Virtual Gathering Platforms in Academic Teaching: Potential and Applications

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Abstract: The COVID-19 pandemic resulted in a rapid shift towards online learning where educators and students had to quickly adapt to new digital formats. However, the core aspects of community building and social interaction that are essential to traditional classrooms became challenging to maintain. To address this issue, we were interested in testing Virtual Gathering Platforms (VGPs) *Topia* and *WorkAdventure* to see how effectively they could be adapted to various academic teaching and learning settings. These examples of Extended Realities (XR), adopted from the 2D metaverse, aim to improve communication and interactivity in a fun and engaging way, allowing users to create immersive worlds for socialising, and collaborating. Using Technological Pedagogical Content Knowledge (TPACK), Technological Self-Efficacy (TSE) and distributed scaffolding frameworks as a guide, we created adaptable templates of both platforms that not only introduced users to how they work, but also included features flexible enough to suit various academic disciplines and promote social engagement and collaborative learning. We then implemented a case study and invited university educators teaching international courses to adapt the templates and assess them within their own learning settings. In addition, it was important for us to use the on-boarding sessions as a focal point. Here, we introduced the templates through multiple resources and offered one-to-one support to develop their use within chosen learning scenarios which ranged from an icebreaker activity to an online student resource centre. Observations then documented the adapted templates being used with students in these settings, and feedback regarding user perceptions of the platforms and the support strategies used was gathered. The study reveals the complex interplay between user experiences, support strategies, and educational frameworks, emphasising the need for adaptable and collaborative approaches to optimise these platforms in higher education.

Keywords: Online learning, Gamification, Virtual gathering platforms, Community building, Social interaction, Collaborative platforms, The metaverse, Teacher support, Digital competencies, Extended realities, Technological pedagogy

1. Introduction

Understanding the impact of emerging technologies in education is crucial for meaningful advancements in teaching and learning practices (Oliveira et al., 2019). This paper explores Technological Integration (TI), defined as the incorporation of technology into educational settings to support educational objectives (Consoli, Désiron & Cattaneo, 2023). Within this framework, Extended Realities (XR), like virtual and augmented reality (Mann and Wyckoff, 1991), have emerged as transformative tools, and metaverse environments in particular, have demonstrated promise in educational contexts, addressing challenges such as maintaining community and collaboration in online settings. However, examples regarding simpler formats, namely 2D metaverse technologies, are less prominent. Therefore, by drawing on the example of Virtual Gathering Platforms (VGPs), a 2D virtual gamified interactive meeting space (Le, MacIntyre and Outlaw, 2020), this paper bridges these existing research gaps by exploring user perceptions and approaches to these platforms, identifying relevant support structures that enhance their use.

In doing so, we aim to contribute to the evaluation of VGPs in alignment with Technological Pedagogical Content Knowledge (TPACK), Technological Self-Efficacy (TSE), and distributed scaffolding frameworks, and to identify areas for future research. With these goals in mind, this paper will first delve into the methodology employed to assess VGPs, followed by an analysis of user perception and support strategies. The study employed a single case study approach using a "triangulation," (Flick, 2007, p.43) data collection method which included observations, interviews, and surveys, thus providing a more detailed comparison on the varied insights into this under-researched area.

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2. Literature Review

2.1 The Education Metaverse Post COVID-19 Pandemic

Even before the pandemic, many universities had established networks and initiatives to promote digitalisation and technical competencies among the university community (Song, 2023), suggesting an already existing focus on digital engagement and skills development (Caena and Redecker, 2019). Yet when the pandemic began and university campuses had to close, new challenges emerged and lecturers had to quickly find solutions by transferring to fully digital formats (Kara, 2021; Fauzi, 2022). Whereas already established online course management systems such as *Moodle* provided a centralised platform for delivering course content, video conferencing software like *Zoom* and *MS Teams* became essential for hosting virtual meetings, classes, and events (Leporini, Buzzi, and Hersh, 2023). These platforms also allowed for features to support continued engagement which not only helped maintain academic continuity but opened further possibilities of social interaction in purely online settings.

This ultimately aided research into collaborative learning through XR of which, due to its recent in fruition and interest, the metaverse will be focussed on. The concept of the metaverse is said to have originated in the 1990s through the works of Neal Stephenson (Ball, 2022) and the first well-known metaverse, virtual world platform *Second Life,* was developed by San Francisco-based firm Linden Lab in 2003 (Orland, 2021). Its aim is online social connection where the user logs into a non-downloadable software replicating a three-dimensional world. To navigate through this, they are represented as an avatar and can access various forms of social media, browse content with other visitors and chat or send messages (Au, 2008). These metaverses are primarily used for multiplayer gaming like *World of Warcraft* and *Fortnite*, however they have also transferred to the education sector and used for virtual classrooms, labs, and training simulations (Kye, et al. 2021). Several studies in this area have already investigated the advantages of these technologies and their potential in creating a more dynamic learning environment that engages students. For example, Zheng, Jun and Di (2022) states that the metaverse can motivate and engage learners because of their immersive and game-like qualities. This is further supported by Jovanović and Milosavljević (2022), who concluded that the metaverse allows for a more entertaining experience of otherwise dry topics making students more motivated and accepting of the subject. In addition, a metaverse can give access to various resources from all over the world and facilitate simulations of experiments that would otherwise be inaccessible or dangerous. For example, Kshetri (2022), noted that the simulation of real environments is not only able to replicate practical exercises, but students feel safe when immersed in them.

However, research into the challenges of metaverse technology cannot be ignored, especially with relation to technical limitations, software requirements and a lack of regulation and security concerns. (Ahmad, et al., 2022). When discussing the potential of metaverse in future teaching and learning scenarios, Onu, Pradhan and Mbohwa (2023) concluded that the technology needed to create and access metaverse environments remains challenging and expensive. In addition, there is still a lack of pedagogical content or class material available for metaverse technologies, limiting educators and students and preventing opportunities to standardise these platforms. Furthermore, there are strong concerns about privacy which Qiu, García-Aracil and Isusi-Fagoaga (2023) highlights as the main issue as with any online environment. This can prevent educators and students feeling comfortable sharing their personal information and engaging in online activities. There is also a compelling case made by Badger, et al. (2023) on how being immersed in virtual worlds can affect students' actions, heightening the risk of cyber bullying and inappropriate behaviour.

Overall, despite its analysis in educational settings, there is limited research into educator's perceptions and their approaches to using this software in their teaching (Downie. et al., 2021). It has been argued that the more positive teacher's perceptions are to the metaverse, the more successful their use in the teaching and learning process, leading to a more developed integration of these technologies (Sunardi. et al., 2022). However, Frith (2022) has argued that more case studies are needed to examine its potential in facilitating learning outcomes before it can become an educational tool. Therefore, by identifying this gap, this study aims to track their integration from a teacher perspective. Namely, to initiate support for educators to adapt metaverse software to their courses, observe this adaption and collect feedback. From there, we can identify practical approaches for metaverse-based teaching and learning and consider how to design resources that aid student learning and develop technical competencies for teachers.

2.2 The 2D Metaverse and VLPs

There is the common view that the metaverse exists through a 3D interface where users meet within an immersive VR environment (Gallagher and Forman, 2021). However, formats on a smaller, 2D scale have also been utilised by various educational institutions as an alternative for current video conference meetings (Larsen, 2022). Allowing people to interact more naturally in these 2D environments attempts to bridge the gap between real-life and virtual interactions. One example are VGPs, where users create an avatar to navigate within a 2D virtual map (MacIntyre and Outlaw, 2020). They mimic many features of real-life interactions and are integrated with spatial technology which connects other users via audio, video, and a chat function when their avatars are close together. When the user moves away, the video stops and the sound mutes. Unlike a video conference call, users are not forced within a single conversation, giving users more fluidly between conversations as speakers or listeners (Kshetri, 2022). In addition, these virtual worlds can be customised depending on the needs of the users, whether it be a virtual office or online event, various platforms offer templates that can be adapted. In his topology of metaverses, Kshetri (2022) highlighted that virtual gathering technology is decentralised and numerous examples of this software exist, many of which becoming established during the COVID pandemic. After researching various examples, five platforms have been selected (Fig.1) alongside our general definition of the metaverse introduced in section 2.1 of this paper.

	Gather	**Wonder.me***	**WorkAdventure**	**Topia**	**Definition of Metaverse**
Features					
Interactive Elements and features	Personalised avatars, collaboration tools: digital whiteboard, emoticons, and reactions. Broadcast and Follow Me feature.	Partially customisable profile pictures as avatars, emoticons, Pop-up icebreaker questions. Broadcasting is available.	Completely customisable avatars. Pop-up split screens with interactive tools, emoticons, and reactions. Moderators can send global messages to all users	Simple monotone figures as avatars. Pop-up messages, maps, and other media applications. YouTube links can be integrated. emoticons and other reactions can be sent	Highly rendered, completely customisable avatars. Collaborative designing and prototyping of models in a virtual environment, social interaction tools available
Customisation	Can embed whiteboards, customisable objects, *Google* Docs, *Microsoft* Docs and PDFs	Only background and profile pictures are customisable	Possibility of embedding external websites, learning management systems etc. Objects completely customisable.	Possibility of linking external websites, learning management systems, live streams etc. Objects and environment both completely customisable.	In a large virtual environment, customisation of all elements possible, possibility of embedding different commercial and non-commercial websites.
Data Security	SOC 2 Type II certified, not GDPR complaint	GDPR complaint	Can be fully secure when self-hosted	Partially GDPR complaint	Not completely GDPR complaint
User Capacity	Free Plan: Up to 10 users Paid Plan: Up to 500 users	Up to 500 users	Free Plan: Up to 15 users Paid Plan: Unlimited number of users	Free Plan: Up to 10 users Paid Plan: Between 20 and 200,000 users	Unlimited number of users
Commercial aspect	Online meetings, collaborative work and team building activities (escape rooms)	Online meetings	Open source, everything accessible	Buying and selling NFTs and Map Templates, promoting online events	Can be fully used for commercial purposes

*No longer in operation as of April 2023

Figure 1: Virtual Gathering Platforms

In contrast to the 3D metaverse, the features of VGPs have the potential to promote online collaboration due to their social nature and capacity to integrate exchange through a variety of communication channels. In addition, they house the gaming mechanisms that not only supports university learning strategies but fits the technical awareness and receptiveness of the current student demographic. This can be reinforced by pedagogical perspectives on collaborative learning and how these platforms have the potential to further enhance it. For example, Gabbert's five basic elements of collaborative learning (Gabbert, Johnson and Johnson 1986) includes positive goal interdependence, verbal interchange, effective communication, individual accountability and group reflection and processing. This also can be further supported with Roodt, de Villiers and Joubert (2012) who linked the importance of collaborative learning with the current university student demographic, the *Net* and *Z Generations*. They have more of a preference for group and peer learning because of their responsiveness and affinity towards multi-media, gaming, and social media technologies. Therefore, students could benefit from teachers using game-based learning as a pedagogical concept. In addition, it can be argued that VGPs could work well within university settings, because course content follows a blended learning approach that requires more independence from the learner. Currently, Virtual Learning Environments (VLEs) and Massive Open Online Courses (MOOC) are the most well-known ways of combining blended and flipped classroom approaches and these platforms could also be integrated into these learning techniques in a more personalised way. For example, they can be accessed at any time which can help build learners' self-confidence and autonomy and learner relationships can still be developed outside of classroom hours. The flexibility of these programs and their capacity to integrate various online tasks and tools could also increase goal-orientation and more personalised learning objectives.

The decision on which platform to use should be based on the intended purpose of the virtual environment and the features that best align with the goals of the users. As evident from the comparison in Fig. 1, *WorkAdventure* and *Topia* were preferred choices due to their simpler features and functions. For one, *WorkAdventure* has the advantage of being self-hosted, making it completely data secure. Conversely, *Topia*'s simplicity and quick set-up makes it suitable for collaborative sessions or team meetings, while *WorkAdventure*'s customisation capabilities cater to more complex virtual events or interactive experiences. However, for educators and students to put their trust into using VGPs and integrate them successfully and efficiently has its challenges. Firstly, Kshetri (2022) noted that many of these VGPs require an advanced network and computing infrastructure. For example, the video chat is a necessary component for the experience, which requires extremely low latency as users move around and connect to each other. Therefore, fears in achieving a stable connection and making sure the system functions effectively could prevent universities from wanting to work with this technology. Furthermore, in a study conducted right before the pandemic by Amhag, et. al. (2019) which investigated university teacher's use of digital tools and need for digital competence, it was concluded that teachers were not primarily using digital tools for pedagogical purposes. This claim is further supported by various OECD surveys that assessed teachers' engagement in online learning activities as being rather limited and the sudden switch to online teaching during COVID-19 highlighted the difficulties educators faced to integrate and process this phenomenon effectively (Minea-Pic, 2020). Therefore, research into suitable frameworks that could be adopted to support educators in integrating 2D metaverse pedagogies will offer a valuable insight into potential on-boarding methodologies that can be used and evaluated in this study.

2.3 TPACK, TSE and Distributed Scaffolding Frameworks

As society became further embedded with technology in the 1990s, it was crucial to adapt competency models and frameworks to form a technological perspective, analyse aspects of digital tools used by educators and assess the needs of digital competence in higher education. Those important to note are TPACK (Mishra and Koehler, 2006) and TSE (McDonald and Siegall, 1992). The TPACK model includes three knowledge domains (pedagogical, technical, and content), and the interaction between these domains measures the effectiveness of teaching with digital tools. For example, effectiveness can be recognised through the teacher being able to use a specific software and integrate that technology into an educational purpose so it can be used together with their didactic knowledge on a subject area within their own teaching practice (Koehler, Shin, and Mishra, 2012). In favour of this framework, Koehler, et al. (2014) underlines that it is essential for educators to also recognise interactions between pedagogical, technological, and content knowledge as there is no single technological solution that can solve every teaching and learning situation. Since its introduction, a variety of methods to assess educator's TPACK, including interviews, open-ended questionnaires and observations have been created (Koehler, et al., 2014). However, it must be noted that, the TPACK model has also faced criticism by Ruthven (2014) who highlighted its lack of precise definition and the difficulties in distinguishing the different domains which can therefore result in contradictions determining user effectiveness.

In comparison, the theoretical methodology TSE, adopted by McDonald and Siegall (1992), was intended to describe feelings towards the ability to adopt new technology and therefore has been purposely left vague to work across several technical spheres. The concept extends from Bandura's self-efficacy theory (Bandura, 1997) which refers to how confident individuals feel when managing certain tasks. For example, those with higher TSE have more confidence using a particular form of technology and are more likely to better engage with and benefit from it, whereas those with lower TSE may face challenges in using the same technology which could negatively impact their learning experience and performance (Gomez, et al., 2022). To better assess these TSE levels, four factors were identified: prior experience, modelling, social persuasions, and physiological factors (Pfitzner-Eden, 2016). However, Pfitzner-Eden (2016) also noted that there are additional precursors that can also be associated and influence a high or low TSE rate. For example, it can be argued that age and gender as well as external factors such as having access to adequate resources are better forecasters than TSE itself. For instance, recognising prior experience is typically a better predictor of task performance, but these factors should not be over-relied on and other variables that can affect TSE on performance-based outcomes should be identified and considered. Overall, when linking these frameworks to VGPs and their use in university settings, it can be argued that the models of TPACK and TSE are relevant tools. However, it would also be interesting to clarify whether these frameworks best apply to the effective utilisation of these technologies in university teaching and learning contexts or if other variables are more influential in determining which support strategies should be employed.

In the context of developing an educator's digital competence through the TPACK and TSE frameworks, distributed scaffolding has been chosen as a pedagogical support mechanism because it involves similar factors. It is a teaching strategy developed by Puntambekar and Kolodner (1998) which provides an ongoing system of support that involves multiple resources, tools, and technologies to increase learning and performance. For example, modelling, is also a common scaffolding tool. Studies have shown that when learners observe successful demonstrations of a task, such as by an instructor, and are subsequently provided with opportunities to practice and demonstrate their own abilities, for instance by using technology independently, their self-efficacy beliefs regarding technology are enhanced (Smith, 1994) This is further supported by previous studies on self-directed learning and its impact on learning experiences through communication technology and the Internet (such as MOOCs and online courses) (Kim, Lee, and Park 2019). When defining scaffolding, there are five common components: A common goal between learner and educator, an ongoing diagnosis of task performance, adaptive support, active learner interactions and a transfer of responsibility to the learner to complete the task (Stone, 1998). These have been orchestrated into the pedagogical support planned for this study.

3. Problem Statement and Research Objectives

This project was initiated to explore the broad question of the usefulness of VGPs and their impacts on university teaching-learning environments, hypothesising that they might improve social interaction. As the research progressed, this inquiry was refined into two specific objectives:

- To explore the advantages and disadvantages of community platforms in university learning and teaching environments
- To identify useful support tools that will help students and teachers use them effectively.

These objectives were chosen based on the research highlighted in the literary review. For example, this technology, especially in 2D format, presents opportunities for immersive teaching and learning experiences due to their features which encourage online community building and support collaborative learning strategies (Zheng, et. al. 2022). However, while studies (Kye et al. 2021, Jovanović and Milosavljević, 2022, Kshetri, 2022) acknowledge this potential, challenges such as technical limitations, privacy concerns, and the lack of pedagogical resources to integrate these tools remain (Ahmad, et al., 2022, Onu, Pradhan and Mbohwa, 2023, Qiu, et. al. 2023, Badger, et al. 2023). Moreover, there is limited research on educators' perceptions and approaches to using 2D metaverse software in educational settings, demanding further investigation into its integration and impact from a teacher perspective (Downie et al., 2021, Frith, 2022). Due to these limitations, it was decided to use open research questions that are answerable with a small sample and fits the qualitative, exploratory research methodology that we wanted to employ. Focusing on the "advantages" and "disadvantages" of these platforms from both a student and educator perspective, also allows us to evaluate the practicality of VGPs in university teaching-learning environments and their potential to improve social interaction.

Regarding the second research goal and the kind of support structures needed to successfully implement these platforms, frameworks such as TPACK and TSE, as mentioned in the literary review (Mishra and Koehler, 2006, McDonald and Siegall, 1992), were used as a guideline in creating support and valuable guidance for educators integrating this technology into teaching. TPACK emphasises the interaction between pedagogical, technical, and content knowledge domains, while TSE addresses educators' confidence in adopting new technology. These frameworks are therefore also relevant for organising the support and data collection in this study, facilitating a holistic understanding of technology integration in educational settings. Additionally, distributed scaffolding complements TPACK and TSE by providing adaptive and interactive support tailored to participants' needs (Kim, et al., 2019). A combination of these structures was used to not only understand how teachers employ *Topia* and *WorkAdventure* within their existing courses and explore whether the perceptions of educators and students align with them, but also to see if these frameworks actually apply to these platforms or the university learning-teaching context.

4. Methodology

To answer our research questions, a single case study (Yin, 2009) format was chosen to fit the inductive and exploratory design of the research method. This was so the use of *WorkAdventure* and *Topia* could be compared in one real-life university context and the patterns or differences between these platforms could be better identified. In addition, data was gathered using a variety of sources and outlets including observations of the platforms in use, one-to-one interviews with the university educators and immediate feedback taken from students through a survey.

4.1 Data Collection and Analysis

It was important for us to investigate the use of the platforms in ways that did not disturb regular class business which is why targeted, and purposeful sampling was arranged and the sampling resulted automatically from the students had already enrolled to these courses. What is important to note is that two specific online classes were purposely selected because the student groups were international and therefore offered a lot of different participants that had not yet met in person. This allowed us to better explore the aspects of social collaboration within these platforms and whether initial meaningful connections between online participants could be created. In addition, to allow better comparability for potentially varying adaptions of the template made by the educators, evaluation questions were formulated to account for this influence to isolate and analyse other factors that might affect educational outcomes, particularly the focus points of the VGPs. This included “navigation,” “collaboration” and “preference for future use.”

4.1.1 Sampling

A total of four university educators and 35 students were selected in the sample. The key demographics of each participant are displayed in table (Fig. 2) which highlights the wide variety of study participants who were sampled.

Number	Role	Location	Platform
T1	Teacher	Weimar, Germany	*Topia*
T2	Teacher	Zadar, Croatia	*Topia*
T3	Teacher	Berlin, Germany	*WorkAdventure*
T4	Teacher	Ilmenau, Germany	*WorkAdventure*
S1	Student	Ilmenau, Germany	*WorkAdventure*
S2	Student	Ilmenau, Germany	*WorkAdventure*
S3	Student	Ilmenau, Germany	*WorkAdventure*
S4	Student	Ilmenau, Germany	*WorkAdventure*
S5	Student	Weimar, Germany	*Topia*
S6	Student	Weimar, Germany	*Topia*
S7	Student	Weimar, Germany	*Topia*
S8	Student	Weimar, Germany	*Topia*
S9	Student	Weimar, Germany	*Topia*

Number	Role	Location	Platform
S10	Student	Weimar, Germany	*Topia*
S11	Student	Weimar, Germany	*Topia*
S12	Student	Weimar, Germany	*Topia*
S13	Student	Weimar, Germany	*Topia*
S14	Student	Weimar, Germany	*Topia*
S15	Student	Weimar, Germany	*Topia*
S16	Student	Weimar, Germany	*Topia*
S17	Student	Weimar, Germany	*Topia*
S18	Student	Weimar, Germany	*Topia*
S19	Student	Weimar, Germany	*Topia*
S20	Student	Zadar, Croatia	*Topia*
S21	Student	Zadar, Croatia	*Topia*
S22	Student	Zadar, Croatia	*Topia*
S23	Student	Zadar, Croatia	*Topia*
S24	Student	Barcelona, Spain	*Topia*
S25	Student	Barcelona, Spain	*Topia*
S26	Student	Barcelona, Spain	*Topia*
S27	Student	Barcelona, Spain	*Topia*
S28	Student	Barcelona, Spain	*Topia*
S29	Student	Barcelona, Spain	*Topia*
S30	Student	Barcelona, Spain	*Topia*
S31	Student	Barcelona, Spain	*Topia*
S32	Student	Barcelona, Spain	*Topia*
S33	Student	Barcelona, Spain	*Topia*
S34	Student	Barcelona, Spain	*Topia*
S35	Student	Barcelona, Spain	*Topia*

Figure 2: Study participants

The teaching experience of the university educators who led the courses ranged from less than one year to more than ten years. Furthermore, most of them reported that they had an "adequate" technical ability meaning that they had some technical knowledge and experience with digital learning tools and could use them to facilitate learning in established scenarios. However, it is important to note that almost all of them had heard of *Topia* or *WorkAdventure*, but had never used them before, making this study their first interaction with VGPs.

4.1.2 Data collection methods

The university educators were first informed about the purpose of the study which was to explore the advantages and disadvantages of VGPs *WorkAdventure* and *Topia* in university learning and teaching environments and identify useful support tools that will help students and teachers use them effectively. This was achieved by introducing specially designed templates from each platform for them to adapt and use in their courses. The single case study was organised into four phases throughout the 2023 summer semester period.

Phase 1: Two starter-kit templates with embedded "How to" resources were sent to each university educator. Here, they were expected to navigate through the template and access the resources by themselves. They could then get a feel for the platforms and choose which template they would like to work with.

Phase 2: One-to-one on-boarding sessions with an educational technology assistant. Here the university educators could get hands-on support to edit their template to a chosen learning scenario that fitted their course aims.

Phase 3: An observation of the learning scenario where the university educator used their edited template in a particular lesson activity. Students involved were first given a 5-minute introduction to the platform with access to technical assistance during the learning activity. The observation was followed by an immediate 10-minute survey with the students.

Phase 4: A post-observation 30-minute interview was conducted with the university educator which collected personal feedback and experiences using the template.

We combined observation, interview, and questionnaires to explore the advantages and disadvantages of VGPs, *WorkAdventure* and *Topia*, and identify useful support in using these platforms. Due to the nature of the study and the variety of participants, one methodological approach was simply not enough and so a "triangulation," (Flick, 2007, p.43) method that enhanced the validity and reliability of findings was adopted. Sampling people for interviews and situations for observation can offer new ways of comparison to better verify the results and increase the robustness of the conclusions drawn. In addition, each method adds unique perspectives and data types to the study. For example, the observations of the adapted template in use by the university educator in a real-life university context provided detailed insights into actual behaviour and practices interacting with the technology, adapting it to their courses, and integrating it into their teaching methods. This contextual understanding therefore helped interpret the responses from the questionnaires and interviews more accurately (Flick, 2007). The questionnaires gathered answers from both closed-ended questions from a 5-point Likert scale and open-ended questions to capture broader trends and patterns on participants' perceptions of the platform's usability, interactivity, and impact to learning. Furthermore, the interview questions were adapted from criteria that focussed on the participants TSE and level of confidence and competence in using the template for their didactic situation. This included, ease of use, clarity of instruction, quality of resources, level of support and user control. By combining these methods, a more comprehensive understanding from a range of perspectives on the advantages, disadvantages, and usability of the VGPs in university settings could be determined.

5. Results

In this section, the results have been divided into two subtopics; the first addresses the user perception of *WorkAdventure* and *Topia* from both students and teachers, whereas the second evaluates the effectiveness of the various support strategies that were integrated. Consequently, this arrangement not only highlights all the different perspectives on the virtual gathering platforms from the study participants, but evaluates how these findings align with the TPACK, TSE and distributed scaffolding frameworks.

5.1 User Perception

For the first subtopic, results have been drawn from answers to the same questions taken from both the student survey and the post-observation interviews from the university educators. This allowed us to gain a better understanding of the advantages and disadvantages of *Topia* and *WorkAdventure* in university teaching and learning settings from a broad user perspective.

5.1.1 Experience level with VGPs

In the survey, the 35 participants were asked about their previous experience with VGPs (Fig.3). Of which, 16 were classed as "intermediate users" meaning that they had some experience but not extensive use with VGPs, either using them once or a few times before. There were also 16 participants categorised as "novice users," those that have little to no experience with these platforms and had never heard of them or used them before. Finally, there were 3 participants who regarded themselves as "experienced users" and had frequently used VGPs.

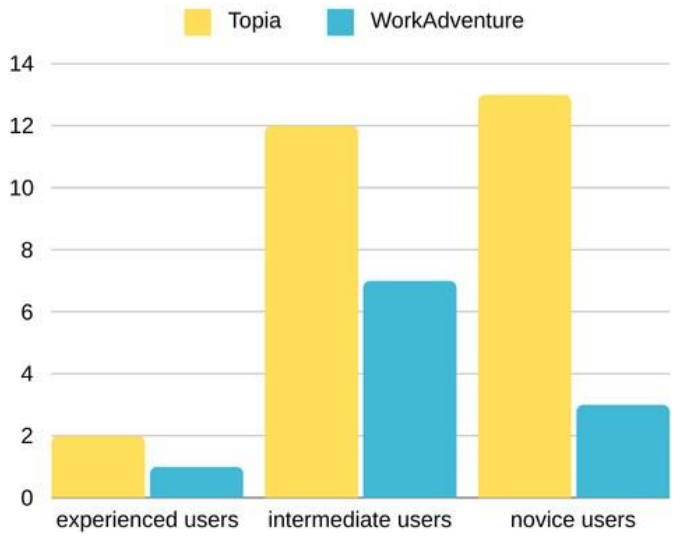

Figure 3: Survey results: "What is your previous experience with VGPs?

5.1.2 Ease of navigation and communication

Results of the survey indicated that just over half the participants, 19 altogether, rated the navigation and communication as "easy" or "very easy" and therefore had a high ease of using these platforms (Fig.4). 11 participants scored navigation and communication as "somewhat easy" and the other 4 participants had a low ease navigating around the platforms and communicating with other participants indicating that this was either "difficult" or "very difficult" to achieve.

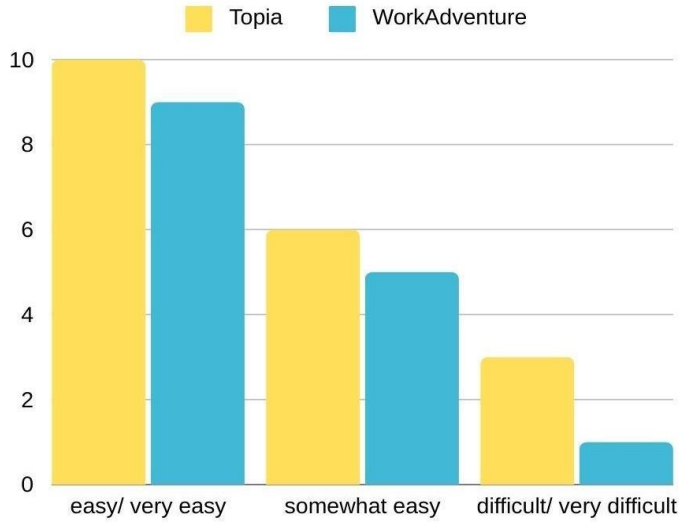

Figure 4: Survey results: "On a scale of 1-5, how easy was it to navigate around the platform?"

5.1.3 Effectiveness of the platforms for collaboration and learning

For supporting collaboration, 9 participants rated these platforms to be either "effective" or "highly effective" (Fig.5). 17 participants rated the platforms more moderately as "somewhat effective" and 11 participants rated them as either "ineffective" or "very ineffective" for collaboration, teamwork and supporting learning activities. However, when it came to using the adapted template in their chosen learning scenario, responses from the university educators were more critical with two rating their template as unsuccessfully supporting their learning scenario.

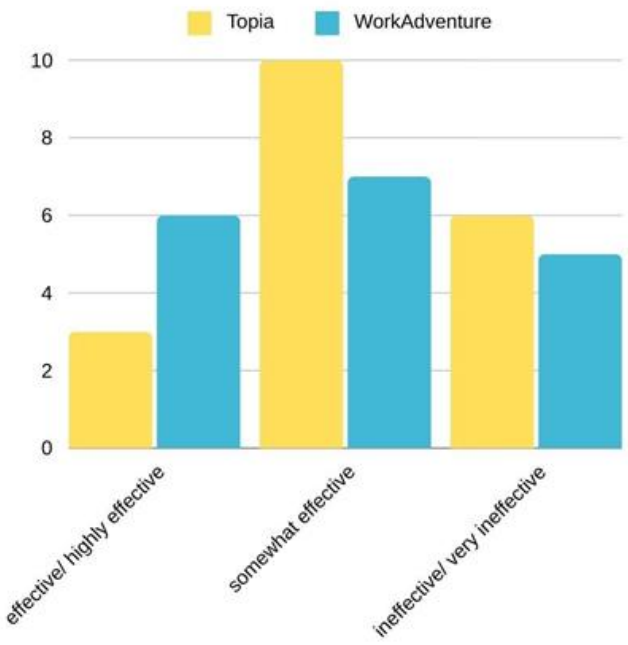

Figure 5: Survey results: "On a scale of 1-5, how effective was the platform in supporting your collaboration and teamwork with other students? / On a scale of 1-5, how easy was it to communicate with the other participants in the platform?"

5.1.4 Positive experiences

Participants who identified specific features of *WorkAdventure* and *Topia* that positively affected their learning experience included T2's comment that the platforms are "easy to use" and the way of navigating and talking to other participants and the simulation of a "real life" video game is motivating. For example, T4 commented that "students were more engaged and relaxed," a condition that could not be replicated with other video conferencing software like *Zoom*. S12 and S19 emphasised "the customisable avatar" as a positive feature. S17 wrote "It was nice and playful to walk around and talk to people." This was further supported by S16 who added "navigating like in a video game was very interesting and brought the team closer to each other." In addition, S19 stated that "real life simulation helps overcome the long-distance barrier.", and S21 remarked that "It was a lot of fun" meaning a more personal and enjoyable experience.

In addition, many students felt that having the platform interface as a storage space for all work material was very useful and has a lot of potential for a variety of learning situations. For instance, S34 highlighted that "having all the sources in one platform and having team-mates to talk to is useful while working on something", and S15 liked "using different features (audio, video, links to *Miro* board, etc.)" within one platform. This aspect was also mentioned by S4 who attributed the "one-step storage place for all the work material" as a positive feature.

Another positive feature noted by the university educators was the "follow me" option which allows users to follow the movements of others like a guided tour. "When I asked my students to follow me and I showed them the rooms available in *WorkAdventure*, it turned out to be playing hide and seek […] The students are more relaxed and I had the feeling that they are enjoying it," highlighting the increase in engagement compared to a regular video conference meeting.

5.1.5 Negative experiences

Regarding the limitations, participants who identified specific features of *Topia* and *WorkAdventure* that negatively affected their learning experience noted that usability could be slow at times with buffering problems and other connection issues with the internet browser. For example, T1 wrote that there were "too many technical issues." S25 wrote "I had quite a few problems with loading the platform, it was buffering constantly" and S26 mentioned that they had "connection issues." S23 also described the experience as "glitchy" and S10 noted that "people experienced difficulties with audio."

Furthermore, many participants noted the time needed to get used to the platform beforehand, emphasising the importance of clear user instructions and on-boarding of the platform before the learning scenario takes

place. For example, S15 said "it needed a bit of time to get used to." This was further reciprocated by some of the university educators who emphasised the amount of time needed to adapt the templates if they encountered problems and needed to troubleshoot. T3 mentioned "due to problems with linking the sources I had to invest some more hours to fix it." S16 also described the initial experience as "chaotic" and S28 emphasised "I spent more than ten minutes at the beginning to understand how it works." S19 recommended that "before letting students use *Topia*, it is better to give them some tips or make some tutorials integrated into the system."

Moreover, the nature of the spatial technology which connects the users was also criticised. For example, even though the user area of the templates was big enough to avoid conversations overlapping, there was little regulation for students to interrupt other conversations if they wanted to. S31 picked up on this stating "people joining within a discussion is quite interrupting." S28 also added "When wanting to talk to someone, you would always hear and see everyone else as well." This was further supported by S14 who remarked "there were too many people talking at the same time." However, it must be noted that some participants saw the advantages. For example, S24 viewed "the freedom to leave a conservation" as a positive feature.

Some of the university educators felt that there was no obvious way to offer feedback to the students on whether their instructions could be heard or not. For instance, T1 tried using the broadcast feature and realised that the participants could not give feedback. T2 also commented "the broadcasting tool is not so good as one does not know if the other hear you or cannot respond to you." Therefore, there were limitations to how the whole group could be coordinated.

5.1.6 Preference for future use

Despite these experiences, 19 participants expressed an interest in using VGPs in future teaching and learning situations with 9 participants somewhat interested, and 7 participants not interested and unlikely to use them again (Fig.6). Generally, participants felt more motivated using them compared to other online learning settings highlighting their potential. For example, S9 described it as "a great concept" for teaching and learning experiences and S10 saw it as "promising for group work." S21 also highlighted that they "would love to use it again" and S28 remarked "with more time and more precise interactions, it would be perfect." T3 also showed interest if there was an opportunity to increase the user limit, stating that they would like to use these platforms for courses with larger student groups. This was further reinforced by T4 who said, "the platform has potentials to be used in teaching," but also highlighted that "the most difficult thing is to find the time to prepare the scenario that will fit the needs of the class." Others were more sceptical with T2 highlighting the technical problems outweigh the possibilities and is "not so suitable to coordinate a whole group" or use in complex teaching projects. T1 also expressed it caused "more stress than fun" and was "unlikely" to use it in future.

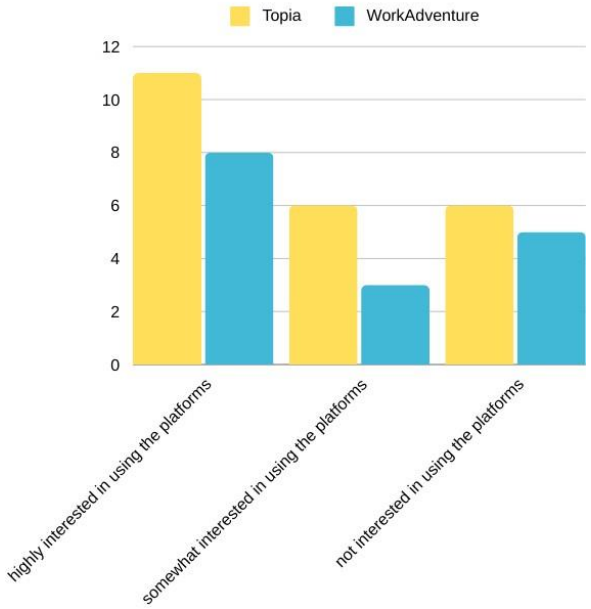

Figure 6: Survey results: "Would you like to use this platform or similar VGPs in future learning situations?

5.2 Support Strategies

The second subtopic showcases the results from the post-observation interviews with the university educators which collected personal feedback and experiences using the template. The interview focussed on the participants TSE and level of confidence and competence in using the template for their teaching situation. This included, ease of use, clarity of instruction, quality of resources and level of support. This data has been further supplemented with information collected during the observation of the learning scenario where the university educator used their edited template in a particular lesson activity. Through these results, we could gain a better understanding of the different support strategies and their effectiveness and thus, use this to examine TPACK, TSE and distributed scaffolding frameworks.

5.2.1 Learning scenario planning

During the study, one learning example from the *Topia* starter-kit template was created, and one from *WorkAdventure*. *Topia* was chosen to host an initial online icebreaker activity for an international student group based in Germany, Croatia, and Spain for their first meeting of the semester. They were split between four *Topia* worlds and interacted in pairs for three-minute sessions guided by simple "getting to know you" questions which replicated "speed dating," moving from one person to the next.

A second example adapted the *WorkAdventure* starter-kit template into a virtual space where international students based in Germany could access material and tools needed for their seminars at any time. This included an online cloud storage drive, related course websites, links to a video conference room and collaborative whiteboard as well as contact information of the teachers and opportunities to meet them directly in the template. Its use was observed through a scenario in which a group of students were offered an online guided tour of the template and its resources.

5.2.2 Adaption process

The time taken to adapt the starter-kit templates varied widely (Fig.7). *Topia* required a quick adaption with T1 taking between 1-3 hours and T2 taking less than 1 hour. However, for those who used *WorkAdventure* the adaption time was more moderate to lengthy because of the extra steps needed to download software and view modifications. It generally takes more time to set-up and use effectively. For example, T3 dedicated 5-10 hours and T4 took more than 10 hours to adapt their template. Generally, the more time teachers engaged with the software, the faster they could learn how to use it and adaption became more intuitive. However, it must also be noted that the number and various types of features that the teachers wanted to integrate into the template also had an effect. Some of these options meant editing the already included coding encryption which therefore took more time to complete.

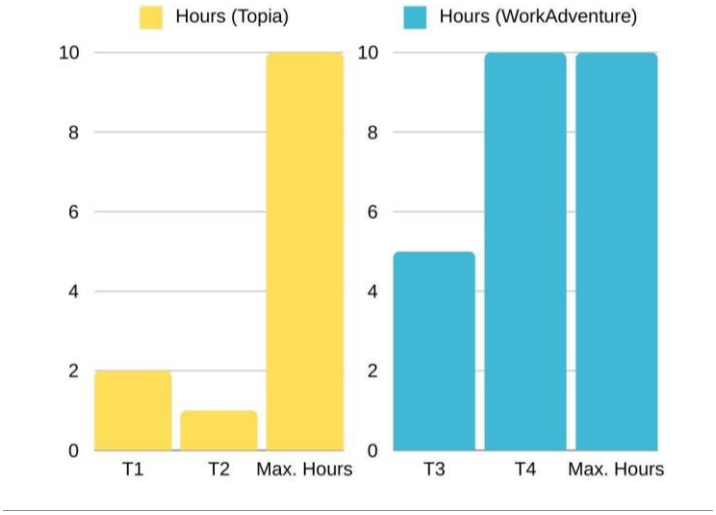

Figure 7: Survey results: "Approximately how many hours did it take you to adapt the starter-kit template for your learning scenario?"

5.2.3 Perceptions of the starter-kit templates with integrated "how to" resources

When using the starter-kit templates as an interface for on-boarding and learning how to use a new software, two participants rated this as "highly effective." One rated the on-boarding as "somewhat effective" and the final teacher did not use these resources, preferring to only use the one-to-one technical support (Fig.8). Generally, the templates provided a good starting point for the participants to create their own online rooms, as T3 noted "the template provides a good basis for an online room, with a few adjustments we could adapt it to our teaching scenario." In terms of the resources provided given to work with these platforms independently, most participants felt that the template provided the necessary resources. However, interestingly, the video tutorials embedded into these templates were only used by one participant. In terms of missing resources, T2 identified a need to provide guidance on how to help others (the students) use the tool and T1 suggested clearer information on the capabilities of the platform's features. For instance, knowing that when using the broadcasting feature, the other users are unable to give feedback.

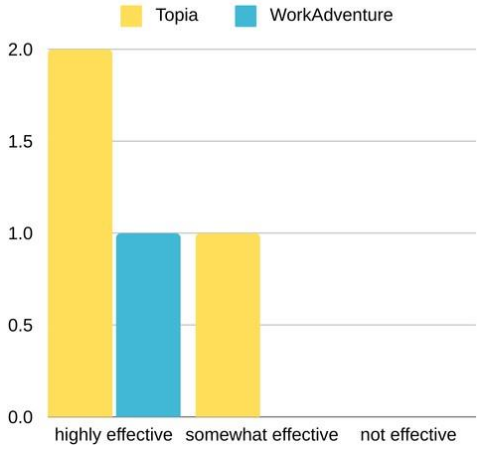

Figure 8: Survey results: "In your view, how effective was the template as an interface to access all of the onboarding resources and show what is possible"

5.2.4 Effectiveness of the one-to-one on-boarding session

The on-boarding sessions were rated most highly with all participants finding this type of support as "effective" or "very effective" (Fig.9). Furthermore, three of the participants noted that they would not have used these platforms if this type of support was not available to them. Regarding what could be improved in the on-boarding sessions, T3 suggested a better explanation on how to use *Github*, the online repository that allows users to self-host their *WorkAdventure* map.

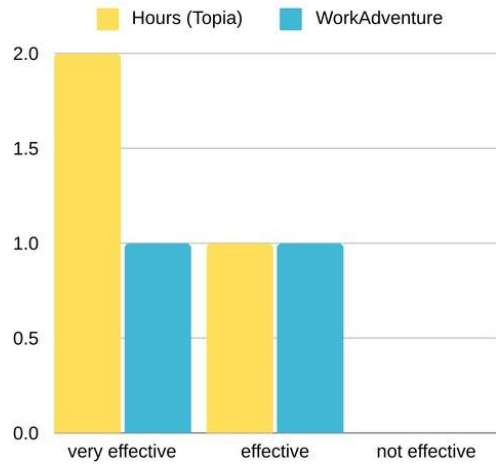

Figure 9: Survey results: "In your view, how effective was the one-to-one technical support and feedback during the 1:1 session?"

6. Discussion

The analysis of the survey results from the 35 participants reveals that they exhibit a diverse range of experiences and perceptions regarding VGPs *Topia* and *WorkAdventure*. Through this, various advantages and challenges associated with the use of these platforms in university teaching and learning environments were identified as well as the preferred support strategies that assisted their use. At first sight, these experiences could be assigned to the existing frameworks of TPACK, TSE and distributed scaffolding, as identified by previous literature. However, as a more detailed comparison below shows, there are some differences that only partially align, and these should be acknowledged when designing and implementing effective support strategies for the integration of 2D metaverse technology into educational practices.

6.1 User Perception

The study exposed a range of experiences among participants regarding VGPs, ranging from "novice" to "experienced" users. Understanding the participants' proficiency levels against whether they viewed the platforms to be "effective" or not confirms the view of Gomez, et al. (2022) on the importance of understanding users' TSE when integrating virtual technologies into teaching and learning situations. For example, participants with higher TSE have more confidence using this technology and are more likely to better engage with and benefit from the interactive experiences offered by these platforms. Conversely, learners with lower TSE may face challenges in navigating and using the 2D metaverse environment, which could negatively impact their learning experience and performance. However, the study also highlights other variables that can affect TSE on technology performance-based outcomes. For example, while most participants found navigation and communication within the platforms "easy" or "somewhat easy", a notable portion encountered difficulties because of connection issues despite their levels of experience. This led to their rating of platform effectiveness for collaboration and learning as "somewhat effective" or "ineffective." It must be said that even when integrating tailored support strategies from TSE and TPACK framework models to accommodate diverse user needs, there is still a strong possibility that the communication channels of the user experience is challenged. This is especially the case for VGPs which aim to connect users from different locations. Therefore, the necessity of understanding external variables such as having access to the resources needed to effectively use these programs (in this case, a stable internet connection) has a stronger influence than previously thought.

Furthermore, the result of the study also shows a keenness to use these platforms in future despite the technical problems. This aligns with Zheng, Jun and Di (2022) who concluded that students are more susceptible to metaverse technologies and the features of *WorkAdventure* and *Topia* made an impact. The rate of technological development that students have become accustomed to provides hope that the stability and capacity of these platforms will improve in future, leading to a stronger confidence in using them in teaching and learning contexts. It can be argued that the recent pandemic's impact on teaching and learning has influenced the current attitudes of the participants, particularly as they were the generation whose education experiences included a significant amount of telepresence in their real-time courses (Kang and Park, 2022).

6.2 Support Strategies

Insights into the adaptation process of starter-kit templates for specific learning scenarios highlighted varying time investments and perceptions on the integrated "How to" resources. Participants generally found the starter-kit templates effective for on-boarding, although improvements were suggested in certain areas. Interestingly, the low utilisation of the embedded user guides and video tutorials suggests a preference for more interactive and hands-on technical support methods. This challenges some of the principles of distributed scaffolding which suggests a system of support that involves multiple resources and demonstrations of a task with opportunities to practice independently afterwards. Participants instead expressed a need for a quick familiarity with the platform and this was enhanced during the one-to-one sessions where participants could meet directly within the templates and receive their on-boarding at a steady pace. Receiving immediate support through the tool itself allowed them to become more familiar with the platforms and better understand the collaborative user relationship that they demonstrate. In other words, they were essentially simulating the student collaborative experience that they would later facilitate. This resonates with Kshetri's (2022) observation on metaverse technology and its ability to replicate practical exercises, an advanced form of active learning and problem solving.

Furthermore, the results show a preference for collaborative support structures when facilitating technology integration. For example, the effectiveness of one-to-one on-boarding sessions was highly valued by participants, emphasising their role in facilitating platform adoption and use. Personalised technical guidance

initiated through scaffolding tools such as modelling and demonstrations on how to use VGPs proved effective for successful technology integration efforts. Moreover, encouraging a collaborative environment by defining clear goals with the participants with a shared aim in adapting the template to a particular learning setting promoted a mutual understanding and enhanced teamwork as well as implementing Pedagogical Content Knowledge. This necessity for tailored support aligns not only with the principles of distributed scaffolding, but reflects the interplay between technological knowledge, pedagogical knowledge, and content knowledge within TPACK.

6.3 Recommendations

Irrespective of the results obtained, there are limitations regarding the number of survey participants. Firstly, even though there were participants from various countries involved, only four university educators took part in the study. Therefore, subsequent future analysis should involve more participants for broader results that can be employed by quantitative methods and representative samples to validate and expand upon the current findings. Secondly, ongoing template development based on participants' feedback and suggestions would be the next logical step for enhancing the usability and effectiveness of VGPs in educational settings. However, it is also important to note the influence of the educator's utilisation of the template and how this can have an impact. For example, it would be interesting to research into potential design principles of VGPs and how this can increase their effectiveness in educational settings and mitigate troubleshooting issues. For instance, the exploration of the features of VGPs for resources to be used individually outside of the classroom within blended learning scenarios. This specific template direction not only avoids the technical problems previously encountered through an overloaded system from simultaneous usage but supports the potential of using these platforms as a storage space for accessing material at any time and meeting their peers or teachers aside from regular class activities.

7. Conclusion

This study shows the impact of VGPs *Topia* and *WorkAdventure* on both user perception and support strategies in higher education contexts. The findings generally support the potential of these platforms to enhance engagement, collaboration, and learning experiences, aligning with recent trends towards 2D metaverse technologies. However, the study also emphasises the complexity of integrating VGPs into educational practices highlighting challenges such as technical limitations and the need for tailored support strategies to effectively address diverse user needs. Current educational literature is constantly trying to address similar challenges by exploring various frameworks and methodologies to guide technology integration and develop the digital competencies of educators. This brings into question the best support needed for teachers to successfully engage with these technologies and streamline the adaptation of already existing learning materials.

Using the example of *Topia* and *WorkAdventure*, the study contributes to the existing literature by providing insights into the experiences of users, adaption methods and certain support strategies that can aid their use in higher education learning scenarios. It is already clear that their implementation can be adjusted to specific educational contexts as well as accomplish collaborative, hands-on technical support that simulates the interactive features of the platforms. This provides a valuable starting point for future study, particularly into suitable design principles of VGPs that increases their effectiveness in educational settings to mitigate troubleshooting issues. In addition, there is a necessity to understand external variables of the users such as location, access, and age as well as existing frameworks for educational technology integration. Only in doing so can the integration of VGPs into teaching and learning environments be successful. By addressing these areas and answering questions about the support needed for teachers, institutions can strike a balance between facilitating teacher-led initiatives and understanding the minimal technical support required to host them.

Ethics

Ethics approval was not required for this study. All participants provided informed consent before their involvement in any aspect of the research. As there were no experimental interventions, ethical review was neither sought nor deemed necessary.

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