

Exploring Cognitive Engagement in Extreme e-Service Learning for Multimedia Creative Course During the COVID-19 Pandemic

Valerie Bukas Marcus¹, Noor Azean Atan¹, Sanitah Mohd Yusof¹, Lokman Tahir¹

¹School of Education, Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia

* valeriebukas92@gmail.com, azean@utm.my, p-lokman@utm.my, p-sanitah@utm.my

Received: 13 March 2024

Received in revised form: 25 April 2024

Accepted: 5 May 2024

Published: 25 July 2024

ABSTRACT

The COVID-19 pandemic prompted a global shift towards online learning, necessitated by restrictions on physical interaction. Consequently, Multimedia Creative Courses incorporating Service Learning were transformed into Extreme e-Service Learning (Xe-SL), conducted entirely online. In the realm of online e-Service Learning, ensuring student engagement and knowledge retention are crucial to successful course completion. While behavioural engagement can be easily observed, assessing cognitive engagement presents a challenge. Cognitive engagement involves the learner's psychological investment in the learning process, their willingness to comprehend the material, and their drive to attain the highest levels of understanding. This study explores the cognitive engagement of students in Extreme e-Service Learning (Xe-SL), an online learning approach implemented during the COVID-19 pandemic. A case study was conducted involving 27 undergraduate students undertaking a Multimedia Creative project within Xe-SL. Thematic analysis of collected reflections revealed distinct patterns of cognitive engagement across different phases. Prior to Xe-SL, students demonstrated cognitive engagement through understanding concepts, problem solving, critical thinking, self-reflection, and self-improvement. During Xe-SL, cognitive engagement was evident in the acquisition of new skills and tools, overcoming challenges, reflection, and recognizing the impact and benefits of their work. Post-Xe-SL, students exhibited increased skills and knowledge, engaged in teaching and mentorship, fostered collaboration and teamwork, applied problem-solving skills, and retained and applied their knowledge. These findings provide insights into the cognitive engagement processes within Xe-SL and offer practical guidance for designing effective online learning activities. Furthermore, the study highlights the enduring impact of Xe-SL on students' skills, collaboration abilities, problem-solving proficiency, and knowledge application. This research contributes to the understanding of effective online pedagogy and underscores the benefits of Xe-SL. Educators, instructional designers, and policymakers can leverage these findings to enhance student engagement and promote meaningful learning experiences in online service learning environments.

Keywords

student engagement; cognitive engagement; e-service learning; extreme e-service learning; online service learning

Introduction

The outbreak of the COVID-19 pandemic led to unprecedented disruptions in the education sector, compelling educational institutions worldwide to swiftly adapt their traditional face-to-face learning processes to fully online formats. Among the courses affected by these changes was a Multimedia Course offered at a public university in Malaysia. This course incorporated service learning as a critical element of its curriculum, presenting a unique challenge for instructors who were now required to make rapid adjustments to ensure the continuity of this essential component in the online environment. Service Learning is an educational approach that combines academic instruction with meaningful community service, allowing students to apply their theoretical knowledge and skills to real-world situations (Eyler et al., 1999). It involves engaging in service activities that address community needs while fostering students' personal and social growth. The transition to online learning posed significant challenges for the effective implementation of service learning, as the face-to-face interactions, hands-on experiences, and direct community engagement that are integral to this pedagogical approach were suddenly rendered impossible due to physical distancing measures and restrictions.

In response to the challenges posed by the pandemic, educators and institutions turned to innovative approaches to adapt service learning to the online environment. One such adaptation is Extreme e-Service Learning (Xe-SL), which encompasses service learning activities conducted entirely online (Waldner et al., 2010). Extreme e-Service Learning aims to provide students with opportunities to engage in meaningful service activities, collaborate with community

partners, and apply their learning remotely. One of the key benefits of Extreme e-Service Learning is its ability to maintain the core principles of service learning while overcoming the physical barriers imposed by the pandemic (Drewelow & Granja Ibarreche, 2021). According to Yu et al. (2023), students can still make valuable contributions to their communities and develop a sense of civic responsibility, albeit in a virtual context. They can utilize various digital platforms and technologies to connect with community organizations, design and implement projects, and reflect on their experiences (Khatani et al., 2023). Apart from this, Xe-SL also offers several advantages. Firstly, it promotes flexibility and accessibility (Waldner et al., 2010). Online platforms allow for a wider range of community partnerships, as geographical constraints are no longer a limitation. Students can collaborate with organizations and individuals from different regions, expanding their understanding of diverse community needs and contexts. Secondly, Xe-SL encourages the development of digital literacy and technological skills, which are essential in the modern workforce (Selmo, 2020). Students gain experience in utilizing digital tools, communicating effectively online, and navigating virtual environments.

However, Extreme e-Service Learning also presents its own set of challenges. According to Waldner et al. (2012), building and maintaining meaningful connections with community partners can be more complex in an online setting, as face-to-face interactions and personal relationships are limited. Effective communication and coordination become crucial to ensure successful collaboration and alignment of project goals. Additionally, the absence of physical presence and hands-on experiences may affect the depth of students' engagement and the immersive nature of their service activities (Chesser et al., 2021). The challenges posed by Xe-SL in terms of building and maintaining meaningful connections, effective communication, and the absence of physical presence and hands-on experiences directly impact students' cognitive engagement (Waldner et al., 2012). According to Richardson and Newby (2006), cognitive engagement refers to the mental processes and activities through which students actively participate in learning, make meaning of information, and develop critical thinking skills. In the context of Xe-SL, cognitive engagement is influenced by the level of interaction and connection established with community partners (Li et al., 2016). The limited face-to-face interactions and personal relationships in the online setting may hinder the development of a deep sense of engagement and connection with the service project (Waldner et al., 2012). Students may find it challenging to establish rapport and understanding without the benefit of in-person interactions. Consequently, their cognitive engagement in the service learning experience may be affected, as the depth of their involvement and investment in the project may be compromised (Marcus et al., 2020).

Moreover, effective communication and coordination play a vital role in fostering cognitive engagement (Bond & Bedenlier, 2019). Clear and frequent communication between students and community partners is essential to ensure that project goals are aligned, expectations are managed, and feedback is provided (Waldner et al., 2010). Without effective communication channels, students may struggle to fully understand the needs and expectations of the community, resulting in reduced cognitive engagement as they may not be able to effectively apply their knowledge and skills to address those needs. The absence of physical presence and hands-on experiences can also impact the depth of students' cognitive engagement. In traditional service learning, students often engage in immersive experiences that allow them to directly interact with the community, apply their learning in real-world settings, and reflect on the outcomes (Bringle & Hatcher, 1996). In an online setting, the lack of physical presence and hands-on experiences may limit the opportunities for students to fully immerse themselves in the service activities (Ngai et al., 2023). This may result in a reduced level of cognitive engagement, as students may find it challenging to connect their theoretical knowledge to real-world applications and reflect on the impact of their actions (Yu et al., 2023). The challenges and considerations surrounding cognitive engagement in Extreme e-Service Learning (Xe-SL) during the COVID-19 pandemic highlight the importance of exploring this topic in greater depth. Understanding how cognitive engagement is affected by the unique characteristics of Xe-SL can provide valuable insights for educators, instructional designers, and policymakers in designing and implementing effective online service learning experiences.

Therefore, this study explores cognitive engagement in Extreme e-Service Learning (Xe-SL) during the COVID-19 pandemic, specifically within the context of a Multimedia Creative course. By conducting a case study and analyzing the reflections of participating students, this research aims to identify the themes or characteristics of cognitive engagement that emerge throughout the Xe-SL experience. Understanding the themes or characteristics of cognitive engagement in Xe-SL is crucial for several reasons. Firstly, it allows us to gain insights into how students engage cognitively in the online service learning environment, considering the unique challenges and opportunities it presents. By identifying these themes, we can better understand the factors that influence cognitive engagement and how they manifest within the context of Xe-SL. Secondly, exploring the themes or characteristics of cognitive engagement in Xe-SL helps us assess the effectiveness of this online learning approach in promoting active and meaningful student

participation. By understanding the nature and extent of cognitive engagement, we can evaluate the outcomes and impact of Xe-SL on students' learning, personal development, and ability to apply their knowledge and skills in real-world settings.

Additionally, the findings of this study can provide practical implications for educators, instructional designers, and policymakers involved in designing and implementing online service learning experiences. By identifying the themes or characteristics that foster cognitive engagement, these stakeholders can develop strategies and interventions to enhance students' cognitive engagement in Xe-SL. This, in turn, can lead to more meaningful and transformative learning experiences for students in the online learning environment. In conclusion, this study aims to explore the themes or characteristics of cognitive engagement in Xe-SL during the COVID-19 pandemic. By conducting a case study and analyzing student reflections, we seek to gain insights into how cognitive engagement manifests within the context of an online Multimedia Creative course. Understanding these themes can provide valuable information about the effectiveness and impact of Xe-SL, while also offering practical implications for enhancing students' cognitive engagement in online service learning experiences.

Literature Review

Introduction to Service Learning and Extreme e-Service Learning

According to Eyler and Giles Jr (1999), service-learning is a form of experiential education where learning occurs through a cycle of action and reflection as students work with others through a process of applying what they are learning to community problems and at the same time, reflecting upon their experience as they seek to achieve real objectives for the community and deeper understanding and skills for themselves. As articulated by Hatcher et al. (2004), service learning entails more than mere community engagement; it's a credit-bearing educational endeavour that encompasses a deliberate intertwining of academic content and practical service engagement. Students not only contribute to the betterment of their communities but also have the opportunity to gain a richer grasp of their course content, fostering a broader appreciation for their field of study. This engagement goes beyond academia, cultivating a heightened sense of civic responsibility. This holistic approach to education seeks to bridge the gap between theoretical knowledge and its practical application, fostering well-rounded learners who are not only equipped with subject expertise but are also actively engaged citizens.

In the rapidly evolving landscape of online education, online Service Learning emerges as a dynamic approach that pushes the boundaries of traditional virtual learning experiences. Online Service Learning also known as e-Service Learning was first being introduced by Waldner et al. (2012). According to Waldner et al. (2012) there are four types of service learning. There are Hybrid Type I where service fully conducted on site with teaching fully online, service fully online with teaching fully online as Hybrid Type II, a blended format of instruction and service done partially online and also on site known as Hybrid Type III and lastly, the Extreme e-Service Learning which instruction and service was done fully online which is the setting of this study.

Up until the recent COVID-19 pandemic, not much research was directed towards Extreme e-Service Learning. Prior to this, most of the research in the field of Service Learning mainly concentrated on creating and shaping online service learning experiences, along with comparing them to the traditional in-person ones (Marcus et al., 2020). However, when the pandemic struck, many educators had to quickly shift their services online due to safety reasons. As a result, there has been a noticeable increase in research regarding Extreme e-Service Learning. This sudden change in circumstances sparked a surge of interest in understanding how to effectively use technology for service learning, especially in situations where physical presence is not possible. This shift has led to more exploration into the unique aspects of Extreme e-Service Learning and its impact on both learners and the communities they engage with.

Recent research by Wong and Lau (2023) substantiates that e-service-learning stands on par with traditional service-learning in its efficacy to enhance student developmental outcomes. Meanwhile, Khiatani et al. (2023) conducted a scoping review on service-learning under the COVID-19 context, unveiling the challenges and opportunities that emerge in practicing service-learning within the 'New Normal'. Further insights from Yu et al. (2023) reported that Mainland Chinese students hold favorable perceptions of their engagement in e-Service Learning during the pandemic, appreciating its convenience and online efficiency. Yet, their study participants voiced a desire for heightened direct interaction with service recipients to enrich their reflective processes. In a comprehensive study, Ngai et al. (2023) delved into students' e-Service-Learning experiences and outcomes during the pandemic on a large scale, indicate that

e-Service Learning is effective in enhancing students' cognitive and civic learning. Much of the existing research has primarily concentrated on the quantifiable outcomes of e-Service Learning, such as academic achievement, skill development, and personal growth. While these outcomes are important, they often overshadow the deeper examination of how students actively engage with the learning process, both intellectually and emotionally.

In the realm of Extreme e-Service Learning (Xe-SL), a significant gap exists within the literature concerning the exploration of student engagement – a critical dimension of effective learning experiences. Waldner et al. (2012) suggested that Online Service Learning could help bridge the engagement gap in Online Learning. While this idea is valuable, it's important to dive deeper into student engagement dynamics within online service learning. The reason for this exploration lies in the changing educational landscape. Integrating service learning into online platforms brings in new factors and challenges that need thorough examination. This study aims to understand student engagement in online service learning, recognizing that blending these two methods might lead to different outcomes compared to traditional online learning or service learning separately. By focusing on this blend, the study aims to offer a detailed understanding of how students engage in online service learning. Understanding how students engage cognitively in Xe-SL projects holds the potential to enhance the quality and impact of their learning experiences. The gap is notable not only due to the transformative potential of Xe-SL but also because cognitive engagement is an established predictor of academic success and long-term learning outcomes.

Cognitive Engagement in Online Learning

Studies in student engagement especially for cognitive engagement has been around for a decade. Fredricks et al. (2004) stated that cognitive engagement involves investment, requiring thoughtfulness and a willingness to put in the necessary effort to comprehend complex ideas and master difficult skills. They add on that the extent of cognitive engagement can vary from basic memorization to implementing self-regulated learning strategies that foster in-depth understanding and expertise. Quoting definition of cognitive engagement from Richardson and Newby (2006), cognitive engagement was defined as “the integration and utilization of students’ motivations and strategies in the course of their learning.”

Cognitive engagement in online learning distinctly differs from cognitive engagement in online service learning due to the unique nature and objectives of each approach. In online learning, cognitive engagement primarily involves students’ active participation in absorbing and processing information presented within digital platforms (Shan, 2021). Learners interact with course materials, engage in discussions, and complete assignments in virtual settings. The focus here is on the assimilation of subject matter, often through individual exploration, reflection, and comprehension. Cognitive engagement in online learning revolves around understanding concepts, retaining knowledge, and demonstrating mastery of content within the context of the course.

Extensive research has been conducted on cognitive engagement in online learning, with multiple studies examining different aspects of this phenomenon. Scholars such as Pavel and Wysocki (2007) and Richardson and Newby (2006) have emphasized the critical role of students’ motivations and strategies in their cognitive engagement. Shukor et al. (2014) takes this further by proposing a predictive model based on students’ participation and written messages, identifying factors such as sharing information and posting high-level messages as significant contributors. Meanwhile, Peng (2017) expands on this by introducing a model that includes behavioural, knowledge, and emotional engagement, and develops evaluation indicators for each dimension. Together, these studies underscore the complex nature of cognitive engagement in online learning and the importance of a comprehensive model to fully understand and measure it.

On the other hand, cognitive engagement in online service learning expands beyond the acquisition of knowledge to encompass the application of learned concepts in real-world scenarios. In online service learning, students collaborate virtually to address community needs, solve problems, and contribute meaningfully to external contexts. The engagement goes beyond cognitive processing; it integrates critical thinking and problem-solving skills to create tangible solutions that have an impact beyond the virtual classroom. This form of engagement involves interacting with diverse perspectives, negotiating complexities, and adapting knowledge to address authentic challenges.

Previous Studies on Cognitive Engagement in Extreme e-Service Learning

Existing research on cognitive engagement within the context of Extreme e-Service Learning is relatively limited. There's a notable lack of comprehensive literature examining the intricate relationship between cognitive engagement and Service Learning, let alone within the unique framework of Extreme e-Service Learning. Notably, Rockquemore and Harwell Schaffer (2000) conducted a study investigating the cognitive processes that students undergo while participating in service learning experiences. They emphasized that comprehending how students engage cognitively is pivotal for enhancing the efficacy of Service Learning as an educational tool. Their findings unveiled a three-stage progression that students typically traverse: (i) shock, (ii) normalization, and (iii) engagement. Similarly, Li et al. (2016) delved into the impact of student engagement on the outcomes of Service Learning. Their research indicated that student engagement exhibited different developmental trends throughout the Service Learning process. These insights highlight the complex interaction between cognitive engagement and the evolving dynamics of Service Learning.

Online service learning is a promising area for engagement, but there is a notable gap when it comes to models that specifically address cognitive engagement. Despite extensive research on engagement in various educational settings, there is a lack of comprehensive frameworks or models that focus on cognitive engagement in the context of online service learning. This presents an opportunity for further exploration and development of effective engagement models in this important area.

Considering the scarcity of research in the context of Extreme e-Service Learning, these prior studies serve as valuable starting points to recognize the cognitive dimensions of student engagement. The gaps in the existing literature underscore the significance of conducting in-depth investigations into cognitive engagement within Extreme e-Service Learning. By delving into this unexplored terrain, the current study seeks to contribute fresh insights into the intricate relationship between cognitive engagement and the unique aspects of online service learning.

In conclusion, the imperative to study cognitive engagement in Extreme e-Service Learning is rooted in the alignment between cognitive engagement's intrinsic attributes and the objectives of Xe-SL. This investigation has the potential to offer insights into enhancing students' collaborative problem-solving abilities, adapting to virtual environments, and nurturing a sense of global citizenship. Through this exploration, educators can refine instructional strategies, curriculum design, and pedagogical practices, ensuring that cognitive engagement is maximized, and the transformative potential of Xe-SL is fully harnessed.

Introduction to the Cognitive Apprenticeship Model

The Cognitive Apprenticeship Model, developed by Collins et al. (1989), is a theoretical framework that has been widely used to understand and promote effective learning across various domains. This model is rooted in the notion of learning as an active and social process, where learners acquire knowledge and skills through guided participation in authentic tasks within a supportive learning environment.

Key Components of the Model:

Social Context: The Cognitive Apprenticeship Model emphasizes the importance of social interaction in the learning process. Learners engage in authentic tasks within a community of practice, where they have opportunities to observe, collaborate with, and receive guidance from more knowledgeable others, such as teachers, mentors, or peers.

Scaffolding: Central to the Cognitive Apprenticeship Model is the concept of scaffolding, where learners are provided with structured support to facilitate their learning. This support may include modelling, coaching, and fading of assistance over time, allowing learners to gradually develop independence and expertise.

Authentic Tasks: Learners in the Cognitive Apprenticeship Model engage in authentic tasks that resemble real-world problems or challenges. These tasks are situated within meaningful contexts that are relevant to learners' interests and goals, enhancing their motivation and engagement.

Cognitive Processes: The model identifies several cognitive processes that are essential for effective learning, including knowledge acquisition, problem-solving, critical thinking, reflection and metacognition, active information

processing, and transfer of learning. These processes are fostered through active engagement in authentic tasks and supported by social interaction and scaffolding.

The Cognitive Apprenticeship Model offers a valuable framework for understanding cognitive engagement in learning and its implications for instructional design and practice. In the context of exploring cognitive engagement in Extreme e-Service Learning, this model provides insights into how learners acquire and apply knowledge and skills in online service learning environments. By examining the key components of the model and its application in relevant studies, we can gain a deeper understanding of the cognitive processes underlying effective online service learning experiences.

Methods

Research Design

This study aimed to explore the cognitive engagement of undergraduate students in Extreme e-Service Learning (Xe-SL) during the COVID-19 pandemic. A case study approach was employed to gain in-depth insights into the students' cognitive engagement experiences within the context of a Multimedia Creative course. The participants of this study were 27 undergraduate students enrolled in a Multimedia Course at a public university in Malaysia. The course implemented Xe-SL to integrate service learning into the online learning environment. The participants were purposively selected based on their involvement in the Multimedia Creative course, which served as the focal point of the study. This research was designed based on qualitative research, specifically a case study to answer the research question of '*How does student engage cognitively in Extreme e-Service Learning?*' The case study approach was selected as the research design for this study to gain detailed insights into the cognitive engagement experiences of undergraduate students in Extreme e-Service Learning (Xe-SL) within a Multimedia Creative course during the COVID-19 pandemic. This approach allows for a contextual understanding of the specific setting, facilitates the collection of rich qualitative data, accommodates an exploratory investigation into a relatively unexplored topic, and enables the examination of contextual factors influencing cognitive engagement. Through this qualitative case study, the research aims to provide a comprehensive understanding of how students engage cognitively in Xe-SL within the context of the Multimedia Creative course during the pandemic.

Procedure

In this study, a multimedia course at the university implemented Extreme e-Service Learning as part of its experiential learning approach. To facilitate the program, students from diverse disciplines were divided into small groups, and each group undertook the responsibility of serving secondary school students through an online workshop focused on web-based multimedia applications. Throughout the 12-week duration of the Extreme e-Service Learning program, participants completed various phases of the project, which included preparation, implementation, and post-phase activities.

During each phase, students engaged in reflective practices and documented their experiences in reflective journals. A total of 27 reflective journal entries were collected for each phase of the e-Service Learning program, providing valuable insights into their thoughts, emotions, and reflections at different stages of the project. By focusing on the three major phases of the Extreme e-Service Learning program which is preparation and planning phase, implementation phase and post phase, this study can provide valuable insights into the cognitive engagement experiences of students during critical stages of the learning journey. It allows for a more focused analysis while still capturing the essence of their cognitive engagement throughout the online service learning experience.

Data Collection

Data for this study were collected through a series of reflections obtained from the participating students. The reflections were collected using the ClassDojo platform, which served as a convenient and accessible medium for students to document their thoughts and experiences. Throughout the Extreme e-Service Learning (Xe-SL) program, students were prompted to write reflections at various intervals, allowing for a comprehensive understanding of their cognitive engagement. The reflections took the form of written narratives or online journal entries, enabling students to express their insights, challenges, and growth throughout the Xe-SL journey. The utilization of ClassDojo as the platform for data collection ensured the confidentiality and privacy of students' reflections while providing a user-friendly interface for their contributions.

Trustworthiness and Rigor

To ensure the trustworthiness and rigor of the study, several measures were implemented. Firstly, multiple researchers were involved in the data analysis process, allowing for triangulation and verification of the identified themes. Secondly, an iterative process of data analysis was followed, with regular discussions and consensus-building among the researchers to enhance the reliability and validity of the findings. This process involved examining the data from various perspectives and engaging in critical reflections to ensure a comprehensive and accurate representation of the themes. Finally, the researchers maintained a reflexive stance throughout the study, acknowledging their own biases and preconceptions that may have influenced the data analysis process. This reflexivity was incorporated through regular reflections and discussions among the research team, promoting transparency and self-awareness in the interpretation of the data.

Ethical Considerations

Ethical guidelines were followed throughout the study to ensure the protection and privacy of the participants. Informed consent was obtained from all participants, clearly outlining the purpose of the study, their rights as participants, and the confidentiality of their responses. The researchers adhered to ethical principles of voluntary participation, anonymity, and confidentiality when collecting and analyzing the data. To protect the identity and privacy of the students, pseudonyms were used throughout the study. This practice ensured that the participants' real names were not disclosed in any of the research materials or findings. By using pseudonyms, the researchers aimed to maintain the confidentiality of the students' identities, thereby safeguarding their anonymity, and upholding their right to privacy.

Data Analysis

The collected reflections were analyzed using thematic analysis, following Clarke et al. (2015) Braun and Clarke's (2016) six-step approach. This systematic process illuminated students' cognitive engagement experiences within the Extreme e-Service Learning (XE-SL) context. Table 1 describes the six-phase thematic analysis.

Table 1. Six phase thematic analysis

Phase	Description
1. Familiarization with the Data	<ul style="list-style-type: none">• We thoroughly immersed ourselves in the students' reflection journals, reading and rereading the entries to gain a deep understanding of the content and identify recurring themes or patterns.
2. Generating Initial Codes	<ul style="list-style-type: none">• Following familiarization with the data, we began the coding process by identifying initial codes that captured the essence of the students' reflections. Each journal entry was systematically coded to categorize the content into meaningful units.
3. Searching for Themes	<ul style="list-style-type: none">• Through iterative coding and constant comparison of coded segments, we searched for overarching themes that emerged from the data. This involved identifying patterns, similarities, and differences across the coded segments.
4. Reviewing Themes	<ul style="list-style-type: none">• Once the initial themes were identified, we reviewed and refined them to ensure coherence and relevance to the research questions. This iterative process involved revisiting the coded data to confirm the validity and significance of each theme.
5. Defining and Naming Themes	<ul style="list-style-type: none">• After careful review and discussion, we defined and named the final themes that encapsulated the key findings from the reflection journals. Each theme was supported by relevant excerpts from the data to provide evidence and context.
6. Producing the Final Report	<ul style="list-style-type: none">• Finally, we synthesized the thematic findings into a cohesive narrative, highlighting the insights gained from the reflection journals and their implications for student's cognitive engagement in Extreme e-Service Learning.

The theme of cognitive engagement encompasses various aspects of how individuals interact with and process information. Table 2 below presents descriptions for each theme, drawn from research conducted by Fredricks (2004); Jimerson et al. (2003) and Collins et al. (1989).

Table 2. Description for each theme

Themes	Description
Knowledge Acquisition	This refers to the process of obtaining new information, concepts, or skills. It involves activities such as reading, listening, observing, and experiencing, through which individuals absorb and internalize new knowledge.
Problem Solving	Problem-solving involves identifying, analysing, and resolving challenges or obstacles. It requires cognitive effort, creativity, and the application of relevant knowledge and skills to find effective solutions.
Critical Thinking	Critical thinking involves the ability to analyse, evaluate, and interpret information objectively and logically. It entails questioning assumptions, considering multiple perspectives, and making informed judgments or decisions based on evidence and reasoning.
Reflection and Metacognition	Reflection involves introspection and thoughtful consideration of one's own thoughts, experiences, and learning processes. Metacognition, on the other hand, refers to the awareness and understanding of one's own cognitive processes, including thinking strategies, strengths, and areas for improvement.
Active Information Processing	Active information processing involves mentally engaging with and manipulating information to enhance understanding and retention. This may include activities such as summarizing, organizing, and synthesizing information, as well as making connections between new and existing knowledge.
Transfer of Learning	Transfer of learning refers to the ability to apply knowledge, skills, or strategies learned in one context to solve problems or navigate situations in different contexts. It involves recognizing and adapting previously acquired knowledge or experiences to new challenges or environments.

In summary, cognitive engagement encompasses the dynamic processes by which individuals acquire, process, and apply knowledge, engage in problem-solving and critical thinking, reflect on their learning experiences, and actively participate in the transfer of learning across various contexts. In the subsequent section of this paper, we present a detailed analysis of the themes identified through the thematic analysis of the students' reflection journals.

Results

The results of the thematic analysis revealed distinct patterns of cognitive engagement across different phases of Extreme e-Service Learning (Xe-SL): pre Xe-SL, during Xe-SL, and post Xe-SL.

Preparation and Planning phase (Pre Xe-SL)

During the preparation phase of Xe-SL, several themes emerged from students' reflective journal. These themes provide insight into the various aspects of student's cognitive processes and highlight their engagement in learning and knowledge acquisition. These themes encompass Knowledge Acquisition, Problem Solving, Critical Thinking, and Reflection and Metacognition.

Knowledge Acquisition

This theme describes students acknowledge the valuable guidance provided by their lecturer, which helped clarify confusions and provide in-depth understanding through notes and slides. This underscores the importance of expert guidance in fostering knowledge acquisition. Additionally, the excerpts showcase how engagement in the production of a proposal led to the enhancement of knowledge and the development of new skills. The recognition of the significance of teamwork and the acquisition of new skills, such as using Google Slides, further indicate cognitive engagement and a proactive approach to learning.

These excerpts illustrate that the pre-Xe-SL phase serves as a foundation for knowledge enrichment and cognitive engagement, setting the stage for active participation in the subsequent Xe-SL experience:

- S27: But with the help of excellent guidance of our lecturer, **we have already cleared out our all the confusions** and our lecturer have already provided us with notes and slides for our in depth understandings.
- S12: Throughout the production of the proposal, **I have enhanced my knowledge** for different aspects and **developed new skills**.
- S14: In these few weeks, **I learned a lot of knowledge** that I never experienced before. I know that in the preparation of E-SL, it must include a high teamwork spirit if not that is difficult to success. **I also know that how to use the google slide very well** because before that I always use PowerPoint to do my own slide.

Problem Solving

This theme describes how the students reflect on their experiences of encountering challenges during online service learning and how they addressed them. They mention the process of reviewing documents and materials to gain clarity on tasks. This highlights the problem-solving aspect of evaluating available information to make informed decisions. Preparing for interviews and practicing speaking skills also underscores the students' proactive approach to overcoming challenges through preparation and practice. Below are the selected excerpts:

- S1: We have all of the relevant slides, as well as a connection to the drive where our instructor exchanged the files and documents. [...] **After going through those papers again, I had a better idea of what I needed to do and how to proceed.**
- S9: I'm **going to review the interview questions** that was created and prepare myself for the interview session by **practicing my speaking skill**.

Critical Thinking

Students mention instances where they had to assess information critically. Checking the accuracy of content, considering different aspects, and incorporating feedback from instructors indicate the development of critical thinking skills. The emphasis on creating step-by-step guides and drafts for tutorials demonstrates the application of critical thinking to ensure clear and comprehensive communication to readers:

- S11: Sometimes, during preparing the question for students, **I had** to open the websites **to check to ensure the accuracy**. It could be due to lacking experience, there were some aspects that were not considered until Dr and Miss pointed them out. By which, **I think it improves my critical thinking skills although some works seem to be a piece of cake.**
- S15: The challenge in this job is that **I need to think of the steps-by steps guide** for the readers. To solve this problem, I use draft as my guide in making the tutorial.
- S25: My plan for the next week **is to further touch up the questionnaires draft with my team and revise the functions and tools available in the multimedia platform.** Besides, I will try my best to cooperate and always there whenever my team need helps or opinion.

Reflection and Metacognition

The students show awareness of their learning processes and strategies. They reflect on the importance of checking instructions carefully and seeking feedback for improvement. The intent to conduct a rehearsal for a teaching session suggests a proactive approach to evaluating their teaching strategies in advance. These instances reflect metacognition, where students are considering their own learning approaches and making adjustments based on their experiences:

- S5: I learned that we need to **check through the instructions given** as sometimes we overlook the things that need to be done."
- S21: **I will be aware and active** to get feedback to improve the video tutorial.
- S4: Next week will be the first week of the teacher session which is Pixton Teaching by [A], and **I am planning to do a rehearsal** for this class tonight **so that we can plan on what are the DOs and DON'Ts** in order to make the class going smoothly.

In summary, the students' excerpts highlight a well-rounded learning experience that encompasses knowledge acquisition, problem-solving, critical thinking, and reflection. Their experiences demonstrate the significance of guidance, resources, and active engagement in online service learning. The ability to tackle challenges, think critically, and engage in metacognitive reflection showcases the students' growth as learners in an online service learning environment. These insights illustrate the multifaceted nature of learning beyond traditional classroom settings and the valuable skills that students can develop through such experiences.

Implementation phase (During Xe-SL)

During the implementation phase of online Extreme e-Service Learning, students also engaged cognitively in various ways. There are four significant themes related to cognitive engagement. These themes encompass Knowledge Acquisition, Problem Solving, Reflection and Metacognition, Active Information Processing, and Transfer of Learning.

Knowledge Acquisition

The students describe how they actively acquired new information and skills during their online service learning experiences. They mention learning to arrange programs, gaining a deeper understanding of software tools like Pixton and PowToon, and gathering creative ideas from their peers' works. These experiences demonstrate the importance of hands-on learning, exposure to diverse approaches, and the practical application of tools and concepts:

- **S10:** I have learned how to arrange a program well as I have seen how other members arrange the workshop and also have a chance to arrange the schedule for our group meeting. Besides, I also have a deeper understanding in Pixton and PowToon as I have refreshed my knowledge during the explanation of the workshop team during the teaching session.
- **S13:** I have a deeper understanding of PowToon and Pixton after these activities. Through these activities, I gain a lot of different ideas from other people's works. This helps me on design more creative video on PowToon or comic on Pixton in the future.
- **S14:** I also now have a better understanding on how to use the Pixton and PowToon during the teaching by the workshop team. This is because I am still not familiar with some tool bars although we have learned it before. For example, after joining the tutorial teaching, I know how to adjust the position of the characters in the PowToon.

Problem Solving

Students reflect on challenges encountered during their online service learning activities and how they approached these challenges. They mention technical issues, such as lagging websites, internet problems, and last-minute changes. Despite these challenges, the students demonstrate resilience and resourcefulness in finding solutions. This highlights their ability to adapt and overcome obstacles while maintaining professionalism and teamwork:

- **S13:** Although some of the activities have some delayed due to some issues such as internet problems or technical problems, the thing that let us feel proud is the workshop team members were still able to complete the organization to all the activities professionally and on time.
- **S15:** PowToon group met with a lot of problems such as lagged website where it doesn't load, and it took a lot of time to produce a video. I did help them by creating a free account just for smoother run though it is still lagging sometimes. I did my best to help them export as my laptop run faster. Well, overall, the video and comic are both awesome and I learn how to solve minor issues regarding various problems. I learnt how to start a conversation in awkward situation and how to solve problems.
- **S18:** During the implementation process there are many problems and challenges that we have to overcome. For example, we have to organize the schedule and group names also the tentative of the events.

Reflection and Metacognition

The students show a deep level of introspection and self-awareness about their learning experiences. They reflect on the satisfaction of helping and teaching others, the adaptability required in real-life situations, and the effectiveness of engaging presentation techniques. These reflections demonstrate a keen understanding of their own growth, areas for improvement, and the broader impact of their actions on both themselves and their peers:

- **S21:** From this implementation of e-Service Learning, I have realized that teaching and assisting the student who is really passionate about learning is a very nice experience to improve myself... I will try to concentrate on our e-Service Learning next week and see the overall e-Service Learning done and what my group, my video tutorial team, and I did.
- **S11:** There were still some inevitable events that happened, for example late registration of students and the last-minute-updated grouping list. Yet, that was also a good training for being more flexible and adapting to the changes because in real life, things will not always go as what they are planned to be.
- **S15:** During these 2 weeks, the thing that I found that I learnt is how to attract people during a talk. Most of the times, sharing info session is boring and of course to a secondary student...it is a "dull" session.

However, the presenter from the workshop team did a great job by attracting students with humors or real-life situation comparison.

- **S21:** From this implementation of e-Service Learning, **I have realized that teaching and assisting the student who is really passionate about learning is a very nice experience to improve myself. I could learn from students** that how pure and passionate on learning new things. Furthermore, **I could learn Bahasa Melayu words** through the conversation between students and colleagues.
- **S27:** **I got to know a lot of new things** and **met some new people**, which as well a joyful event for me.

Active Information Processing

The students mention how they engaged in the process of actively processing information during their online service learning. They express admiration for school children's confidence in public speaking, indicating their attentive observation and appreciation for their peers' achievements. Additionally, the realization that the teaching and learning process had broader benefits beyond software skills shows their ability to critically assess learning outcomes. Students described such experiences as follows:

- **S4:** **To see school children have this kind of courage to talk publicly** and share their progress is something that some of the graduate students cannot even do it. **So, I'm very impressed by that.**
- **S19:** At first, **I thought that this teaching and learning process would only be helpful to develop students' understanding on using Pixton and PowToon**, without any other additional benefits. But after the students presented their creation, **I could see that there were other benefits, namely, increasing literacy and understanding of COVID-19 to the community.**

Transfer of Learning

Students discuss how they applied and adapted the knowledge and skills gained from their online service learning activities to different contexts. They mention using software tools like Pixton and PowToon to teach secondary school students, thereby transferring their learning to an educational context. The emphasis on contributing to society underscores the value of applying university-acquired knowledge for the greater good. Students' reflections are as follows:

- **S9:** **We learned PowToon and Pixton** so that **we can teach the student** how to use it.
- **S11:** In the past few weeks, where we had the implementation of e-Service Learning in **teaching the secondary school students** to use the Pixton and PowToon in order to create the comics and animated video.
- **S18:** For me, the implementation of e-Service Learning is crucial. This is because **as a university student** we should **contribute back to the society** such as schools' students.

In summary, the student extracts provide a comprehensive view of the multifaceted nature of online service learning. These experiences encompass not only the acquisition of knowledge and skills but also the development of problem-solving abilities, self-awareness, and the capacity to apply learning to various scenarios. The students' reflections demonstrate the significance of practical engagement, adaptability, and continuous improvement, showcasing the holistic growth that can be achieved through online service learning endeavors.

Post phase (Post Xe-SL)

During the post-service phase, students showed cognitive engagement by reflecting on their experience and articulating the lessons they learned. The findings from student's reflective journal indicate several key themes related to cognitive engagement in the Post Xe-SL phase. The provided student excerpts offer insightful perspectives on the themes of Knowledge Acquisition, Problem Solving, Reflection and Metacognition, and Transfer of Learning within the context of online service learning.

Knowledge Acquisition

The students reflect on how they actively acquired new information, skills, and concepts during their online service learning experiences. They highlight the enjoyment in creating Pixton comics, learning tools like PowToon and Pixton, and gaining a deeper understanding of subject matters by teaching others. These excerpts emphasize the value of hands-on learning, the enjoyment derived from it, and the enhancement of their expertise:

- **S1:** In short, in my experience as a student, **I have learned a lot from this course.** Among them, I have enjoyed making Pixton comics and teaching school students.
- **S2:** **Learning PowToon and Pixton** really **help me** in **gaining new knowledge.**

- **S8:** Apart from that, teaching others helps me understand about a certain topic better. Therefore, through ESL I have improved my overall knowledge massively and I cannot be more happier knowing that.
- **S10:** I have learned new knowledge, made new friends, and enhanced my soft skills and be a better me. During the teaching session, I able to revise again the knowledge of creating comics and animations. I also able to retain the knowledge again when giving briefing and advice to the group 6 members.

Problem Solving

Students acknowledge the cognitive process of identifying and overcoming challenges during online service learning. Internet issues, technical challenges, and unexpected situations are mentioned. However, these challenges are viewed as opportunities for growth, highlighting the development of problem-solving and adaptability skills. The ability to address problems head-on and learn from them is a recurring theme. Below are some student narratives demonstrating this theme:

- **S11:** I also felt that this e-Service Learning had helped me to develop my critical thinking and problem solving skills.
- **S13:** Since there was a virtual activity, internet issue become the main problem that faced by everyone, which is inevitable. This impacted me not to focus on the activities and forces me to ask the classmates when I can't receive the complete information. However, by facing this problem, I have learned how to solve this problem immediately and how to get along with the classmates.
- **S15:** Although I met with few problems during this session, but it was really fun to have the chance to learn and solve different problems according to different situation.

Reflection and Metacognition

Students engage in introspection and self-awareness about their learning experiences and the broader impact of their contributions. They highlight the transformative experiences of being a teacher, gaining a deeper appreciation for education, and understanding the importance of technology in bridging gaps. These reflections showcase an understanding of personal growth and the societal implications of their actions:

- **S4:** A lot of great experiences I have learned and one of the experiences that gave me the biggest impact is when I did the PowToon Teaching, never that I have ever thought that I would be a teacher, and teaching school children some knowledge. It's a good involvement that I'm able to contribute something to our future generation and I hope that they will remember and use the knowledge learned. I think being a teacher has taught me a lot of things especially on preparing what to teach, how to interact excitingly, and how difficult it is to get someone's attention. That day is the day I realized how hard it is to be a teacher and I appreciate everyone that wholeheartedly does this job for the sakes of our generations.
- **S5:** One thing that impacted me throughout this e-Service Learning is the importance of learning the ICT skills, especially during this pandemic. I realized that not many people know and have the opportunity to learn and use the technology due to various factor. As I finished this e-Service Learning, it made me realize how many of those still don't know how to use the technology since there might be some people who do not have the access to them and there might be also people who are not exposed to the use of ICT, especially in the rural areas.

Transfer of Learning

Students discuss how the knowledge and skills gained from their online service learning experiences can be effectively applied to different contexts. They express interest in future collaborations and opportunities to share their newly acquired skills. The theme of contributing to the community and promoting sustainable development emerges, demonstrating the intention to use their learning for the betterment of society. The following narratives illustrate this theme:

- **S4:** I really looking forward to having another amazing SL in the future. As the president of the Jazari Innovation Club, we are always open to any collaboration if needed for the next semester.
- **S5:** Overall, for the e-Service Learning, I feel like I have accomplished something that benefits the community. I am pleased to be able to contribute to this e-Service Learning since I got to learn new skills such as making animation videos and comics and after that using that skill, I got teach other people the knowledge for them to apply in the future.

- **S20:** On a side note, **this E-Service Learning has encouraged me to join virtual volunteering project in collaboration with Aiesec in Malaysia and Berkat Children's Home** to promote sustainable development goal four which is quality education as a Local Virtual Volunteer (LVV) this coming August during semester break.

In summary, the student excerpts paint a comprehensive picture of the multifaceted outcomes of online service learning. These include the active acquisition of knowledge, the development of problem-solving abilities, deep reflection on personal growth and societal impact, and the intention to apply newfound skills in diverse contexts. The students' insights highlight the practicality and adaptability of skills gained through online service learning, showcasing a holistic approach to education that extends beyond the traditional classroom.

Overall, the results highlight the multifaceted nature of cognitive engagement within the context of Extreme e-Service Learning. The findings demonstrate students' active involvement in understanding and applying concepts, problem-solving, self-reflection, preparation, motivation, learning new skills, overcoming challenges, reflecting and improving, appreciating impact and benefits, acquiring increased skills and knowledge, engaging in teaching and mentorship, collaborating in teams, applying problem-solving and adaptability, and retaining and applying knowledge. These findings provide valuable insights into the cognitive engagement processes experienced by students throughout Xe-SL, illustrating the diverse ways in which they engage cognitively during different phases of the learning journey.

Discussions

The analysed student excerpts shed light on the multifaceted nature of online service learning, encompassing themes such as Knowledge Acquisition, Problem Solving, Reflection and Metacognition, and Transfer of Learning. These themes collectively illustrate the rich and holistic learning experiences that students undergo when engaged in Extreme e-Service Learning activities.

In regard to theme Knowledge Acquisition, it seems that this theme is central throughout the three different phases of Extreme e-Service Learning. This aligns well with the principles of the Cognitive Apprenticeship Model, which emphasizes the importance of learners acquiring knowledge through various means, including exposure to expert demonstrations, coaching, and scaffolding provided by more knowledgeable others.

Students' reflective journal highlight the active pursuit of new information, skills, and concepts as a central aspect of their online service learning experiences. Through hands-on engagement with tools like Pixton and PowToon, students not only gain expertise but also express enjoyment in the process. The inclusion of teaching school students further amplifies the depth of their knowledge acquisition. This theme underscores the effectiveness of experiential learning in fostering a deep understanding of subject matter (Kolb, 1984).

Challenges encountered during online service learning emerge as valuable opportunities for students to hone their problem-solving skills. Internet issues, technical glitches, and unforeseen circumstances are acknowledged as hurdles that necessitate critical thinking and adaptability. The students' reflections on overcoming these challenges with resilience and resourcefulness underline the real-world applicability of problem-solving skills cultivated through online service learning. This finding is similar to research that indicated Extreme e-Service Learning enhance students' problem solving skills (Ngai et al., 2023; Wong & Lau, 2023; Yu et al., 2023). This theme aligns with the social context component of the Cognitive Apprenticeship Model, emphasizing the importance of social interaction and collaboration in learning. Participants engage in problem-solving activities within a community of practice, where they learn from each other and receive support from more experienced peers or mentors.

The introspective reflections shared by students reveal their growing self-awareness and a nuanced understanding of the broader implications of their actions. Engaging in teaching roles, whether through PowToon tutorials or comics creation, prompts students to appreciate the complexities of effective communication and the role of technology in bridging educational gaps. These reflections underscore the transformative power of online service learning in fostering personal growth and instilling a sense of social responsibility. This finding resonates with research reported that reflection activity in Service Learning is able to foster metacognitive growth and a deeper understanding of one's own learning journey (Eyler et al., 2001; Fullerton et al., 2015). Participants engage in reflective activities to monitor and regulate their learning, demonstrating awareness of their own thinking processes and learning strategies. This aligns

with the Cognitive Apprenticeship Model's emphasis on developing learners' metacognitive skills through guided reflection and self-assessment.

The students' intent to apply the knowledge and skills acquired during online service learning to different contexts is indicative of the versatility of their learning experiences. This theme showcases the active agency students develop in taking their learning beyond the virtual classroom, into their community and future pursuits. Whether through collaborations or contributing to societal goals, the ability to transfer learning underscores the practicality and real-world impact of online service learning endeavours. This finding aligns with research conducted by Darling-Hammond and Bransford (2007), indicating that students excel at applying learned concepts when instruction explicitly emphasizes the process of transfer within real-world scenarios. The concept of transfer inherently involves the capacity to apply acquired knowledge in different settings, highlighting the students' capability to effectively translate their learning from one context to another. This theme resonates with the notion of authentic tasks in the Cognitive Apprenticeship Model. Participants engage in hands-on, real-world tasks that are relevant to their service learning goals, providing opportunities for authentic learning experiences and skill development.

In synthesizing these themes, it becomes evident that online service learning is not confined to the acquisition of information within a virtual environment. Instead, it serves as a platform for holistic growth, fostering critical skills such as problem-solving, self-awareness, and adaptability. The experiences shared by the students illuminate the synergy between knowledge acquisition and its application in real-world scenarios. Moreover, these narratives emphasize the integral role of technology in modern education, allowing for interactive and experiential learning even in remote settings. As educational paradigms continue to evolve, online service learning emerges as a powerful tool that not only imparts subject-specific knowledge but also cultivates essential life skills. The narratives of these students offer a glimpse into the potential of this approach to education in fostering well-rounded individuals who are equipped to tackle challenges, drive change, and contribute positively to their communities.

Conclusion

In conclusion, this study delved into the cognitive engagement experiences of undergraduate students in Extreme e-Service Learning (Xe-SL) within the context of a Multimedia Creative course during the COVID-19 pandemic. The exploration of student perspectives across various themes of online service learning paints a vivid picture of its transformative impact. As demonstrated through the themes of Knowledge Acquisition, Problem Solving, Reflection and Metacognition, and Transfer of Learning, online service learning stands as a dynamic and comprehensive approach to education.

The synthesis of these themes underscores the comprehensive nature of online service learning. It transcends the confines of traditional education, nurturing intellectual, practical, and empathetic dimensions of learning. The narratives shared by the students illuminate the potential of this approach to mold individuals who are not only adept in their chosen subjects but also equipped to navigate challenges, contribute meaningfully, and lead by example. As education continues to adapt to evolving landscapes, online service learning stands as a beacon of innovation, fostering a generation of learners ready to make a positive impact on both local communities and the world at large.

Limitations and Future Studies

The COVID-19 pandemic has brought unprecedented changes to the way education is delivered, and students worldwide have been forced to adapt to remote learning environments. As educators and learners navigate these challenges, understanding how students engage cognitively with multimedia materials is more crucial than ever. This is where our research comes in - we explore the impact of the pandemic on student engagement and learning experiences in multimedia courses, addressing a significant gap in the existing literature. Our study offers ground breaking insights into the underlying cognitive processes of student interaction with multimedia materials, such as attention, comprehension, and critical thinking. By examining the mechanisms driving engagement and learning in virtual settings, we provide a comprehensive understanding of the complex interplay between instructional design, student engagement, and learning outcomes. Beyond mere description, our research offers practical recommendations

for educators, instructional designers, and policymakers seeking to optimize the online learning experience for students.

Our findings have significant implications for curriculum design and pedagogical practices, making a timely and meaningful contribution to the scholarship on educational technology and online learning. By identifying strategies and approaches that promote cognitive engagement in virtual learning environments during times of crisis, we make a significant contribution to the development of supportive learning environments in the digital age. In summary, our study provides unprecedented insights into student cognitive engagement in multimedia courses during the COVID-19 pandemic. As the world continues to grapple with the challenges of remote learning, our research offers practical implications for educational practice and policy, contributing to the ongoing effort to enhance online learning experiences for students.

While this study provides valuable insights, it is important to acknowledge its limitations. The research focused on a specific Multimedia Creative course within a single university, limiting the generalizability of the findings. Additionally, the study relied on self-reported reflections, which may be influenced by participants' subjective perspectives. Although this study offers valuable insights into the cognitive engagement experiences of undergraduate students in Extreme e-Service Learning (Xe-SL), it is crucial to recognize its limitations.

First, the research focused exclusively on a specific Multimedia Creative course within a single university. As a result, the findings may not be fully generalizable to other disciplines or institutions. The unique characteristics of the course, the instructional methods employed, and the student population involved may have influenced the observed patterns of cognitive engagement. Therefore, caution should be exercised when applying the findings to different contexts.

Secondly, the study relied on self-reported reflections as the primary source of data. While reflections provide a rich qualitative understanding of students' experiences, they are subject to participants' subjective perspectives and potential recall biases. Participants may have selectively highlighted certain aspects of their cognitive engagement or may have unintentionally omitted important details. Additionally, social desirability bias could have influenced the content of the reflections, as participants may have felt compelled to present themselves in a positive light. Therefore, the accuracy and reliability of the data collected through self-reported reflections should be considered when interpreting the findings.

To address these limitations and expand our understanding of cognitive engagement in Xe-SL, future research could adopt a multi-case design involving multiple universities and courses across diverse disciplines. This would enhance the generalizability of the findings and provide a broader perspective on the cognitive engagement experiences of students in online service learning. Additionally, incorporating complementary data collection methods, such as observations and interviews, could provide a more comprehensive and triangulated view of students' cognitive engagement. Furthermore, it would be valuable to investigate the potential influence of external factors, such as the technological infrastructure and support available to students, on their cognitive engagement in Xe-SL. Understanding the contextual factors that facilitate or hinder cognitive engagement in online service learning can inform the development of effective strategies and interventions to enhance student engagement and learning outcomes.

Despite these limitations, this study contributes valuable insights into the cognitive engagement processes within Extreme e-Service Learning and provides practical implications for designing effective online learning activities. By acknowledging these limitations and considering them in future research, we can continue to advance our understanding of cognitive engagement in online service learning and strive for the development of more engaging and impactful learning experiences in the digital era. Future research could explore cognitive engagement experiences in Xe-SL across different disciplines and institutions, as well as incorporate multiple data sources to gain a more comprehensive understanding. Additionally, investigating the effectiveness of specific instructional strategies and interventions in fostering cognitive engagement in Xe-SL would be valuable for educators and researchers.

Acknowledgement

Authors acknowledge the Ministry of Higher Education (MOHE) for funding under the Fundamental Research Grant Scheme (FRGS) (Cost Center No: R.J130000.7853.5F666).

References

- Bond, M., & Bedenlier, S. (2019). Facilitating Student Engagement Through Educational Technology: Towards a Conceptual Framework. *Journal of Interactive Media in Education*, 2019(1). <https://doi.org/10.5334/jime.528>
- Bringle, R. G., & Hatcher, J. A. (1996). Implementing service learning in higher education. *The Journal of Higher Education*, 67(2), 221-239.
- Chesser, S., Durham, K., & Aydarova, E. (2021). Using Action Research to Promote Meaningful E-Service-Learning Experience for Preservice Teachers. In *Handbook of Research on the Global Empowerment of Educators and Student Learning Through Action Research* (pp. 49-67). IGI Global.
- Clarke, V., Braun, V., & Hayfield, N. (2015). Thematic analysis. *Qualitative psychology: A practical guide to research methods*, 3, 222-248.
- Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In *Knowing, learning, and instruction: Essays in honor of Robert Glaser*. (pp. 453-494). Lawrence Erlbaum Associates, Inc.
- Darling-Hammond, L., & Bransford, J. (2007). *Preparing teachers for a changing world: What teachers should learn and be able to do*. John Wiley & Sons.
- Drewelow, I., & Granja Ibarreche, X. (2021). Developing students' solidarity disposition: A case for translation in community-based service-learning. *Foreign Language Annals*, 54(3), 800-822.
- Eyler, J., & Giles Jr, D. E. (1999). *Where's the Learning in Service-Learning? Jossey-Bass Higher and Adult Education Series*. ERIC.
- Eyler, J., Giles Jr, D. E., & Gray, C. J. (1999). At a glance: What we know about the effects of service-learning on students, faculty, institutions and communities, 1993-1999.
- Eyler, J., Giles Jr, D. E., Stenson, C. M., & Gray, C. J. (2001). At a glance: What we know about the effects of service-learning on college students, faculty, institutions and communities, 1993-2000.
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59-109.
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. . (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74(1), 59-109. <https://doi.org/https://doi.org/10.3102/00346543074001059>.
- Fullerton, A., Reitenauer, V. L., & Kerrigan, S. M. (2015). A grateful recollecting: A qualitative study of the long-term impact of service-learning on graduates. *Journal of Higher Education Outreach and Engagement*, 19(2), 65-92.
- Hatcher, J. A., Bringle, R. G., & Muthiah, R. (2004). Designing Effective Reflection: What Matters to Service-Learning? *Michigan Journal of Community Service Learning*, 11(1), 38-46.
- Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward an understanding of definitions and measures of school engagement and related terms. *The California School Psychologist*, 8, 7-27.
- Khiatani, P. V., She, M. H. C., Ho, O. Y. Y., & Liu, J. K. K. (2023). Service-learning under COVID-19: A scoping review of the challenges and opportunities for practicing service-learning in the 'New Normal'. *International Journal of Educational Development*, 102813.
- Kolb, D. A. (1984). *Experiential Learning*, 1984. In: S.
- Li, Y., Guo, F., Yao, M., Wang, C., & Yan, W. (2016). The role of subjective task value in service-learning engagement among Chinese college students. *Frontiers in psychology*, 7, 954.
- Marcus, V. B., Atan, N. A., Yusof, S. M., & Tahir, L. (2020). A Systematic Review of e-Service Learning in Higher Education. *International Journal of Interactive Mobile Technologies*, 14(06), 11. <https://doi.org/10.3991/ijim.v14i06.13395>
- Ngai, G., Lau, K.-H., & Kwan, K.-P. (2023). A Large-Scale Study of Students' E-Service-Learning Experiences and Outcomes During the Pandemic. *Journal of Experiential Education*, 10538259231171852.
- Pavel, M., & Wysocki, C. D. (2007). A study of cognitive engagement in online learning.
- Peng, W. (2017). Research on Model of Student Engagement in Online Learning. *Eurasia Journal of Mathematics, Science and Technology Education*, 13, 2869-2882.
- Richardson, J. C., & Newby, T. (2006). The role of students' cognitive engagement in online learning. *American Journal of Distance Education*, 20(1), 23-37.
- Rockquemore, K. A., & Harwell Schaffer, R. (2000). Toward a theory of engagement: A cognitive mapping of service-learning experiences. *Michigan Journal of Community Service Learning*, 7(1).
- Selmo, L. (2020). Higher Education and Digitalization: E-Service-Learning, A New Methodology for Developing Professional Competences. In S. Enakshi, B. Patrick, & M. Craig (Eds.), *International Perspectives on*

- Policies, Practices & Pedagogies for Promoting Social Responsibility in Higher Education* (Vol. 32, pp. 133-145). Emerald Publishing Limited. <https://doi.org/10.1108/S2055-364120200000032010>
- Shan, L. (2021). Measuring cognitive engagement: An overview of measurement instruments and techniques. *International Journal of Psychology and Educational Studies*, 8(3), 63-76.
- Shukor, N. A., Tasir, Z., Meijden, H. v. d., & Harun, J. (2014). A predictive model to evaluate students' cognitive engagement in online learning. *Procedia - Social and Behavioral Sciences*, 116, 4844-4853.
- Waldner, L., McGorry, S., & Widener, M. (2010). Extreme e-service learning (XE-SL): E-service learning in the 100% online course. *Journal of Online Learning and Teaching*, 6(4), 839-851.
- Waldner, L. S., Widener, M. C., & McGorry, S. Y. (2012). E-service learning: The evolution of service-learning to engage a growing online student population. *Journal of Higher Education Outreach and Engagement*, 16(2), 123-150.
- Wong, M. M. L., & Lau, K. H. (2023). E-service-learning is equally effective as traditional service-learning in enhancing student developmental outcomes. *Interactive Learning Environments*, 1-15. <https://doi.org/10.1080/10494820.2023.2200817>
- Yu, L., Du, M., & Zhou, X. (2023). E-Service-Learning during the COVID-19 Pandemic: The Experiences of Mainland Chinese Students Enrolled at a University in Hong Kong. *Sustainability*, 15(12), 9211.