs) (Altalhi, 2021), Virtual Learning Environment (Raman and Rathakrishan, 2018), Wikis (Yueh, Huang, and Chang, 2015), or teaching and learning concepts using technology like blended learning (Bamoallem and Altarteer, 2021, Chan et al., 2015), or flipped classroom (Agyei and Razi, 2021).

Reflecting the currently developing need to analyze the technology acceptance of platforms like Zoom and Microsoft Teams and the emerging interest of researchers in measuring their acceptance among its users, it was decided to investigate the acceptance level of Microsoft Teams among groups of teachers. This is due to the slight prevalence of research on measuring educational technology acceptance levels among students (Yee and Abdullah, 2021, Magano et al., 2020) and the intention to measure and contrast acceptance levels among two

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distinct groups of teachers: schoolteachers and academic teachers. The teachers may perceive the software in very different ways due to the nature of their teaching, which may translate into their technology use. This context of the study can provide important insights into the perceptions of Microsoft Teams software by two groups and identify differences and similarities between them. Additionally, in this model, the authors include a new moderator, work experience, which can influence the strength or valence of relationships among variables.

3. Research Questions

The authors' previous discussion leads them to two main research questions:

- *Q1*: How can behavioral intention to use MS Teams be explained?
- *Q2*: How does technology acceptance of MS Teams differ between two important user groups: academic teachers and schoolteachers?

The answer to the first question is crucial because it can provide the information needed to analyze the factors influencing the intention to use a given computer program. Knowing what factors are essential for users, the strengths and weaknesses of the program can be discussed, as the changes that can be made to improve its acceptance and the potential market value. One can also divide these influencing factors into those under the program developers' or providers' control and those over which they have no influence. In the UTAUT model, factors under control are predictor variables, while those out of control are moderator variables. The importance of the second question requires a more detailed analysis. Based on previous research (Smolinsk et al., 2022) and authors' experience, four factors were identified as contributing to differences in technology acceptance in those two groups. These are teacher education, course types, student age, and teaching objectives.

3.1 Teacher Education

First, the differences in the technology acceptance in both groups may stem from the didactic preparation. Among those teaching in schools, pedagogical and vocational education are predominant. However, a pedagogical qualification among academic teachers is rare. Most university teachers have yet to become familiar with various teaching methodologies, sometimes resulting in reduced teaching competencies. The authors would expect to see a difference in technology acceptance between schoolteachers and those employed at universities. Those differences may be especially salient in the expectations towards program 'performance', with schoolteachers needing lower performance and thus having lower PE.

3.2 Course Types

The following reason for the difference in technology acceptance between the two groups is the course form. In schools, classes are most often conducted in a uniform formula of exercises. However, there is a clear division between lectures, workshops, and university seminars. Although the same functionalities of e-learning software are used in all forms of courses, their level of use varies considerably. The functional requirements for computer programs used for e-learning should be higher at the university level. Furthermore, that requirement might be reflected in higher PE in the academic teacher group.

3.3 Student age

Another critical factor is the age of students. Younger students may be less acquainted with e-learning technology, and the schoolteacher must opt for more accessible software. As a result, Effort Expectancy may become a more salient variable in the teacher group.

3.4 Teaching Objectives

The last differentiating factor is the teaching objective. In education, the emphasis is mainly on the transmission of knowledge. In higher education, the objective is more complex, with workshops, practical exercises, and internships also playing a crucial role. For instance, the broader objective of higher education may find its reflection in the more significant effect of PE on BI.

These differentiating factors imply the need to use the functionalities offered by e-learning software to a different extent and with a different intensity in both groups, leading to significant intergroup differences.

4. Hypothesis

H1: Performance expectancy positively affects the behavioral intentions to use MS Teams in e-learning.

H2: Effort expectancy positively affects the behavioral intentions to use MS Teams in e-learning.

H3: Social influence positively affects the behavioral intentions to use MS Teams in e-learning.

H4: Facilitating conditions positively affect the behavioral intentions to use MS Teams in e-learning.

These hypotheses are fundamental because they tell us which UTAUT variables impact technology acceptance of the software under study. The additional hypothesis for moderation effects in the model can also be formulated:

H5: All four predictor variables are moderated by work experience.

To answer the second question, the authors analyze both groups regarding their technology acceptance. Due to a lack of knowledge of the existence of any studies that investigated differences in technology acceptance between academics and schoolteachers, the general exploratory hypothesis can be formulated, which is as follows:

H6: There are differences between academic teachers and schoolteachers regarding technology acceptance of MS Teams in e-learning.

5. Methodology

The authors have conducted a structural equation analysis (SEM) for both study groups to answer the first research question. SEM is a common research design for UTAUT models (Alshammari, 2021). SEM aims to see if a theory (UTAUT) explains the "pattern" observed in the data well. This pattern (questionnaire responses) is assumed to reflect the actual relations occurring in the population. If this is the case, the model/theory the authors postulate will display a good "fit" to the data set. To answer the second research question, a multi-group SEM was conducted. This analysis involves the simultaneous evaluation of the postulated model in two research groups and the successive restriction of specific model parameters to detect statistically significant differences. Imposing restrictions is commonly divided into four stages: congruent invariance (theoretical model), metric invariance (factor loadings), scalar invariance (intercepts), and strict invariance (residuals).

Because this analysis relies on a full structural equation model with regression relations between major latent variables (H1 to H4), regression invariance was also introduced, which imposes restrictions on regression coefficients. In the authors' view, this is the most important invariance test for this study because it can tell whether the effects of four major UTAUT variables on behavior intention differ between the two groups.

5.1 Participants

The sample comprises 964 teachers from Poland and consists of two sub-samples: academic teachers (n = 245) and schoolteachers (n = 719). The first sub-sample comes from previous research by (Smolinski et al., 2022) where the questionnaire was administered to the employees of selected universities in Northern Poland. The second sub-sample was collected via professional social media pages for schoolteachers in Poland. Participation was voluntary and anonymous.

5.2 Preliminary Analysis

The first two responses with missing data from the schoolteachers' sub-sample were eliminated. Next, IRT analysis based on Guttman errors (van der Flier, 1977) was conducted to eliminate aberrant responses. The number of responses that did not meet the established criterion of $G < 0.4$ was 8 from the Academia sub-sample and 29 from the schoolteachers' sub-sample. One response with work experience above 50 years was detected as an outlier and consequently removed from the schoolteachers' sample. Two sub-samples containing 237 responses (female = 55%; mean job tenure = 15.79, SD = 11.22) and 689 responses (female = 94%; mean job tenure = 19.87, SD = 10.31) for academia and schoolteachers, respectively were established.

5.3 Measurement Instrument

UTAUT questionnaire for MS Teams created and validated by (Smolinski et al., 2022) was used. In this study, the questionnaire has reached satisfying psychometric properties represented by factor loadings and reliability measurements (see Table 1). The factor loading for the item FC2 is below the recommended value of 0.7 in both groups. However, it has reached a significant p-value ($p < 0.001$), and it was decided to keep it in the analysis. The exclusion of the FC2 item would reduce the number of items measuring the Facilitating conditions construct to 3 (which should still be enough). However, a few points of additional variance explained by item FC2 can only help understand the measured construct and do not harm the analysis results.

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Table 1: Model Reliability and Factor Loadings

		Congruent model				Final restricted model	
		Group 1: Academia		Group 2: School teachers		Multigroup	
Latent construct	**Item**	**Factor Loading**	**Alpha**	**Factor Loading**	**Alpha**	**Factor Loading (unstandardized)**	**Alpha**
Performance Expectancy (PE)	PE1	0.815	0.87	0.885	0.93	1.000	0.91
	PE2	0.919		0.955		1.318	
	PE3	0.866		0.936		1.314	
	PE4	0.769		0.837		1.390	
Social Influence (SI)	SI1	0.813	0.80	0.796	0.87	1.000	0.86
	SI2	0.812		0.876		0.955	
	SI3	0.720		0.851		0.929	
Effort Expectancy (EE)	EE1	0.793	0.89	0.802	0.89	1.000	0.89
	EE2	0.912		0.906		1.138	
	EE3	0.728		0.770		0.929	
	EE4	0.832		0.825		1.184	
Facilitating Conditions (FC)	FC1	0.704	0.77	0.684	0.73	1.000	0.73
	FC2	0.561		0.573		1.276	
	FC3	0.723		0.813		1.117	
	FC4	0.710		0.628		1.270	
Behavioral Intention (BI)	BI1	0.804	0.88	0.778	0.86	1.000	0.86
	BI2	0.788		0.737		0.931	
	BI3	0.945		0.938		1.095	

Heterotrait-monotrait (HTMT) ratio of correlations to assess discriminant validity was used. A value below a threshold of 0.85 indicates good validity (Kline, 2011). In this case, all values are below that threshold for both groups. Discriminant validity measures are presented in Table 2.

Table 2: Discriminant Validity (HTMT)

	PE	**SI**	**EE**	**FC**	**BI**
PE	1	0.714	0.791	0.680	0.769
SI	0.807	1	0.706	0.659	0.764
EE	0.768	0.732	1	0.814	0.701
FC	0.716	0.699	0.772	1	0.600
BI	0.840	0.830	0.814	0.727	1
Note. Top diagonal: discriminant validity for academia, bottom diagonal: discriminant validity for schoolteachers					

6. Results

All statistical analysis was conducted in R software. The models were validated using a maximum likelihood estimator from package lavaan.

6.1 General Model Validation

The UTAUT models in both groups reach satisfying statistical properties. Fit statistics are presented in Table 3. The presented expected values for fit measures come from Konarski (2010). UTAUT measurement model accurately represents the actual population relations captured in the data. The only statistics that deviate from the expected value are chi-square statistics, which suffer from many drawbacks (Konarski, 2010). First, a chi-square statistic heavily depends on the sample size, and when the sample is too large, the null hypothesis can be wrongly rejected. Second, the more complex models are punished as a chi-square statistic gets inflated with increased degrees of freedom. Third, a chi-square statistic is not a representative fit criterion when data does not have a multivariate normal distribution. Considering all mentioned weaknesses, it is not appropriate to assume a poor model fit based solely on chi-square statistics.

Table 3: Model fit Statistics

Statistics	Critical Value	Academic Teachers	School Teachers	Final Restricted Model
CMIN/DF	< 2	2.165	5.455	3.737
GFI	> 0.8	0.985	0.983	0.980
NFI	> 0.9	0.910	0.931	0.917
CFI	> 0.9	0.949	0.943	0.938
RFI	> 0.8	0.889	0.916	0.912
RMSEA	< 0.08	0.070	0.080	0.077
$\mathbf{R^2}$	N/A	0.800	0.818	0.757
ECVI	N/A	1.682	1.175	1.355
AIC	N/A	11875	33140	45062
BIC	N/A	12097	33430	45501

The statistical significance of the four main effects of the four main variables of the UTAUT model is the same in both study groups (see Table 4). However, it cannot yet be concluded that the effect sizes are identical. PE (H1), EE (H2), and SI (H3) positively affect the intention to use MS Teams in e-learning, regardless of whether the study group is academia or schoolteachers. In contrast, FC (H4) do not affect behavioral intention, regardless of the studied group. FC are not a variable that users consider when deciding whether to use MS Teams in e-learning; hence they do not influence technology acceptance.

Table 4: Model Standardized Regression Coefficients

Pathway	Hypothesis	Academia	School Teachers	Final Restricted Model
PE → BI	H1	β = 0.630 (se = 0.152) ***	β = 0.407 (se = 0.066) ***	β = 0.485 (se = 0.064) ***
EE → BI	H2	β = 0.207 (se = 0.091) *	β = 0.412 (se = 0.412) ***	β = 0.336 (se = 0.057) ***
SI → BI	H3	β = 0.435 (se = 0.087) ***	β = 0.400 (se = 0.055) ***	β = 0.405 (se = 0.049) ***
FC → BI	H4	β = 0.062 (se = 0.127) n.s.	β = 0.040 (se = 0.040) n.s.	β = 0.088 (se = 0.076) n.s.
Note. significance code: < 0.001 '***', < 0.01 '**', < 0.05 '*'				

6.2 Moderation Analysis

The moderation analysis proceeded after establishing that the UTAUT model fits well in both analyzed groups (H5). The method proposed by Steinmetz et al. (2011) was used to create moderator variables in the structural equation model. However, that caused a dramatic decrease in the fit statistics as the model had become too

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complex (degrees of freedom increased from 125 for the simple model to 481 for the moderation model). It was still decided to present the obtained moderation coefficients (see Figure 1), as they do not change drastically in value with the decrease in overall model fit and can still provide helpful insight into the mediating nature of work experience.

In this research, the moderation coefficients reached significance only for PE and EE and only in the schoolteachers' group ($\beta = -0.11$, $p < 0.05$ and $\beta = 0.12$, $p < 0.01$, respectively for PE and EE). However, the magnitude of the coefficient is small, and the significance levels are above $\alpha = 0.001$, which may be considered too liberal for this type of analysis. Caution is advised in drawing firm conclusions from the presented moderation results.

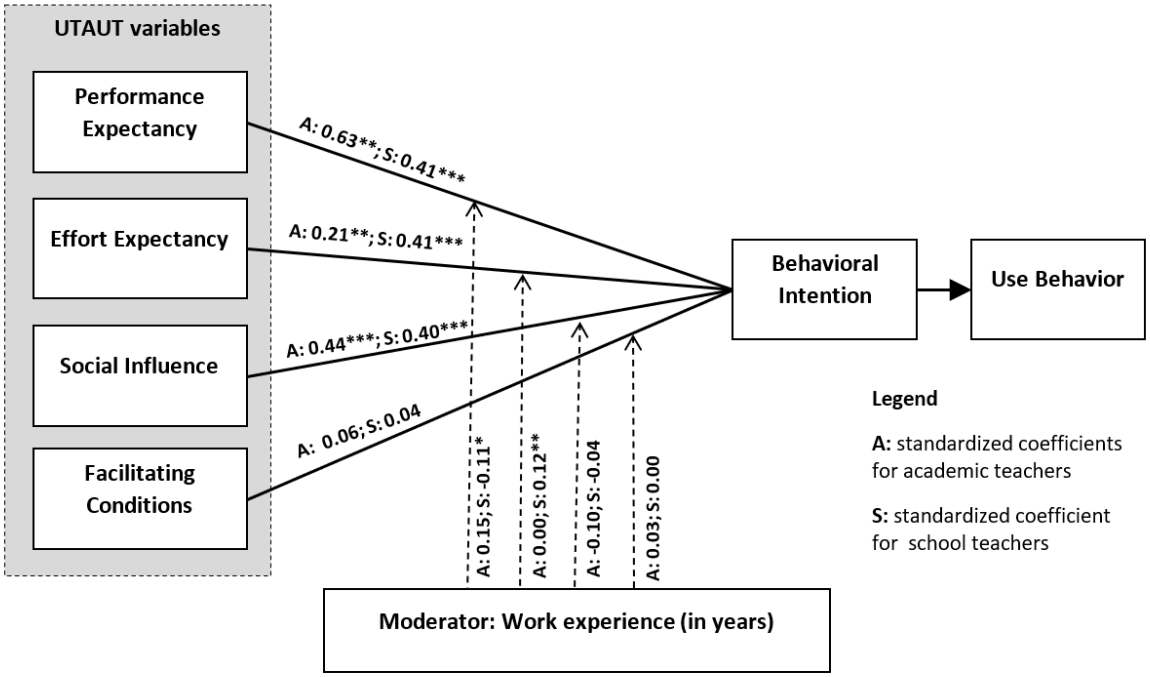

Figure 1: UTAUT Model

6.3 Invariance Analysis

The last hypothesis (H6) regarding the equivalence of technology acceptance in both study groups was verified through five multi-group analysis stages described in the methodology section.

First, the congruent model was analyzed, which showed a good model fit in both groups, indicating that the UTAUT theory adequately explains technology acceptance in both groups (Table 5). In the second stage, factor loading equivalences between groups were imposed. Based on the criteria proposed by Chen (2007) and Rutkowski and Svetina (2014), it was concluded that the resulting metric invariance model is not significantly different from the congruent model ($\Delta CFI = -0.002$, $\Delta RMSEA = 0.00$ $\Delta TLI = 0.00$), suggesting that the latent constructs and their measurement are the same in both study groups.

Next, the model was restricted further to ensure scalar invariance. The results suggest that the perception of specific MS Teams characteristics differs between the two groups ($\Delta CFI = -0.032$, $\Delta RMSEA = +0.008$ $\Delta TLI = -0.015$). After closer analysis, it was determined that the perception of characteristics represented by the items PE1, PE4, FC2, FC3, BI2, BI3 differ in academic teachers and schoolteachers. After allowing these parameters to vary between the two groups, the model fit has returned to the previous values ($\Delta CFI = +0.031$, $\Delta RMSEA = -0.009$ $\Delta TLI = +0.015$). Having assessed scalar invariance, strict invariance on the model was imposed, and it was found that it significantly decreases model fit ($\Delta CFI = -0.014$, $\Delta RMSEA = +0.006$, $\Delta TLI = -0.012$). The parameters responsible for this decrease in fit were PE2, PE3, PE4, FC2, and FC3. It suggests that the perception of MS Teams characteristics represented by these items has higher variance in one group and consequently is less consistent. Freeing these parameters improves model fit ($\Delta CFI = +0.011$, $\Delta RMSEA = -0.006$, $\Delta TLI = +0.011$).

The last stage of analysis focused on regression invariance. The regression parameters were restricted, and it was found that there was no significant decrease in fit statistics (ΔCFI = +0.001, ΔRMSEA = 0.00, ΔTLI = +0.001), suggesting that the effects of four main variables in the UTAUT model do not differ in size between the two studied groups. It is the most critical finding of this study and is discussed in depth in the following sections.

Table 5: Model Invariance Analysis

Model Variant	CMIN	ΔCMIN	Df	CFI	ΔCFI	RMSEA	ΔRMSEA	TLI	ΔTLI
Academia	270.57	-	125	0.949	-	0.070	-	0.937	-
Schools teachers	681.818	-	125	0.943	-	0.080	-	0.930	-
Congruent invariance	952.39	-	250	0.944	-	0.078	-	0.932	-
Metric invariance	997.40	+45.01	263	0.942	-0.002	0.078	0.00	0.932	0.00
Scalar invariance	1216.43	+219.03	276	0.910	-0.032	0.086	+0.008	0.917	-0.015
Scalar released	1010.68	-205.8	270	0.941	+0.031	0.077	-0.009	0.934	+0.017
Strict invariance	1213.35	+202.67	288	0.927	-0.014	0.083	+0.006	0.922	-0.012
Strict released	1067.93	-145.42	283	0.938	+0.011	0.077	-0.006	0.933	+0.011
Regression invariance	1072.60	+4.67	287	0.939	+0.001	0.077	0.00	0.934	+0.001

6.4 Latent Variable Mean Comparison

Additionally, the latent means of the five main UTAUT variables were compared (Table 6). The latent means are created by calculating the mean of all items for a latent variable multiplied by its factor loading. The latent means for each group are presented in Table 6. The results show that the latent means for all four UTAUT predictor variables differ significantly between the two groups. However, most effect sizes are small or medium, with the most significant difference being for SI (Cohen's d = - 0.441). It can be interpreted that these values as the degree to which a particular user's belief, represented by one of the UTAUT four predictive variables, differs between academia and schoolteachers. For example, the most significant difference in EE can be interpreted as a difference in the strength (degree) of the belief that MS Teams is easy and intuitive to use, with schoolteachers believing stronger in MS Teams ease of use. However, the most interesting latent mean is the mean for Behavioral intention (BI), which does not differ between the two groups. It means that the actual intention to use MS Teams in e-learning is the same in both groups.

Table 6: Latent Variable Means

Latent construct	Academia	Schools teachers	t-test	Cohen's d
PE	M = 5.76, SD = 1.47	M = 6.28, SD = 1.48	-4.83***	-0.367
EE	M = 4.74, SD = 1.12	M = 5.09, SD = 1.17	-4.21***	-0.305
SI	M = 4.11, SD = 0.92	M = 4.56, SD = 1.03	-6.31***	-0.441
FC	M = 5.40, SD = 1.19	M = 5.59, SD = 1.18	-2.10*	-0.16
BI	M = 4.45, SD = 1.18	M = 4.48, SD = 1.31	-0.25 n.s.	-0.021
Note. significance code: < 0.001 '***', < 0.01 '**', < 0.05 '*'				

7. Discussion

The results provide us with three main conclusions.

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7.1 Technology Acceptance of MS Teams can be Represented by the UTAUT Model

The first conclusion stems from the answer to the first research question: How can behavioral intention to use MS Teams be explained? The UTAUT model proves to be an excellent tool for assessing technology acceptance. Behavioral intention to use MS Teams in e-learning is over 70% explained by the UTAUT model (R^2 = 0.818 in schoolteachers and R^2 = 0.8 in academia), which means that created models provide enough information to decide about the use of MS Teams in e-learning.

This information provided by the UTAUT models can be used by developers or software providers who wish to improve their technology. For example, the presented UTAUT variables can be interpreted in the context of SWOT analysis, where variables positively influence behavioral intention are strengths. In contrast, variables with negative or no influence are evaluated as weaknesses.

Latent means can also be helpful in such analyses. For example, although they do not significantly affect behavioral intention, FC have a high latent mean, suggesting that MS Teams users believe it has good technical support and software infrastructure. Nevertheless, these high 'facilitating conditions' do not affect the intention to use MS Teams for e-learning. Thus, the problem may not lie in the level of support or infrastructure but in users' perception of these 'facilitating conditions' as unimportant.

It is also essential to consider UTAUT moderators, which provide information about external factors beyond developers' and providers' control that still affect users' technology acceptance. Work experience has a significant moderating effect on PE and EE, but only in the group of schoolteachers. The negative effect of work experience on PE means that as experience increases, the importance of PE decreases, i.e., the effect of the belief that MS Teams works well in e-learning on the intention to use the program decreases. It is important to note that those with more experience are often older and thus less familiar with the technology and overall have lower expectations of its performance. However, we advise approaching this interpretation with caution for three reasons: first, the moderation occurs only in the group of schoolteachers, and second, the effect sizes of moderation are small. And third, the hypothesis of a relationship between age and work experience has not been tested in the context of this study. Nevertheless, this conclusion is provided as an illustration of how moderation can be interpreted in the context of UTAUT models and as an impulse for future research.

7.2 Technology Acceptance of MS Teams is the Same in Schoolteachers and Academic Teachers

At the highest level of analysis, the technology acceptance of MS Teams, represented by the effect of the four main UTAUT variables on Behavioral intention, is the same among schoolteachers and academic teachers. The effects of the four main variables are identical in both groups. From the final model, it can also be concluded that the influence of three out of four variables is very similar to each other (standardized β = 0.336 - 0.485), and it is difficult to distinguish a variable with a dominant influence. On the other hand, what can be distinguished is a variable that does not affect behavioral intention in both groups: FC, which may constitute a weakness in SWAT.

All the differences in education systems mentioned in the introduction and research question sections: teachers' educations, types of courses, age of students, and different teaching objectives, do not lead to differences in technology acceptance of MS Teams.

7.3 Perception of MS Teams Characteristics Differ Between Schoolteachers and Academic Teachers

The fact that technology acceptance of MS Teams is the same in both groups does not mean that the perception of MS Teams characteristics is identical. The general conclusion from the analysis of the UTAUT models is that the influence (and direction) of these perceived characteristics on BI is the same. In contrast, the extent to which MS Teams is perceived to have a particular characteristic may differ.

7.3.1 Performance expectancy

The variable with one of the highest differences in perception, measured by Cohen's d, is Performance expectancy. It can be concluded that the degree of perception that MS Teams possesses software characteristics that are useful and beneficial for e-learning is lower among academic teachers. The differences in course types likely explain this variance. The spectrum of courses offered at the university level is broad (workshops, seminars, lectures). On the other hand, the dominant form of courses in schools is standard classes. Given these observations, the lower PE among academic teachers is justified.

7.3.2 Effort expectancy

The difference in the latent means of the Effort expectancy between the groups (Cohen's d = -0.305) indicates that among schoolteachers, the belief that MS Teams is easy to learn and its use is more significant than among academic teachers. This finding might be surprising because, before the COVID-19 pandemic, schoolteachers were almost exclusively classroom teachers. One might expect that this urgent need to master unfamiliar software and reformulate their classes would cause a greater need for the software to be easy and user-friendly than in the academic teachers' group, where there is a higher exposure to various forms of learning. However, it is advised to stay aware that the academic teachers' group had a significantly greater challenge in adjusting various course types to e-learning. Organizing standard classroom exercises via online software is more straightforward than complex workshops.

7.3.3 Social influence

The difference in the Social influence variable equals approximately 0.44 standard deviations. It is the most significant difference in the study and indicates a lower degree of perception among academic teachers that essential people would use MS Teams software. Academic teachers, for the most part, are, at the same time, scientific researchers, often appearing in public as experts. Such persons are professionally tracking the latest knowledge and determining technology development directions. They most often play the role of professional authorities in today's society. Schoolteachers do not require such competencies; therefore, they are more inclined to consider other people as authorities and accept their views as valid or motivating for action. This fact explains that the results obtained among schoolteachers indicate a higher degree of perception of the belief that important people would use MS Teams software.

7.3.4 Facilitating conditions

The difference in the size of the Facilitating condition variable between the researched groups is the smallest among all the variables (Cohen's d = -0.16). School teachers are more likely to believe that support is available. This result is undoubtedly a consequence of the implemented actions on the part of the regional administration overseeing the operation of schools or the managers of individual educational units. On the other hand, academic teachers, due to the specificity of their profession, are more inclined to undertake autonomous activities, attempts, and experiments while relying less on the possibility of receiving support.

7.3.5 Behavioral intention

The Behavioral intention to use MS Teams is not significantly different in the study groups. It means that both groups equally want to use this software for e-learning regardless of the differences in perception of individual characteristics described above.

8. Practical Implications

This section presents the practical implications of the differences described above.

8.1 Performance Expectancy

In terms of Performance expectancy, the lower perception among academic teachers indicates the need for the further development of software to support various forms of teaching, including laboratories and workshops. It becomes necessary to develop digital simulators using elements of artificial intelligence and virtual reality.

School teachers have a lower degree of IT culture (they use MS Teams only for standard online classes) than university teachers. Actions should be taken to verify this thesis. If confirmed, it becomes necessary to plan and implement training to increase schoolteachers' knowledge, skills, and competencies in modern information technologies.

8.2 Effort Expectancy

Noting small but significant differences in the perception of Effort expectancy, it is recommended to increase the number and scope of MS Teams training for academic teachers. It is important to show how an academic teacher can apply the software to the advanced requirements of the academic didactic processes.

8.3 Social Influence

To increase the perception and potentially the effects of Social influence, teachers, software designers, and providers can implement selected principles described by Robert Beno Cialdini (2004). The following rules may

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be applied: authority, social proof, commitment, and consistency. The primary purpose of these initiatives should be to present MS Teams in a manner that creates favorable conditions to increase the level of perception among teachers rather than to support Microsoft's marketing strategy.

8.4 Facilitating Conditions

Providing technical and organizational support in fulfilling employees' tasks resulting from work activities is the obligation of every employer. Several initiatives, the implementation of which may lead to an increase in perception of Facilitating conditions, may encompass the provision of a helpdesk service or making available profiled instructional materials on the Internet. It is advisable to organize a training at basic, advanced, and specialized levels and provide training in the form of tutoring. Additionally, in situations demanding it, offering selected employees the possibility to undergo coaching sessions.

9. Limitations and Further Research

Technology acceptance is a concept that needs to be systematically determined. In the Authors' view, it requires three following steps:

- The basic software acceptance.
- The comparison of the software acceptance in the relevant groups.
- The comparison of the software acceptance with software intended for a similar purpose.

In this research, the first two steps were done. MS Teams was established as a well-accepted software and compared its acceptance in the two relevant groups (schoolteachers vs. academic teachers), finding no significant differences in acceptance but significant differences in perception where implications were explained in the previous sections. The third step concerning different software is our study's main limitation as we focus exclusively on Microsoft Teams. More work needs to be done on comparing software intended for a similar purpose (like Zoom or Google Classroom).

10. Conclusions

The Unified Theory of Acceptance and Use of Technology (UTAUT) model is found to be an effective explanatory model for the technology acceptance of e-learning software, specifically in the case of Microsoft Teams. The findings suggest that Performance expectancy, Effort expectancy, and Social influence are key determinants of teachers' intention to use Microsoft Teams in online education. There is no significant difference in technology acceptance between academic and schoolteachers, demonstrating the robustness of the UTAUT model. However, differences in perception of e-learning software characteristics between these two groups of teachers exist and are likely driven by their differing job requirements. To further improve technology acceptance, we propose the implementation of enhancements in the software that focus on facilitating conditions and teacher education and support. Teacher education and support refer to training and resources aimed at improving teachers' understanding and use of technology in the classroom. This may include workshops, online resources, and support from technology specialists.

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Adopting WhatsApp to Reduce Transactional Distance During the COVID-19 Pandemic

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Abstract: Mobile devices have penetrated all levels of society worldwide, including what are predominantly considered inaccessible, low-income communities in developing nations. Mobile devices are frequently used for economic, political, and social interactions and even business transactions. In a similar fashion, teachers are slowly adapting to the use of mobile devices as a pedagogical tool in education. The aim of this study was to ascertain how a WhatsApp group, a messaging facility, could be used to enhance group interaction among pre-service teachers during the COVID-19 pandemic. Moore's Transactional Distance theory and Salmon's five-stage model guided this qualitative study. Twelve pre-service teachers, out of a class of thirty-five, were purposely selected to work on a group task using the WhatsApp application during the COVID-19 pandemic. They also participated in a focus group interview. WhatsApp artifacts and focus group interview transcripts were analyzed deductively; the results showed that the WhatsApp intervention helped improve pre-service teachers' engagement and the sharing of content to successfully undertake the group activity virtually. WhatsApp's social nature has proven to be an enabler for keeping people connected despite physical distance: reducing cognitive loneliness resulting from social isolation. It is recommended that teacher educators, academics, and researchers, as well as students working remotely take advantage of the usability of WhatsApp for learning and research purposes.

Keywords: COVID-19, Remote learning, Social media mediated learning, Transactional distance, WhatsApp

1. Introduction

The COVID-19 global pandemic, also known as the coronavirus pandemic, brought daily human operations to a standstill, after a lockdown was implemented to curb the spread of the disease (Gamage & Perera, 2021). Education was no exception. Given the abruptness of the effects of the pandemic, learning institutions were caught unprepared for such a disruption; they had to think fast and rationally to produce innovative interventions so that learning would continue. In many cases, institutions transitioned into remote and online learning systems. Students from privileged institutions and backgrounds, easily transitioned to the online environment. However, it was not the same case for students coming from vulnerable backgrounds with limited or no access to online learning resources (Gamage & Perera, 2021). The COVID-19 pandemic exposed the many inequalities within South African communities. Although the educational institutions made efforts to put learning management systems in place to support online learning during the pandemic, in many cases, educators and students relied more on their own resources, internet connectivity and digital devices. This was because during conventional face-to-face sessions, both educators and students used institutional facilities, therefore very few invested in their personal technologies. In addition, Learning Management Systems provided by the institutions were not easily accessible for all. This therefore highlighted a need for educators to make use of resources that were easily available to all students to facilitate learning. Mobile smartphones present such an opportunity.

Research has shown that worldwide there is a rise in access to affordable smartphones and data networks, therefore affording endless opportunities for the uptake of mobile-enhanced business, social and educational activities (Chigona, 2013). The use of technology such as mobile smartphones for learning reduces the tractional distance that is presented by remote and online learning. Transactional distance (TD) in this study is defined as a psychological and communications separation between a student, his peers, and learning content (Moore, 1993).

In higher education, specifically, in teacher training institutions, there has been insignificant adoption and use of technology in teaching and learning (Johnson, Becker, Estrada, and Freeman, 2015; Gachago et al., 2017). However, the COVID-19 pandemic became a catalyst for these institutions to embrace the opportunities technology brings to teaching and learning. Thoms and Eryilmaz (2014) revealed that the technology used in online learning does indeed still matter and have profound effects on students learning experience. Sun (2016) finds that support, accessibility, and usability of the course technology predicted satisfaction through the instruction-technology fit. This study adopted the use of WhatsApp to reduce TD.

It is hoped that the findings of this study will encourage educators to adopt the use of mobile-mediated technology in teaching and learning (Bhardwaj, 2016). Furthermore, education policymakers and administrators

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may become aware of the importance of adopting social media applications in teaching and learning. The researchers also hope that pre-service teachers will see the benefit of engaging with mobile devices as educators' model mobile-mediated teaching strategies in their preparation programs.

This study is guided by the following question: In *what ways can WhatsApp group interactions influence the reduction of Transactional Distance (TD) in a remote learning pre-service teachers' virtual group activity?*

2. Literature Review

Social interaction plays a critical role in teaching and learning. Peer-to-peer interaction has proven to be an optimal way for people to learn. In most cases, in a physical learning environment, students and educators interact face-to-face; however, the advent of COVID-19 and its interruption of physical meetings isolated students and educators, disrupting the status quo. Having to make do with what's available, social media platforms and Learning Management Systems were adapted into education institutions. In this study, due to the limited digital resources, the researchers explored the use of WhatsApp in a group project. The researcher chose WhatsApp because it is a widely and easily accessible social media platform (Tunjera & Chigona, 2021) which students could easily access on their mobile smartphones.

In 2009, Brian Acton and Jan Koun purposely invented WhatsApp to improve mobile mediated communication. The short messaging service that had been available to people at this point, had some challenges and was expensive as it was linked within a mobile service provider (WhatsApp, 2021). The duo created an independent multiplatform application that only required one to have an internet connection. In addition to being a text-based messaging application, WhatsApp application has the following collaborative features:

- Users can share videos, text, pictures, and audio (voice) notes as messages.
- WhatsApp group can be created to support unlimited synchronous and asynchronous interaction of up to 256 group members.
- Group administrators can restrict by opening and closing administration and user privileges
- Group audio or video calling features can host eight participants at one go.
- WhatsApp gives registered users an unlimited number of messages which one can share if they are connected to the internet.
- WhatsApp is a cross platform application compatible with different types of platforms android, iPhone, windows devices
- The WhatsApp desktop guarantees that one can have access to messages even when working on their laptop or desktop computer independently from their mobile devices.

All the above features' function when one has access to the internet.

However, before the COVID-19 pandemic, educators viewed WhatsApp as a social application, not a communication-enabling application, despite researchers highlighting its possible impact on teaching and learning (Sherine, Seshagiri, and Sastry, 2020). In their study investigating the impact of WhatsApp interaction, Ebireri, Kalli and Sakir (2021) found that using WhatsApp improved student access to information from anywhere and at any time. However, other studies found that WhatsApp negatively affected students' performance as they can be easily distracted from their learning tasks. The social nature of WhatsApp makes it easy to receive contain unimportant messages i.e., jokes, videos, memes and other content which may attract the learners attention away from the educational tasks (Asmara, 2020). In this study the aim is to explore WhatsApp influence in reducing transactional distance in remote and virtual group assignment.

2.1 Virtual Groups

Virtual WhatsApp groups collaborations have been researched, and studies have shown that younger generations are increasingly using social networks such as WhatsApp to chat with each other online and instantly (Nadeak, 2020; Aldoobie, 2015). It has also been observed that students share anything of interest to them and their peers within these groups (Rashid & Asghar, 2016; Gill et al., 2015). With regards to student engagement during the social isolation period due to COVID-19 pandemic, mobile mediated online engagements are said to have improved and increased interactions (Tunjera et al., 2015; Clayton, 2016). Active engagement and participation in group activities is fundamental. The more students participate in learning activities the more they gain knowledge. Student engagement is linked to high quality learning outcomes (Baishya & Maheshwari, 2020). Social interaction is an important means of learning, as it keeps them connected with peers. The following section, therefore, explores how WhatsApp helped increase social interaction during the COVID-19 pandemic.

2.2 Social Constructivist Learning Theory

Social constructivist philosophers has proven that knowledge is collectively created within students' shared communities (Timmermans & Tavory, 2016). This social sharing of information with their peers is how the conception of new information begins (Tunjera, 2014). Students within a virtual group form a collaborative team as they take turns sharing information on a common topic. Within the dialogues, group members apply four reasoning strategies: questioning, summarizing, clarifying and predicting (Gunawardena et al., 1997).

Moore (1993) argues that these dialogues advance key tenets of structure, discourse, and student self-regulated learning thus reducing the psychological gap that is created when students misunderstand some concepts. As the students are working in a team task, they co-construct knowledge within their group, mediated within a social media platform. The construction of new connotations is achieved through the sharing of different and conflicting perspectives through the WhatsApp group platform (Economist.com, 2012).

Researchers reveal that access to online platforms such as WhatsApp, enhances students' engagement (Nadeak, 2020; Tunjera, 2014). Furthermore, Ally and Tsinakos, (2014) observed that the accessibility of mobile-mediated learning is growing, thereby boosting learning opportunities in developing nations. Rambe and Bere (2013) observed in their study great opportunities for advanced tools in social media that open mobile learning opportunities. Ngaleka and Uys (2013) and Tunjera (2014) assert that mobile-mediated social media, for instance WhatsApp, has the potential to increase dialogue as participants co-construct and generate new information.

However, El-hussein and Cronje, (2010) advised that mobile learning designers need to understand the students' context and the appropriate application of mobile-mediated social network useable for learning (Pachler et al., 2010). Additionally, Le, Janssen and Wubbels, (2018) observed that a lack of participation, and economic challenges should be anticipated in making use of mobile social networks in learning environments. While it could be true that social networks may have some challenges, it does not necessarily follow that all platforms carry these risks, as with the use of WhatsApp, which is available freely to download (WhatsApp_Inc, 2021).

WhatsApp acceptance, mostly in developing contexts, is attributed to its unique feature that allows enhanced interactions within a group - synchronously or/and asynchronously (Bouhnik et al., 2014). In addition to the usability and affordability of WhatsApp, unlimited data bundles are being offered by many mobile service providers in South Africa's such as Cell C mobile service provider (Akande et al., 2020). Hence, WhatsApp group facility was used in this study to enhance interactions, as well as nurturing social engagement inherently to the reduction of Transactional Distance (TD) effects.

2.3 Transactional Distance Theory

Moore's TD theory stands as the underpinning theory for distance education pedagogy. TD refers to the psychological or communication gap that arises when a student encounters a challenge in understanding a concept, and fails to get help (Moore, 1993). The current generation students easily gets anxiety as they expect instant feedback to complete a task (Tunjera, 2014). This implies that when help is sought and does not get resolved within a certain time, student disengage with the task. Moore's TD theory (1993) and Park, (2011) Pedagogical Framework for mobile learning highlights four types of mobile learning interactions that take place in a distance-learning context within a single continuum mediated by mobile devices.

Figure 1 illustrates that TD is either high or low, dependent on the structure of the learning activities. Secondly, he views learning activities as either individualized or socialized. This study's WhatsApp group activity was intended to fall on quadrant type three to reduce TD in a student-centred setting, the findings showed that the students had autonomy of the activity, although initially the tutor facilitated and initiated follow-up by encouraging direct discussion of the virtual group activity.

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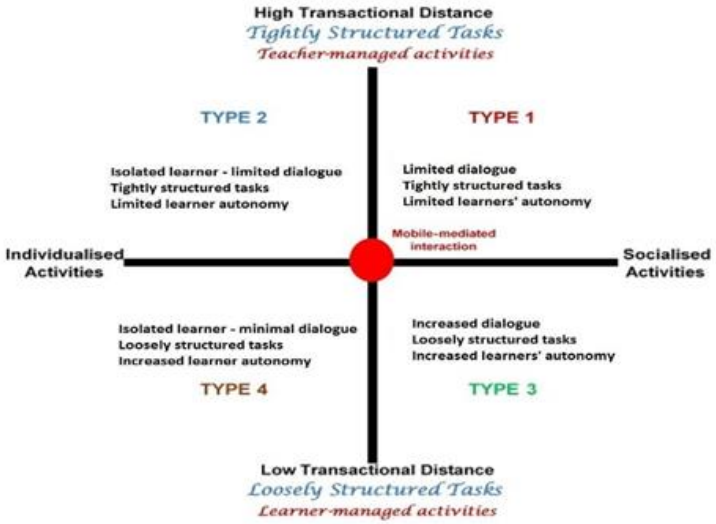

Figure 1: Pedagogical Framework for Mobile Learning (Park, 2011)

To help accomplish the virtual group activity with the aim of examining how TD could be reduced through increased virtual social interaction, Salmon's five-stage model was used to guide the group activity implementation.

2.4 Salmon's 5-Stage Model

Salmon (2000) designed a five-stage model for e-modelling online presence activities for learning. The model (Figure 2) was used in the setting up of the study's mobile online activity and consists of five stages in an interactive activity.

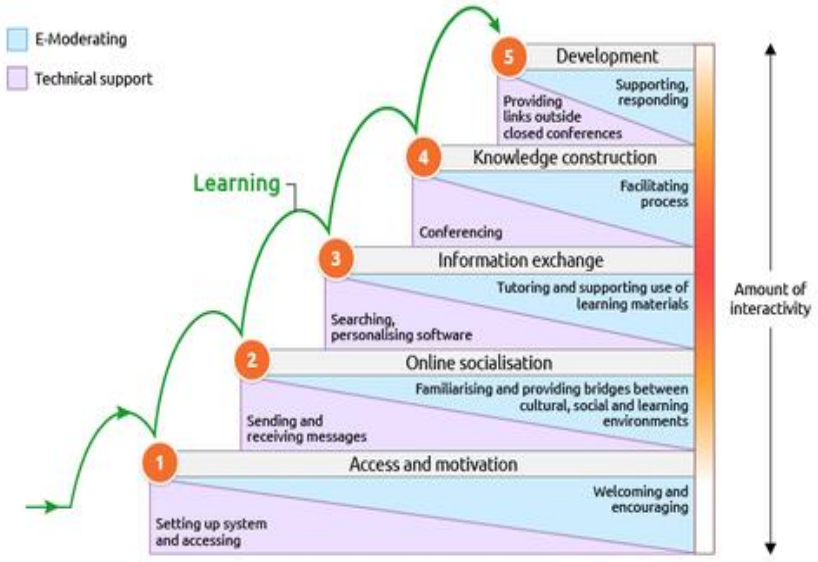

Figure 2: Salmon's 5-Stage Online Learning Interaction Model (Salmon, 2000) Used With Permission

Stage 1, 'Access and Motivation', is the initial phase in the online engagement process. According to Salmon, Nie and Edirisingha, (2010; p…..?), "gaining access is an essential precondition for learning in any online environment", the group administrator ensures that participants have access to the online environment (Tunjera, 2014).

Stage 2, Online Socialization, Gregory and Salmon, (2013) indicate stage 2 as when participants are familiarising with the system and finding other group members to interact with. At this stage, individuals are trying to understand and explore how to use the platform for learning as well as building trust and mutual respect for working in a group.

Stage 3 is Information Exchange, in which Salmon, Nie and Edirisingha (2010) indicate that online engagements are characterized by enquiries and responses taking place in continuous succession. Similarly, Moore (1993) agrees that group members share and exchange ideas as they master overcoming communication barriers.

Stage 4,÷ Knowledge Construction, Salmon (2000), posits that group members value each other's contribution as a knowledge construction community. The group leader's role is to amalgamate and combine members contribution guiding group members toward the attainment of the group task. The group members are actively engaging at this stage.

Finally, in the fifth development stage, Salmon, Nie and Edirisingha, (2010), note that group members are able to accomplish individually allocated tasks as they aim to integrate current learning experience from the activity into other forms of learning in their own space This last stage allows group members to apply and test their gained knowledge in their own setting (Gunawardena et al., 1997; Moore, 1993).

3. Conceptual Framework

To understand the identified principle that guides remote learning, the researchers created a conceptual framework guided by the reviewed literature. Figure 3 illustrates how the learning concepts guiding this study, virtual group (Anderson & Elloumi, 2008), social constructivist pedagogical approaches (Sadeck & Cronjé, 2017), and transactional distance (TD) (Moore, 1993) are mapped together. These concepts are discussed in detail in the following sections.

Tunjera (2014) used the conceptual framework (Figure 3) to illustrate how the different variables relate with each other in a virtual interaction activity. A virtual group indicates that the participants are physically separated, due to varied circumstance, in this study, the COVID-19 lockdown forced people to stay behind closed doors. Moore (1993) argued that a transaction distance is created when a student is separated from the teacher or other learners. However, due to the accessibility of mobile mediated interactions the psychological gaps are seen to reduce thereby increasing learner autonomy.

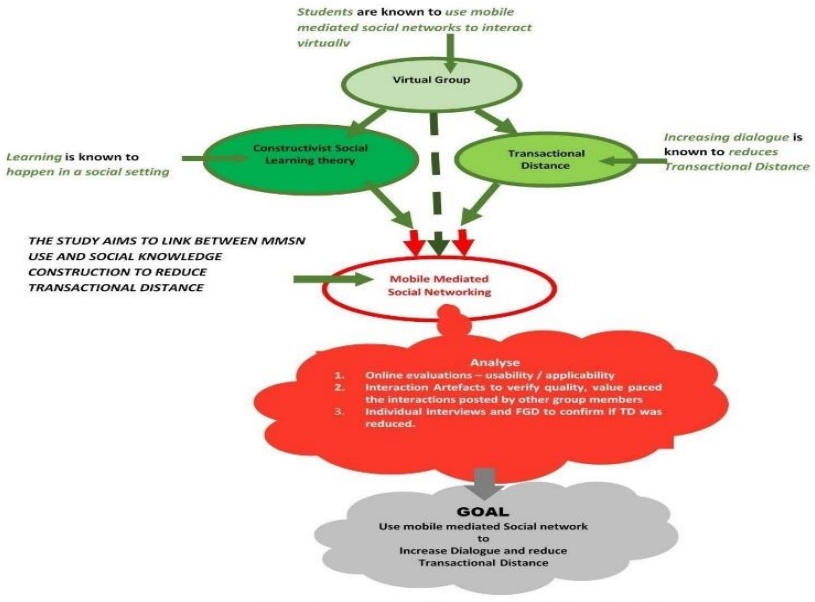

Figure 3: The Conceptual Framework (Tunjera, 2014)

Young people are known to connect and interact with one another using their mobile phones, as they keep each other updated on what is happening (Hwa & Peck, 2020) Studies reveal that social media plays a big part in young people's lives. Global statistics show that–97% use social media such as WhatsApp, YouTube, and Facebook constantly (Hwa & Peck, 2020). On the other hand, social learning theorists suggest that learning is a social activity that happens within a social setting using available and appropriate social tools (Manca & Ranieri, 2016). This ←esearch further reveals how the advent of social media has changed social interaction and human engagement (Manca & Ranieri, 2016). Therefore, keeping students engaged using social media tools within their social learning eco system helps alleviate the increase in TD.

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4. Research Design

The study followed a qualitative interpretative paradigm using an in-depth interpretation of a single case. Data was collected using the WhatsApp transcripts, and a focus group interview. A post evaluation survey was developed as a follow up on participants' experiences on using WhatsApp group activity. The reason for using the qualitative paradigm was that participants can constitute a rich and valuable source of information (Creswell, 2008). Qualitative research provides rich and in-depth data that aids in exploring the meanings of the phenomena under study.

This study is part of the longitudinal 21st Century project (21CP), is a project funded by the National Research Fund (NRF) that is exploring how pre-service teachers could be adequately equipped with 21st Century skills for ICT integration. The ethical approval obtained from the Institutional Ethics Committee guided this study. Thirty-five third year education students who were registered for the Information Communication Technologies (ICTs) in Education course, which is part of the Professional Studies Course, consented and volunteered to participate in this study. The ICTs in Education course aims to equip pre-service teacher with theory technology integration skills.

4.1 Participants

The study was conducted online on WhatsApp messenger application over a duration of 6 weeks. The researchers divided the 120 students into groups of five students each. A group leader was appointed to create, administer a WhatsApp group, and send invite links to join. Due to the lockdown and social distance, students were physically separated, therefore the assigned group activity was accomplished virtually. The researchers were part of the WhatsApp groups but were non-active observers.

A survey was sent to all students to evaluate the course, students were asked to indicate if they volunteer to participate in focus group discuss to indicate by selecting a volunteer to participate in FGD/ interview. 40 out of 120 students indicated that they were willing to voluntarily participate, however 5 participate withdraw due to technical difficulties. The participants were further randomly divided to groups of 5 to afford in-depth discussion on the WhatsApp intervention. A schedule for each group FGD was created in MS Teams. Each member was given a chance to respond to every discussion question.

4.2 Data Collection and Analysis

The WhatsApp group's interactions were transcribed verbatim to help categorise the emerging themes (Tunjera, 2014), concentrating on the quality of the interactions exchanged (Moore, 1993). Participants volunteered to participate in a focus group discussion to reflect and discuss WhatsApp usability and applicability for group activities.

The participants were asked, in their groups, to work on a task to develop a teaching podcast on a topic of their choice. Students had to work virtually with a variety of technological resources or tools and interact within a WhatsApp group.

The final podcast and WhatsApp chats were submitted to Blackboard for assessment. WhatsApp dialogues artefacts were analysed using indicators from the Interaction Analysis Model (IAM) (Gunawardena et al., 1997). The IAM uses statements of observations or opinions, agreeing on clarification of statements. The group members firstly shared and compared facts as they interact. Secondly, as the discussion continued to grow, discussions moved on to indicators such as agreement and disagreement statements, and then moved further on to consensus on new understanding. In the fourth phase the discussion moved up to evaluating the validity of the new information in their setting, and in the final stage, the application of new knowledge in their own contexts. The emerging categories were fitted onto five-stage and IAM models (Gregory & Salmon, 2013; Gunawardena et al., 1997).

Focus group interviews (FGI) conducted on the usability and applicability of WhatsApp in the group activity context, were transcribed verbatim. The transcribed data was allocated codes categorizing viewpoints common to the central purpose of the study (Lynch, 2013). The codes were summarized into themes used for reporting findings. All the collected data was analysed thematically.

To ensure that the process of data collection and analysis was credible and trustworthy, transcribed data was sent to participants to verify the accuracy of the data. The raw data was discussed with participants for member checking to ensure that it represented what they had said. Participants verified the accuracy of transcribed WhatsApp artefacts as well as FGI and interview transcriptions.

5. Findings and Discussions

The study explores the use of a mobile-mediated social media, WhatsApp, in a group activity during the COVID-19 pandemic lock down. The findings reveal that pre-service teachers accomplished the group activity using WhatsApp interactions. The pre-service teachers indicated that the group projects ran smoothly and reduced a lot of anxiety previously experienced when they were in physical classrooms.

The findings are presented under the following themes:

- Increased connectedness
- Enhancing exchange of ideas
- Usability and accessibility of mobile-mediated WhatsApp

5.1 Increased Connectedness

The focus group and interviews revealed that the WhatsApp application enabled group members to stay connected and kept up to date as one could read through the synchronous conversations. The interactions pattern happens continually as the group members engage on what they already know about the subject under discussion (Tunjera, 2014). This observation is in agreement to Salmon, Nie and Edirisingha (2010) findings that reveal that interactions in online discussions are characterized by questions and responses occurring in succession. Similar patterns were observed in this study as participants socially engaged with each other to accomplish the given task. This is in line with TD theory in that as group members share and exchange ideas, communication barriers are overcome. Virtual group members shared information relevant to the group's assigned task. Teamwork happened as group members shared and supported each other, working towards achieving their virtual group's task goal.

The pre-service teacher revealed that even though lockdown physically isolated them, however, through the virtual WhatsApp groups made them feel connected with others. One pre-service teacher highlighted how the advancement of WhatsApp features such as group video call helped her/him to connect with others,

> *I felt very much part of a team, or I can say classmates… I never felt lonely, although the group was meant for ICTs project*

WhatsApp Inc website reveals that it managed over thirty billion messages every 24 hours during the COVID-19 pandemic. It is managing over a billion monthly active users and over seven hundred million photos and videos shared every day, Researchers have also revealed that WhatsApp is the most popular messaging application (Udenze & Oshionebo, 2020).

During the COVID-19 lockdown and social distancing restrictions, WhatsApp was the cheapest and most accessible technology available to most students. Internet service providers had social media uncapped bundle that could last for a month available for purchase

> *Using WhatsApp was a relief for me. I am from a small town outside Eastern Cape. I have challenges of poor network access to Blackboard and other platforms being used. I am happy using WhatsApp allowed me to participate in this group assignment. I used WhatsApp monthly bundles…which made me fully connected…*

Researchers have raised concerns of widening of the digital-divide that is caused by online learning (Chigona, 2017; Pieri & Diamantini, 2010), however in this case WhatsApp group activity revealed its inclusivity as all the participants had access to WhatsApp and were happy to use it for learning. In their study, Udenze and Oshionebo (2020) state that WhatsApp was very useful for undergraduate students to actively participate in class activities.

5.2 Enhancing Exchange of Ideas

The participants in this study reported that they enjoyed and were able to accomplish the assigned group task using the WhatsApp group, which enhanced not just the knowledge they generated but the connectedness and sharing that took place amongst them. This is consistent with Udenze and Oshionebo (2020) who report that there was a noticeable increase in the use of social media in the 15 - 29 age group. Studies reveals that young people are known to connect and interact with one another using their mobile phones (Zachos et al., 2018; Hwa & Peck, 2020). Therefore, it is not surprising that pre-service teachers adopted the use of WhatsApp groups as they use it socially to keep each other up to date with current affairs.

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In this study, students engage in a group activity, knowledge is constructed through the shared platform. According to Gregory and Salmon (2013), each member of the group is valued for their critical role as a group member. Each group member has an integral role of bringing their individual ideas to contribute towards achieving the group task goal. Here, the group leader's role is to help in directing participants toward the completion of the group task. Sherine, Seshagiri and Sastry (2020) predicted that enhancing interaction is the process of exchanging and sharing ideas and has the potential of reducing TD. One participant revealed that the WhatsApp group activity helped her understand things better,

> *Participating in this group, helped me understand some difficult content that had taken me long to understand during face-to-face classes*

In this study, group members worked together, sharing ideas to accomplish a common goal. Udenze and Oshionebo (2020) assert that in enhancing mobile-mediated interactions, group members can motivate each other; responding to each other's posts is extremely critical at this stage.

> *…I liked the use of audio chats; we were talking as if we were in the same room…*

WhatsApp features such as audio, video and group call were also highlighted as the features that helped students construct and share ideas on the group activity. However, contrary to these benefits, (Udenze & Oshionebo, 2020) have indicated that WhatsApp was distractive and caused problems related to spelling and grammar use. However, in this study it was observed that the students used Textism notation in the WhatsApp group interaction. Textism consists of the abbreviations and slang often used in internet-based conversations (Oreoluwa & Omotayo, 2022). However, it was interesting to note that this had no impact on the final submission as the pre-service presented their work in proper academic writing.

The analysis of the interaction revealed the needed intensity and active participation of every group member. Both formal and informal conversations held with the goal of achieving their group assignment were observed. The observation showed that each group member was critical for the successful completion of the given task. Each member was assigned a task to accomplish towards the group task from initial conception through to completion. One group leader noted,

> *In our group we first discussed on ground rules, we, together identified key concepts and assigned each member a concept to research prepare to report back to the group during our meet-up scheduled time, we used WhatsApp to interact with each other on any urgent arising matters…*

The above extract reveals the importance of group members playing their part as a team to achieve the goal. Final assessment involved peer assessments, in which each member assessed other group members. This helped to grade individuals on team skills and contributions. This implies that every group member participated to successful completion of the group task.

WhatsApp provides educational affordances of immediate feedback, therefore reducing the TD that is created when students cannot get immediate feedback. Also, note that using WhatsApp for discussion provided deeper clarity on abstract concepts. A student has this to say about using WhatsApp for studying

> *… enjoyed using WhatsApp in this group activity, we only used it informally with friends, using it as a class project, it made it more exciting as everyone was ready to share and assist in whatever way. This immediate support reduced the stress of waiting to have someone respond promptly…*

The participants appreciated that using WhatsApp afforded them immediate feedback from the educator and peers as students started exchanging information. At this stage, students were exchanging course material to support learning towards the achievement of the learning goal. In their study, Bouhnik, Deshen and Gan, (2014) observed that students shared video links and website links to build towards the learning goals.

5.3 Usability and Accessibility of Mobile-Mediated WhatsApp

The WhatsApp application enables limitless interactions and access to other students at anytime and anywhere. Social media platforms offers both synchronous and asynchronous interactions as indicated by one of the pre-service teachers,

> *The WhatsApp really made my life stress free…. I would send a message to our group in most times I would get someone responding instantly or within 10 minutes… it's always a challenge when you are far, and you need help but do not get it… it is stressful…*

Social media has been heralded as having a negative influence on the young generation. However, when they are physically separated and in need of help, its these platforms that give them access to peers and other sources of knowledge and support which reduces anxiety. There are contradicting observation on the effect of social media on mental health; in this case, the students used ~~social~~ media to alleviate their worries that, if unresolved, would trigger anxiety. On the contrary, studies assume social media as a trigger of anxiety due to overwhelming messaging and sometimes uncensored communication (Chaturvedi et al., 2021) It is important however, to note that social media skills when guided and refined can produce better learning outcomes as it gives more freedom to connect and collaborate beyond the physical spaces.

The WhatsApp interaction are key to provide structure, share content and increase student autonomy as the could actively participate in their assigned group activities. Table 1 below shows the results of participant evaluation on using WhatsApp for interacting and sharing content.

Table 1: Feedback Evaluation After the Group Assignment

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
WhatsApp helped me in gaining knowledge	15	17	3	0	0
WhatsApp was Engaging	26	8	1	0	0
WhatsApp group chats motivation to learn	24	9	1	1	0
WhatsApp group activity encouraged collaborative learning and participation	28	7	0	0	0
Easily available and downloadable	35	0	0	0	0
Learning anytime, anywhere	32	3	0	0	0
High volume of message was overwhelming	0	0	3	12	20
Bad language use	0	0	0	0	35
Straining and time consuming	0	0	0	15	20

The participants were mostly satisfied with WhatsApp as they were strongly agreeing on the advantages of using WhatsApp for the group assignment. All participants strongly agreed that WhatsApp is easily accessible and downloadable.

> *WhatsApp is freely downloadable and easy to use. I liked this group activity, as it was focused on a goal, the members were focused on achieving this unlike other uncontrolled WhatsApp groups… I end up muting some groups*

Students take advantage that it is a free downloadable application; hence, it is available to most people and devices. Furthermore, internet service providers offer WhatsApp data bundles which are cheaper and convenient to use (Jackson, 2020). This implies that WhatsApp can be a tool that can be used in education without worrying about the prohibiting cost of such technology. It should be noted that taking advantage of the digital technologies that are accessible, even in remote and marginalised communities, empowers interaction and engagement that is critical in reducing transactional distances.

6. Implication of the Study

The study implies that if pre-service teachers are exposed on how to appropriately use social media platforms in their teaching and learning, it will be easy for them to use such in their future classroom. Offering students diverse choices of platforms to use can develop self-determination, pride in accomplishment, and increase the degree to which they feel connected to their learning.

7. Conclusion

Overall, the WhatsApp platform has proven that, although it is designed as non-academic social media application, it fit the current needs of pre-service teachers' interaction during the COVID-19 lockdown. WhatsApp improved features and accessibility was a convenient and supportive tool which should be introduced into the formal setting of teaching and learning, as revealed by this study. This implies that WhatsApp can be adopted for flexible learning and effectiveness in providing instant support whenever it is needed. The

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researchers recommend educators take a critical look at mobile mediated social network model available that can be used for supporting and improving the current educational practices for remote learning. Adapting social media platforms into curriculum delivery gives access to those in marginalised communities who experience lack of advanced technology infrastructure and connectivity barriers. The researchers recommend that further studies be done on how WhatsApp diverse features can be exploiting effectively in teaching subject specific content.

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