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Exploring the Impact of the Khan Academy Digital Platform on Elementary Students' Anxiety and Problem-Solving Skills During the post Covid-19 Pandemic.

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Abstract

The Covid-19 pandemic forced significant educational process changes, shifting the emphasis from traditional in-person instruction to online learning. This study analyzes the impact of the Khan Academy Kids learning application on elementary students' anxiety and problem-solving skills in the aftermath of the pandemic. The study explores the efficacy of digital games, essential crisis-related knowledge and skills, as well as the usefulness of various digital learning strategies for elementary school students.

A mixed-method research approach was used to answer the research questions. The Constructivist Learning Theory and Scaffolding Theory of Learning were used as conceptual frameworks in the research. The study found the Khan Academy Kid app enhances students' engagement, teamwork, and problem-solving abilities. Results imply that adaptability, problem-solving skills, resilience, and emotional stability are vital in a crisis. Although the platform may reduce anxiety and positively impact student engagement, it struggles to address complex forms of anxiety, underscoring a need for enhanced anxiety management solutions.

Keywords: Khan Academy Kids, digital learning, elementary students, anxiety, problem-solving skills, post-Covid-19.

Summary for Lay Audience

In the wake of the COVID-19 pandemic, the education landscape underwent a seismic shift, particularly for elementary school students. Virtual classrooms quickly took the place of traditional ones. This study was designed to explore how Khan Academy Kids, a digital learning application, could impact elementary students' anxiety levels and enhance their problem-solving skills in this new educational terrain.

The study used a mixed-method approach to research, including observations, surveys, and teacher interviews to gain insights. It incorporated two educational theories as guiding frameworks: the scaffolding theory, which emphasizes the role of a more experienced individual providing support to facilitate learner progress and the utilization of prior knowledge while acquiring new information and concepts, and the constructivist learning theory, which highlights learning as an active process where students construct new knowledge based on their existing knowledge.

Based on the results, Khan Academy Kids was identified as an effective tool for engaging students. Its interactive, game-based structure contributed positively to students' problem-solving skills and collaborative abilities. Students were more likely to understand ideas because of the application's simulation of a dynamic learning environment. However, the application's effect on students' anxiety levels was more complex and warrants further research.

The complexity of the Khan Academy Kids application's effects on students' anxiety levels can be largely attributed to its self-paced learning and immediate feedback features. These elements foster confidence and independence among students.

Thus, Khan Academy Kids exhibits its potential to decrease anxieties that are directly linked to the learning process. Given separation anxiety is linked to emotional ties and factors that exist outside of the environment of education, the Khan Academy Kids application effectiveness was limited in this particular field. This demonstrates the complexity of anxiety and the need for comprehensive strategies that address different facets of students' psychological well-being.

In conclusion, in a post-pandemic environment, Khan Academy Kids shows potential as a useful educational tool for building problem-solving abilities and lowering particular types of anxiety among elementary students.

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Chapter 1: Introduction

As a result of the Covid-19 pandemic, education systems must change and use technology and innovative tools to be more flexible and meet all children's needs (UNICEF, 2020). The Covid-19 pandemic affected schooling globally, and children worldwide have faced many new problems (UNICEF, 2020). Schools were closed, and students received instruction over the Internet (Kamanetz, 2020; Sun et al., 2020). Technological difficulties such as lack of digital literacy, technical issues with learning platforms, distractions at home, decreased social interaction, and lack of hands-on learning experiences created a new set of challenges for students to overcome in their learning environment and have psychologically impacted children (Li et al., 2020). For example, studies show that students' poor psychological health may lower their immunity, resulting in an imbalance in physiological systems (Madison et al., 2021).

Nevid et al. (2003) state that "anxiety is characterized by physiological arousal, unpleasant feelings of tension, and concerns about bad things happening in the future" (as cited in Arribathi et al., 2021, p. 193). Covid-19, a global pandemic, impacted and continues to impact many aspects of society, particularly the education system (Stambough et al., 2021). Psychological changes and lack of social interactions during the Covid-19 pandemic directly affected children's cognition and emotions (Li et al., 2020). Significant changes such as transforming face-to-face teaching and learning into an online class, using new virtual platforms like Zoom meetings (Wu & McGoogan, 2020), and technical challenges with online learning had negative psychological effects on children (Li et al., 2020) and created learning anxiety in children (Jehi et al., 2022; Kindred & Bates, 2023).

According to Hidayah et al. (2022), the COVID-19 pandemic has transitioned into a new stage and many children may suffer from the predicted condition known as post-pandemic school anxiety. Schools are open now, and students must adapt from their online engagement strategies to face-to-face engagement strategies. All these changes are stressful for students. Moreover, COVID-19 is still a problem in the world today and its effects are causing significant problems for children (Hidayah et al., 2022).

Stress and anxiety can result from adjusting to new situations, particularly when people are unsure of how to handle potential problems (González-Rivera et al., 2020). Fortunately, problem-solving skills may assist people in resolving various issues. Problem-solving can help people feel less stressed because it can enable them to exert control over their surroundings and find solutions in various contexts (González-Rivera et al., 2020).

Students with anxiety require extra motivation, encouragement and support from their instructors and parents to compensate for the detrimental impacts of anxiety on their learning (Arribathi et al., 2021). Play is part and parcel of children's development (Veraksa et al., 2022), and learning and playing in a joyful environment is essential to education (Zaharin et al., 2021). Play improves one's ability to listen, follow established norms, and maintain emotional control (Veraksa et al., 2021). Enjoyable learning creates a good relationship between children and structures. Thus play can help students cope with the pressure or emotions of new challenges (Eryadini, 2021) and find new ways to solve problems (Sjöberg & Brooks, 2022).

Digital games have been linked to young children's enjoyment and play time (Crescenzi-Lanna, 2022). Thus, creating a learning environment based on the educational qualities of games could be an effective technique to boost learning (Gros, 2007). Various digital games have been

produced for children in the current digital age (Rajić & Tasevska, 2019). A digital game is an essential part of children's entertainment and learning, and it is a form of a game that children can play on various digital devices such as tablets, computers, and phones (Rajić & Tasevska, 2019). Digital games are frequently effective teaching aids because they are interactive and allow players to solve problems in various ways (Gunawardhana & Palaniappan, 2015).

Although digital games provide experiences for students in the form of entertainment, good digital games contain principles and the main goals of learning science for children, and they demonstrate how to implement a learning theory into practice (Gee, 2007). Digital games offer self-evaluation and social learning environments, allowing players to gain knowledge from various viewpoints (Gunawardhana & Palaniappan, 2015). Thus a digital game is more than just software; it's a collection of performances by players and social interactions within and surrounding the game (Gee, 2017).

Khan Academy Kids is a free online platform providing interactive educational aid in the field of science (Mota-Macias et al., 2022). According to Prensky's (2011) study, Khan Academy Kids is a learning platform for children 2-8 years old which enables every child to have access to an explainer and watch the explanations many times based on their needs. Khan Academy's strategy is to teach old concepts in new and interesting ways. Prensky (2011) also noted that Khan Academy uses interesting videos and games to improve the learning system.

Therefore, Khan Academy Kids could be an excellent choice for children's learning. DiSalvo and Morrison (2013) state that Khan Academy "includes the addition of badges, accomplishment statistics and skill tree visualizations that reflect the completion of different learning tasks and participation in the online community" (p. 1). Children can easily and more

quickly understand the concepts of lessons when they use them in an enjoyable and interactive environment (Wati, 2020). Play allows children to create new learning experiences and paths for problem-solving. As well children can acquire social, emotional, and cognitive capacities due to these self-created experiences (Elkind, 2007).

1.1 Scope and Purpose

The Covid-19 pandemic created many difficulties and new challenges for children. From my experience as a teacher, I observed that new and unfamiliar conditions can potentially impact children's anxiety and decrease their learning performance. Although studies state that digital games can reduce emotional obstacles to children's learning, improve their communication willingness, and increase their learning interests and performances (Reinders & Wattana, 2015), there is scant research addressing children's anxiety and problem-solving skills during and after the Covid-19 pandemic. Therefore, there is a gap in the literature regarding the impact of digital games on children's learning performance after the Covid-19 pandemic.

I have chosen the Khan Academy Kids platform because it is a popular Internet learning site. As of February 2014, 200 nations have used Khan Academy (Light & Pierson, 2014). It creates an exciting learning environment by incorporating game aspects into the learning environment (Morrison & DiSalvo, 2014). Building on these attributes, the Khan Academy Kids platform stood out in its adaptability and versatility, which I gleaned from feedback from both teachers and parents. Educators and parents whom I spoke with confirmed its efficacy in not just imparting knowledge, but also in maintaining the students' engagement. Furthermore, Khan Academy's emphasis on providing immediate feedback and assessment tools made it particularly

valuable for teachers. They appreciated the real-time insights into a student's learning curve, which facilitated timely intervention and support.

Thus, considering these strengths and my objective to deeply probe into the impact of the pandemic on children's learning, I felt that Khan Academy Kids, with its unique blend of features, was a fitting platform for my research. I used a mixed-method research approach to undertake a thorough investigation of the effects of the Khan Academy Kids' digital platform on children's learning anxiety and problem-solving skills after the Covid-19 pandemic.

1.2 Statement of Problem

The main subject explored in this study is the increasing significance of the role of digital games in the learning process and the negative impacts of the Covid-19 pandemic on children's learning and skills. The Covid-19 pandemic is an unprecedented event in the twenty-first century (Godlee, 2020) and "as of July 2020, 98.6% of learners worldwide were affected by the pandemic, representing 1.725 billion children and youth, from pre-primary to higher education, in 200 countries" (United Nations, 2020, as cited in Pokhrel & Chhetri, 2021, p. 138). This research is dedicated to exploring and assessing the impact of the Khan Academy Kids application, a popular digital platform that many countries use, on children's anxiety and problem-solving skills.

1.3 Research Positionality

I believe education is a fundamental human right for all children. Education is a fundamental human value, a societal requirement, assists in children's survival, and is the foundation of a happy life. UNICEF (2020) noted that "A child's right to education entails the

right to learn." Education provides us with knowledge about the world around us, helps us improve it, and forms our points of view on life (Bhardwaj, 2016; UNICEF, 1989).

From my experiences as a teacher of children with special needs, digital games allow students to try out things, think creatively and learn (Eow & Baki, 2010). Digital games are representations of the real thing; the real experience could be dangerous or too complex for children such as driving or walking in the jungle. Therefore, digital games provide safe situations for children to play (Flynn et al., 2019). My experiences have shown that, digital games also have a profoundly motivating effect on young people. In digital games, young players find competition enjoyable and encouraging, but not in academic settings (De Freitas, 2018). Therefore, I believe that digital games could be practical and helpful tools for teachers.

From my position as a researcher, I decided to explore the impact of the Khan Academy Kids platform on elementary students' learning. In my research, I located a fun and engaging digital tool for potentially decreasing children's anxiety and improving vital skills such as problem-solving. Furthermore, I provided strong research and practical rationale for encouraging teachers to use new and digital learning tools in the classroom.

1.4 Research Questions

1.4.1 Main Questions

The main research questions of the study are:

1. How can digital games be used to engage children's learning process?
2. What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' anxiety?

3. What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' problem-solving skills?

1.4.2 Sub-Questions

4. What knowledge is most valuable when children are part of a crisis, such as the Covid-19 pandemic?
5. Which digital method of learning is more practical for elementary students?

1.5 Significance of the Study

There is not enough related research to address educational challenges caused by the Covid-19 pandemic, especially children's anxiety and problem-solving skills. More than 168 million students' classrooms worldwide were closed for over a year due to the Covid-19 education crisis (UNICEF, 2021). This crisis revealed the importance of digital technology as educational tools during and after the pandemic. Gee and Price (2021) state that digital game-based learning is about integrating deep game-based concepts of teaching and learning across the curriculum, not only in the classroom.

This study is also significant as it takes a critical look at how education is, or is not, preparing students for societal change and crisis situations (Gutek, 1984; Lagemann, 1989). One of the most important goals of education is to give children intellectual competency and prepare them to adapt to new challenges and changes. New educational methods, such as digital games, can improve students' motivation and help them build complicated problem-solving skills (Eseryel et al., 2014).

Moreover, students and instructors needed to stay at home during the pandemic, and this change has challenged the educational system to think outside of the box when it comes to

teaching and learning (Aktan, 2021). According to the United Nations (2020, as cited in Zhao & Watterston, 2021, p. 3), "This crisis has stimulated innovation within the education sector." Therefore, new educational tools such as digital learning platforms may be utilized to enhance the learning experience of students, while simultaneously fostering other skills (Saengprachum, 2021).

1.6 Conceptual Framework

1.6.1 Constructivist Learning Theory (CLT)

One of the theoretical frameworks of this study is constructivist learning theory (CLT). This theory aims to explain how individuals come to know what they know (Gordon et al., 2011). CLT seeks to define how learning processes should be implemented in the classroom and how knowledge is created (Butler & Griffin, 2010).

Bada and Olusegun (2015) state that the main point of CLT is that teachers cannot merely pass on information to students; students must be active in the learning process and develop knowledge in their minds. Von Glasersfeld (2012) also states that "learning is not a stimulus-response phenomenon, but a process that requires self-regulation and the development of conceptual structures through reflection and abstraction" (as cited in Bada & Olusegun, 2015, p. 66).

In CLT, people develop knowledge via activities and reflections instead of passively receiving information (Garmston & Wellman,1994). To promote student participation and engagement, CLT emphasizes students' roles and active learning experiences (Boghossian, 2006). According to Boghossian (2006)," this theory is problem-oriented and favours

encouragement and collaboration strategies during the learning process" (as cited in Chuang, 2021, p. 5).

In CLT, students' viewpoints are critical and acknowledged, and they gain new information through their experiences (Chuang, 2021). Constructivist learning theory (CLT) focuses on hands-on and active learning events to improve student collaboration and engagement (Boghossian, 2006). Children develop their perspective and understanding of the world through encountering new things and reflecting on them (Bada & Olusegun, 2015). The core idea of this theory is that thinking, learning, and growth are all aided by problem-solving (Alzahrani & Woollard, 2013).

Digital game-based learning fosters students' critical thinking ability (Hwang & Chen, 2017) and links simulated-based and actual activities (Saengprachum, 2021). Digital game-based learning also constructs new learning experiences via play and allows children to learn from these experiences (Gee, 2008). In fact, the challenging world of games shapes students' cognitive capacities and expectations about learning (Facer, 2003; Prensky, 2003).

Constructivist learning theory, which is in accordance with the nature and goals of the Khan Academy Kids platform and the usage of online games in education, is relevant to this study. According to Bada and Olusegun (2015), CLT emphasizes that learning is an active process in which students build knowledge through their experiences, reflections, and problem-solving. It recognizes the value of students actively participating in their education and their capacity to create conceptual frameworks through reflection and abstraction (Von Glasersfeld, 2012).

Khan Academy Kids platform, with its interactive books, videos, games, and creative lessons, provides students with hands-on and active learning experiences. Khan Academy Kids contains over 5,500 teaching videos on various topics, decision-making games, teamwork, and active collaboration (Cargile, 2015). This platform promotes problem-solving, collaboration, and critical thinking, all of which are essential to the CLT (Boghossian, 2006). Through engagement with the platform's various activities and games, students have the opportunity to construct knowledge, explore new concepts, and develop their understanding of the world (Chuang, 2021).

This study aims to involve kids in the learning process, promote active participation, and provide opportunities for students to construct knowledge through engagement with the Khan Academy Kids platform, which is founded on constructivist learning principles (Cargile, 2015). Students' involvement and motivation in the learning process are supported by the platform's interactive features, progress tracking, and systems for rewards, which are in line with the fundamental principles of CLT.

In the end, the incorporation of CLT-based Khan Academy Kids platform offers children a dynamic and engaging learning experience that encourages their active involvement, critical thinking, and problem-solving abilities. The platform supports the CLT ideals by giving students the chance to explore different learning environments and build their own knowledge.

1.6.2 Scaffolding Theory of Learning

Another relevant theory that is applicable to digital game-based learning is Vygotsky's scaffolding theory of learning. "Scaffolding instruction as a teaching strategy originates from Lev Vygotsky's sociocultural theory and his concept of the zone of proximal development (ZPD)" (Van Der Stuyf, 2002, p. 2). In scaffolding instruction, a more experienced person offers

support to help the learner progress (Van Der Stuyf, 2002). The scaffolds support students' ability to build on prior knowledge while learning new information and concepts (Olson & Pratt, 2000).

In Vygotsky's scaffolding theory, children will be able to independently grasp concepts and master knowledge (Chang et al., 2002). Sun et al. (2018) discovered that the correct scaffolds assist learners in creating even more complicated learning techniques and improve gaming experiences and creativity. The appropriate scaffolds help children practice creativity, gain experiences and help solve more complicated content. Sun et al. (2018) also illustrate that "incorporating the scaffolding theory into digital game-based learning can help reduce frustration, enhance problem-solving skills, and, through reward mechanisms, increase learning motivation" (as cited in Yang & Lu, 2021, p. 2).

Digital games do not begin with the most challenging level; instead, they arrange the levels as problem sets that build on one another. With the use of digital games, players may assess if they have mastered the level to the point where they can advance without becoming frustrated. Players may replay a level on digital game-based platforms to gain more experience and expertise without facing penalties for failure and without using time as the measurement of learning and success (Gee & Price, 2021). Khan Academy Kids, as a digital game-based learning platform, allows children to watch videos and play games as many times as they want (DiSalvo & Morrison, 2013) to master concepts.

The Scaffolding Theory of Learning, based on Lev Vygotsky's sociocultural theory is quite applicable to game-based learning in digital environments, including the Khan Academy Kids platform used in this study. In scaffolding instruction, a more experienced individual

provides support to learners to help them progress and build on their prior knowledge (Olson & Pratt, 2000; Van Der Stuyf, 2002).

The Khan Academy Kids platform incorporates scaffolding elements that align with Vygotsky's theory. The platform provides instruments to aid students in their learning process and assist them in developing and mastering new concepts, like interactive videos and games (DiSalvo & Morrison, 2013). The platform's design allows students to interact with the content at their own speed, and replay levels, and get additional experience without worrying about failing or running out of time (Gee & Price, 2021). These features are in line with the scaffolding theory's emphasis on giving students the right assistance and fostering an atmosphere in which they can build their own experiences and knowledge structures (Raymond, 2000). The use of scaffolds in digital games can reduce frustration, enhance problem-solving skills, and increase motivation through reward mechanisms (Yang & Lu, 2021). Students navigate through more complicated levels on the Khan Academy Kids platform and have the chance to improve their creativity, problem-solving skills, and learning motivation (Sun et al., 2018).

The Khan Academy Kids platform's design and functionality clearly demonstrate the connection between digital game-based learning and Vygotsky's scaffolding theory. Students receive the appropriate assistance and direction as they play games, comparable to the scaffolding offered by a more knowledgeable person during the learning process (DiSalvo & Morrison, 2013). This connection highlights how Vygotsky's scaffolding theory can be applied to digital game-based learning, as shown through the Khan Academy Kids platform. The application of these principles allows for student development in a controlled and supportive digital environment, reinforcing Vygotsky's theories in a modern, practical setting.

Overall, the Khan Academy Kids platform serves as an example of how Vygotsky's scaffolding theory has been incorporated into digital game-based learning to provide students with the support, challenges, and growth opportunities they need to successfully navigate their educational journeys and improve their motivation and problem-solving abilities. The platform's scaffolding components promote the fundamental ideas of Vygotsky's theory by highlighting the value of directed assistance and the significance of social contact in the learning process.

1.7 Summary

Chapter 1 of this study explored the impact of the Covid-19 pandemic on education systems and the challenges faced by children during this period. It discussed the psychological effects of the Covid-19 pandemic, such as more anxiety and less social engagement, as well as the significance of problem-solving abilities in reducing stress and coming up with solutions. The chapter also explored the constructivist learning theory (CLT) and scaffolding theory as relevant conceptual frameworks.

Chapter 2 builds upon the foundation established in Chapter 1 through a comprehensive review of the literature. It looks further into the subject of new education, digital games, Khan Academy Kids platform examining its features, advantages, and relevance to digital game-based learning. The chapter also explores the broader landscape of digital games as educational tools and their impact on problem-solving abilities of elementary students.

Chapter 2: Theoretical Overview and the Literature

The Covid-19 pandemic was the biggest challenge that educational systems have ever faced (Daniel, 2020). Numerous efforts were made by educators and educational institutions throughout the world to adapt and innovate as a result of the sudden advent of the Covid-19 pandemic and the ensuing school closings (Zhao & Watterston, 2021). During the Coronavirus pandemic, students and young adults in all grades experienced negative educational changes and health implications due to the pivot to online education (Hoofman & Secord, 2021; Salas-Pilco et al., 2022). This crisis has stimulated innovation in the educational field and given teachers and students a chance to work together and assess the quality of education for coping with crisis situations (Pinkham et al., 2020; Selvaraj et al., 2021)

Many institutions and education systems provided instruction online (Kamanetz, 2020; Sun et al., 2020), and teachers reacted quickly to the changes in how lessons were delivered (Zhao & Watterston, 2021). The transition to online learning has forced educators to reevaluate their methods and adopt cutting-edge strategies that focus on student agency, self-directed learning, and the learning of 21st-century skills (Giesecke, 2020). Teachers have to embrace the role of facilitators, assist students to take ownership of their educational paths and acquire the skills required for success in the digital age (Giesecke, 2020; Jalali et al., 2023).

Along with significant changes in education and life routine due to the Covid-19 pandemic and its effects, children faced many concerns, uncertainty, social and physical isolation, and high-stress levels. The Covid-19 pandemic has had an adverse effect on both children's physical and mental health. Due to children's inadequate comprehension of the situation, they are particularly vulnerable (Imran et al., 2020).

Dalton et al. (2020) state that children have limited coping mechanisms and skills. Additionally, they may not have the same emotional expression skills as adults. Therefore, they are unable to avoid the harmful physical or psychological consequences of the Covid-19 pandemic. Due to school closings and being away from their friends, children may feel stressed and anxious (Dalton et al., 2020; Munir, 2021).

According to Nascante (2001), anxiety can be brought on by a variety of factors, including a lack of confidence in one's skills, a fear of failing, and pressure to do well. Nascante (2001) noted that anxiety can reduce a student's capacity for concentration, information processing, and memory. Serrano-Aguilera et al. (2021) and Zheng (2008) also mentioned that student attention, information processing, and memory may all be hindered by learning anxiety, which can negatively impact academic achievement. Children's mental health and well-being may be significantly impacted by anxiety disorders (Anxiety and Depression Association of America, n.d.; National Institute of Mental Health, 2018).

The virus's fast spread instilled anxiety and depression in people of all ages and socioeconomic groups (Arribathi et al., 2021). Li et al. (2020) and Setianingsih et al. (2019) illustrated the significant effect of the Covid-19 pandemic on society, children and the educational system. They asserted that working and studying from home has become a typical

technique for avoiding the illness of the Covid-19 pandemic. As well, studying from home has presented significant difficulty and anxiety regarding social connection (Li et al., 2020; Setianingsih et al., 2019).

The world of education is being pushed to have a massive transformation due to the Covid-19 pandemic. Azorín (2020) believes that "a school reconfiguration that is better able to respond and adapt to these complex times is needed" (p. 382). The Covid-19 pandemic created challenging circumstances that resulted in new curricula that lead to deeper student learning. The Covid-19 pandemic posed difficulties for the educational system, but it also provided a chance for innovation and advancement (Fullan, 2020; Jalali et al., 2023).

Based on Fullan's (2020) study, the transition to remote learning highlighted the need for encouraging student agency and self-directed learning, as well as the necessity for instructors to transition from being knowledge providers to learning facilitators. Schools must adopt innovative approaches to instruction that put an emphasis on problem-solving, critical thinking, and deep learning as well as the acquisition of 21st-century skills like creativity, teamwork, and communication. The Covid-19 pandemic forced educators to rethink what education is required and desirable for the next generations.

2.1 Importance of Problem-Solving Skills for Elementary Students

In response to the Covid-19 pandemic, all students and teachers have undergone significant changes (Munastiwi, 2021). Elementary students faced many educational difficulties during the pandemic. Munastiwi (2021) states that primary school education is a critical step in the educational process, and students need to learn vital skills because "children are experiencing a transformation from non-formal to formal education" (Skouteris et al., 2012, as cited in

Munastiwi, 2021, p. 34). One of the essential skills for young children is problem-solving (Joseph & Strain, 2010)_ a crucial component of a child's social competence development is their ability to solve problems (Denham et al., 2003; Goleman, 1994; Webster-Stratton, 1999).

According to Nezu et al. (2012), problem-solving abilities include the capacity to recognize and understand difficulties, create, and put into practice effective solutions, and assess the results. Taylor and Hamdy (2013) stated that a problem-solving talent is an ability to approach complicated and difficult issues in a methodical and efficient manner by using critical thinking, creativity, and decision-making abilities.

Mayer et al. (2008) explore the relationship between problem-solving skills and emotional intelligence, suggesting that understanding and managing emotions can play a crucial role in effective problem-solving. The development of problem-solving skills is not only essential for individual success but is also imperative for addressing societal challenges and fostering innovation. Problem-solving and critical thinking are becoming more and more integrated into curricula and training programmes at educational institutions and workplaces as a result of the growing recognition of the value of these abilities (Almulla & Al-Rahmi, 2023). Problem-solving abilities are essential for adapting to new environments, getting over difficulties, and making decisions that are in the best interests of the person and the community in today's complicated and ever-changing world (Szabo et al., 2020).

Children need problem-solving abilities to succeed in the academic, social, and emotional spheres because these abilities help them gain independence, self-assurance, and resilience. Additionally, Zelazo et al. (2016) asserted a strong connection between the early development of problem-solving abilities and executive functions, which are crucial for planning, focus, and

impulse control. Children can develop their critical thinking abilities through problem-solving activities, which in turn enables them to analyze information more efficiently and make better judgements (Fisher, 2005). Furthermore, by encountering and overcoming challenges, children develop a sense of competence and are more likely to confidently take on new challenges (Erikson, 1993).

Cognitive, linguistic, and social gains may be derived through problem-solving learning. Problem-solving learning assists students in becoming more aware of and explaining their thought processes, developing their critical thinking abilities, and promoting analytical learning in students. Students actively engage in the learning process, comprehend, and retain a greater ability to recall their own self-improvement (Kanca et al., 2020).

Problem-solving skills involve the capacity to identify and understand problems, consider multiple options, select the most appropriate solution, and effectively implement and evaluate the chosen approach. These skills are crucial for effectively addressing challenges and achieving desired outcomes (Kailani et al., 2019). According to Balin et al. (2011), students use problem-solving as a strategic method to draw conclusions and inferences based on their observations and experiences. Nutting's research (2013) illustrated that problem-solving strategy of learning "brings out student creativity because there are two exploratory activities carried out by them, namely observation and experimentation" (as cited in Kanca et al., 2020, p. 13).

Crick and Dodge (1994) stated that children without problem-solving skills would likely resort to violence to resolve interpersonal conflicts. Broidy et al. (2003) also emphasized the importance of problem-solving skills for young children to prevent violence and alleviate mental health problems.

The National Council of Teachers of Mathematics (2000) and Eisenberg et al. (2010) stated that elementary students need to build their problem-solving abilities since these abilities are critical to their academic, social, and emotional growth. A crucial component of problem-solving abilities that may help kids become more imaginative and creative is the capacity to think creatively and come up with novel solutions to issues (Kaufman & Beghetto, 2009).

2.2 New Education

Before the Covid -19 pandemic, educational systems were already being called into question for being divorced from the needs of children (Azorín, 2020). The World Economic Forum (2020) stated that many countries use traditional forms of learning, such as direct instruction and memorization, in their education system instead of interactive and more practical methods which develop individual thinking needed in the modern world.

New skills using technology will become more critical in the globalized world (Barber et al., 2012; Florida et al., 2013; Wagner, 2008; Wagner & Dintersmith, 2016). Even though it is still important to help students learn basic practical skills, education should also help students grow as people and as members of their local, national, and international communities (Jacobs, 2010).

The idea that educational systems with strict requirements for reading, writing, and math are the most effective systems is one of the most harmful misconceptions in education (Barber et al., 2012). Artificial Intelligence (AI) and related new technologies reduce the important role of learning processes such as pattern prediction and recognition, memory, and other abilities connected to information collecting, storage, and retrieval (Muro et al. 2019). In contrast, skills such as creativity, curiosity, critical thinking, problem-solving, teamwork, communication, and a

growth mindset are more important for students in the current situation (Duckworth & Yeager, 2015; Zhao et al., 2019). Zhao (2012) believes that education must teach students to be creative, entrepreneurial, and internationally competent in order to survive in the era of smart technologies and a globalized world.

The Covid-19 pandemic highlighted the fact that curriculum should emphasize developing students' talents rather than focusing on template information. Zhao and Watterston (2021) mention that the curriculum should also pay more attention to students' social and emotional well-being and mental health. Moreover, another critical aspect of the new education is providing opportunities for students to make decisions and learn about the repercussions of their choices. Thinking about the consequences of decisions and learning from them could teach students meta-learning (Zhao & Watterston, 2021).

Given how quickly conditions are changing in our society today, it is evident that conventional career paths and lifetime occupations will not be as prevalent as they were for earlier generations. We will experience rapid changes in the nature of our work and how we do business. As a result, schools can no longer teach students the skills they will need for the future before they graduate and leave the classroom (Zhao & Watterston, 2021).

Education must be viewed as a means of achieving lifelong learning, enjoyment, welfare, and the ability to make a positive contribution to mankind (Zhao & Watterston, 2021). In order to empower all students to make informed decisions and discover their interests and special skills, schools must offer extensive access and in-depth exposure to all subject areas. For example, schools must assist students in acquiring the new skills necessary for the modern age (Barber et al., 2012; Wagner, 2008, 2012; Wagner & Dintersmith, 2016).

The biggest disruption to educational systems in human history has been caused by the Covid-19 pandemic. Traditional educational techniques have been seriously affected by socially distracting and movement-restrictive regulations. Reopening of schools after limitation easing is another difficulty with several new operational practices put in place (Pokhrel & Chhetri, 2021).

The Covid-19 pandemic shows that the education system needs to change, specifically the curriculum and its accompanying pedagogy (Zhao & Watterston, 2021). Direct instruction would not be an appropriate pedagogy for children because it has impractical success and long-term consequences (Bonawitza et al., 2011; Buchsbauma et al., 2011; Kapur, 2014, 2016; Zhao, 2018). New education should be enjoyable and dynamic and actively encourage students to participate in the learning process. Schools and structures should allow students to participate in their curriculum instead of passively learning the same lessons and content (Zhao & Watterston, 2021).

Zhao and Watterston (2021) state that education will alter dramatically over the next decade. These changes will lead to curricular alterations that illustrate what students should learn and emphasize the important role of technology in education. In online learning during the Covid-19 pandemic, incorporating digital technology helped the learning process as a supportive medium and a way to get a broad overview to raise education quality (Makiyah et al., 2019) and develop 21st-century skills (Dash, 2019). Among the various forms of digital technology, digital games have emerged as a particularly engaging and effective tool for learning. Digital games not only attract students' interest, but they provide engaging, interactive settings that might help them grasp and remember the information more deeply (Gee, 2017). Digital games can promote problem-solving abilities, critical thinking, and teamwork, which are crucial for 21st-century

learning, by adding components of challenges, rewards, and feedback (González-Salamanca et al., 2020). Additionally, digital games can be customized to meet different learning preferences and needs, enhancing inclusivity and personalizing education (Shute & Ke, 2012). As education continues to evolve, it is crucial for educators and curriculum developers to thoughtfully integrate digital games into the learning process to maximize their potential in enhancing student outcomes (Annetta, 2010; Kessler, 2018).

2.3 Digital Game

Digital games are seen as a subgroup of play (Stiller & Schworm, 2019). Play enables children to express themselves through their actions and their own meaning (Pramling Samuelsson & Johansson, 2006) and play is a core resource for learning (Mardell et al., 2019). According to research, play encourages positive effects in the learning setting, such as improved enjoyment (Rubens et al., 2020), heightened engagement (Ofer et al., 2018; Yu et al., 2020), and amplified motivation (Fotaris et al., 2017; Liu et al., 2019; Radu, 2014), which supports healthy childhood development. Additionally, an entertaining learning environment often increases children's learning effectiveness (Cohen, 2017; Hainey et al., 2016; Lai et al., 2018; Lillard et al., 2013; Wilkinson et al., 2018).

Gee (2013) states in a study that digital game-based learning has gained much interest in educational settings in the last 20 years. The potential of digital games as a tool for fostering learning and growth is highlighted in James Paul Gee's (2013) paper "Video Games and Embodied Learning." Digital games, in Gee's opinion, provide embodied learning opportunities by letting players engage with objects and characters in ways that simulate real-world interactions. Digital games may also boost learning via social engagement and encourage

problem-solving and critical-thinking abilities through challenging gameplay. Digital games, according to Gee, may be utilized to help learning across a range of disciplines and to foster an optimistic learning attitude (Gee, 2013).

Gee and Esteban-Guitart (2019) stated that digital games provide players with the chance to practice a variety of cognitive abilities, such as decision-making, critical thinking, and problem-solving. Games may also encourage emotional growth by giving players the chance to control their emotions and practice emotional management. Digital games contain critical elements of learning because they have well-designed problem-solving environments with feedback and unambiguous consequences. Digital games include several opportunities for fundamental skill practice inside goal-based and engaging activities (Gee & Esteban-Guitart, 2019).

With today's games and other digital media, learning may be so effectively planned that completing the game demonstrates mastery of the material (Gee & Esteban-Guitart, 2019). This is due to the fact that virtual obstacles and situations frequently appear in digital games, enabling children to practise problem-solving techniques in an environment more representative of real life (Papanastasiou et al., 2019).

In addition, games' interactive features can keep kids interested and motivated, which is essential for learning (Prensky, 2003). Gunawardhana and Palaniappan (2015) mention that digital games increase player motivation through positive feedback. Players receive immediate feedback on their performance from the game's feedback mechanisms, such as scores and levels, enabling them to recognize and correct their faults (Shute & Ke, 2012). Multi-player digital games also promote cooperation and communication, two crucial life skills (López-Faican

& Jaen 2020; Steinkuehler & Duncan, 2008). Educators are also exploring game-based learning as a means to personalize education and accommodate different learning styles and paces, which is known to improve outcomes (Zheng et al., 2018).

Digital games can improve the user's capacity to simplify challenging tasks through practice or rational thought. Children who are anxious or unsure of their abilities might be motivated by digital games. It is highly effective and may simultaneously manage user behaviour if children or other users utilize digital games appropriately.

This is because the immersive nature of digital games provides a safe space for experimentation, allowing children to take risks and learn from failures without fearing real-world consequences (Gee, 2003). Additionally, the incentive structures in games, such as gaining points or unlocking new levels, can act as positive reinforcement, enhancing kids' motivation and self-esteem, particularly those who might find it challenging to learn in traditional educational environments (Przybylski et al., 2010). In addition, many digital games demand strategic planning, which might improve players' critical and cognitive thinking skills (Adachi & Willoughby, 2013; Chen & Wu, 2021). As children engage with digital games, they can also develop social skills through online collaboration and communication with other players (Granic et al., 201 Granic et al., 2014; Suryani et al.m 2021).

Yuniarti and Hartati (2020) state that using technology in the classroom aids instructors and students in comprehending complex subjects. There are various online learning systems available for students. Soebagyo (2016) illustrates that Khan Academy Kids is one of the famous digital game platforms among children that can be used to support online learning.

2.4 Khan Academy Kids Digital Learning Platform

Khan Academy Kids is a digital application designed for children aged 2 to 7 to provide fun and engaging learning experiences (McGhee et al., 2020). Khan Academy Kids application promotes online science and mathematics study (Putri, 2021) and raises the quality of instruction for online learning (Soebagyo, 2016). Kumar and Bervell (2019) describe Khan Academy Kids as a novel way to learn science concepts through an online technique. They believe Khan Academy Kids helps students get beyond prior lesson delivery issues and offers an alternative for tracking their academic progress.

McGhee et al. (2020) stated that the Khan Academy Kids app is useful for enhancing kids' reading abilities, particularly their understanding of letters and sounds. Another study published in the *Journal of Educational Psychology* found that children who used the app for math tasks showed a considerable increase in their math abilities in comparison to a control group who did not use the app (Sackes et al., 2021). Bergin et al. (2020) also showed that the social and emotional abilities of the kids who used the app improved, particularly their capacity to recognize emotions and communicate empathy.

Putri's study (2021) mentioned that there are more than 10,000 practice questions, 5,500 instructional videos, and puzzles on the Khan Academy Kids platform to help students study. Digital games are frequently effective teaching aids because they are interactive and allow players to solve problems using a variety of ways (Gunawardhana & Palaniappan, 2015).

Thompson (2011) claims that the Khan Academy Kids website does more than just provide educational videos. It also includes software that presents learning exercises or questions that allow students to apply what they've learned. Additionally, when these tasks are completed

successfully, the platform offers game-like rewards to enhance the learning experience. Digital games are usually powerful learning tools as they are active and can solve problem-based tasks through different types of puzzles and techniques. Digital games have the option of self-assessment and social learning environments, thus allowing students to learn from different perspectives (Kirriemuir & McFarlane, 2003).

Digital games are usually powerful learning tools as they are active and can solve problem-based tasks through different types of puzzles and techniques. Digital games have the option of self-assessment and social learning environments, thus allowing students to learn from different perspectives (Karagiannis & Magkos, 2021).

Khan Academy Kids offers coaching features, such as resources for educators and parents to help them accomplish student learning objectives (Putri, 2021). Murphy et al. (2014) state that teachers could utilize this tool to choose the best materials for students. Putri (2021) also noted that Khan Academy Kids could support establishing effective, efficient, and enjoyable learning for students and actively engaging students in the learning process. Moreover, Monteiro et al. (2015) believe that Khan Academy helps children to develop their critical and creative thinking skills, as well as their independence and desire to study.

Thompson (2011) and Ruipérez-Valiente et al. (2015) mention that the Khan Academy Kids platform could be individualized for each child when they need help, and students can view their own information using the learning analytics modules' personalized visualizations. Students can determine how much time they spend on certain abilities or movies using another sort of personal visualization. Additionally, users may select the option "Skill Progress" to view their current standing across a variety of talents (Ruipérez-Valiente et al., 2015).

2.5 Summary

Chapter 2 provided an insightful exploration of the educational challenges and mental health implications faced by students, particularly young ones, due to the unprecedented shift to online education amid the Covid-19 pandemic. The chapter emphasized how the pandemic served as both a barrier and an opportunity for innovation in education, calling for adaptable measures by educators and institutions worldwide (Daniel, 2020; Hoofman & Secord, 2021; Salas-Pilco et al., 2022; Selvaraj et al., 2021; Pinkham et al., 2020; Zhao & Watterston, 2021).

Compared to adults, children have fewer coping strategies and communication skills to deal with stress and anxiety during the pandemic (Dalton et al., 2020; Munir, 2021; Nascante, 2001; Serrano-Aguilera et al., 2021; Zheng, 2008). This has led to an emphasis on the mental health of children, in particular. Additionally, the chapter emphasized the significance of problem-solving abilities for elementary school students (Denham et al., 2003; Goleman, 1994; Joseph & Strain, 2010; Munastiwi, 2021; Webster-Stratton, 1999).

The chapter also covered the topic of digital games as a subset of play and their advantages for learning environments (Gee, 2013; Mardell et al., 2019; Stiller & Schworm, 2019). Lastly, a specific focus was given to the Khan Academy Kids digital learning platform, examining its components and effectiveness in enhancing children's learning experiences (Bergin et al., 2020; DeWinter et al., 2010; Gunawardhana & Palaniappan, 2015; Kirriemuir & McFarlane, 2003; Kumar & Bervell, 2019; McGhee et al., 2020; Putri, 2021; Sackes et al., 2021; Thompson, 2011).

In transitioning into the next chapter, the focus will shift to the methods of research employed in this study. Chapter 3 will provide detailed insights into the research design, the

sample population, the instruments used for data collection, and the procedures followed for data analysis. The chapter will also discuss the ethical considerations taken into account during the research process. The findings and interpretations reported in the next chapters can be understood on the basis of this methodological framework.

Chapter 3: Methodology

The study is conducted to ascertain the impact of the Khan Academy Kids digital platform on elementary students' learning anxiety and problem-solving skills after the Covid-19 pandemic. This chapter is divided into sections that explain the framework of the study, the research design, the participants and settings, the data collection instruments including the classroom observations and teacher interviews that provide the qualitative data, and the student survey that provides the quantitative data. Additionally included are ethical considerations, and the procedures for conducting the study, which describe each stage involved in the research. This chapter addresses research-related questions: about how children participate in the learning process through digital games, the pedagogical effects of the Khan Academy Kids digital platform on students' anxiety and problem-solving abilities, critical knowledge and skills required during crises like Covid-19, and the practicality of digital learning methods for elementary students.

3.1 Research Design

The research design used in this study is an integrated approach, which is a mixed method approach as it uses both quantitative (survey) and qualitative (interview and observation) approaches to research (Dawadi et al., 2021). Creswell and Tashakkori (2007) defined mixed-method research as "research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both quantitative and qualitative approaches" (p. 4). Creswell (2009) and Perez (2021) defined the mixed-method approach as a research methodology popular in the psychological, behavioural, and health sciences that entails

collecting, interpreting, and synthesizing quantitative and qualitative data into a single analysis to address a research question.

Mixed-methods research has been more popular recently since it enables academics to examine difficult research topics that can't be fully addressed by a single method (Johnson et al., 2007; Tashakkori et al., 2020). In order to provide a more thorough knowledge of a study subject or problem, mixed-methods research blends qualitative and quantitative research techniques (Creswell & Creswell, 2018).

Since I used quantitative and qualitative data to answer the study's research questions, I believe a mixed-methods approach is crucial. Mixed-methods approach can fully comprehend the research questions or the goal of carrying out a successful study (Creswell & Creswell, 2018). Data sources for the research entailed a survey and observations of 10 elementary students to determine the effect of the Khan Academy Kids learning platform on their anxiety and problem-solving skills. In addition, I interviewed the teacher to explore their use of digital-game-based learning platforms in the classroom. As well, I explored if and how engaging with the Khan Academy Kids platform impacts their students' anxiety and problem-solving skills. Therefore, a mixed methods approach was utilized, using research tools such as open-ended interviews with the teacher, surveys with students and observing children's behaviour in the classroom as they engaged with the Khan Academy Kids learning platform.

3.2 Participants and Settings

The participants were chosen from a public school located in London, Ontario. The school board facilitated the connection with several schools whose principals were open to

research collaboration. After communicating with grade 1 and 2 teachers, I selected one elementary school and a grade 1 class for the study.

The participating teacher in the study was a female with 15 years of experience teaching in grades 1 and 2. She currently teaches grade 1 and has familiarity with digital technologies, particularly digital games. During the initial interview, she indicated frequent use of digital games in her teaching environment and expressed interest in expanding the use of learning applications and providing tablets for all students. She has already incorporated the ScratchJr digital learning application in her classroom activities. The study was open to all teachers of students aged 5-8, with equal opportunities for both genders. From those who agreed to participate, ten students were selected, comprising an equal gender distribution of 5 boys and 5 girls.

All parents/guardians of students in the class were provided with a letter of information about the study and a letter of consent for their children's participation. Ten first-grade students aged 7 were ultimately chosen to participate in the study from those who received the information. The group consisted of 5 boys and 5 girls, selected based on the consent from parents and assent from the children themselves. A balanced gender ratio was maintained among the students to ensure diversity and representativeness in the data gathered.

The following were the criteria for the inclusion of participants in the study:

1. Elementary students from 5-7 years old (equal number of boys and girls).
2. One teacher of elementary students familiar with digital game-based learning.

The classroom environment was vibrant, hosting a total of 16 students. To facilitate the game-playing sessions with Khan Academy Kids, Chromebooks were provided by the university for the purpose of this study. During the initial session, the teacher organized the students into small groups consisting of two or three students. Students who were taking part in the activity were sitting on one side of the classroom, while those who weren't were seated on the other side playing different digital games on the classroom tablets. In the first interview, prior to game playing, the teacher revealed that, despite having experience using iPads in the classroom, neither she nor her students had ever used the Khan Academy Kid application. There were only five tablets available for the entire class, which made it difficult for each student to have their own device. It was also the first time students were encouraged to play digital games as part of a group.

Despite limited resources, the teacher expressed enthusiasm for integrating digital games and new technologies in the classroom. She was particularly eager to observe the outcomes of using Khan Academy Kids, especially considering that students were using Chromebooks for group play, which was a new experience for them.

This detailed contextual information provides a foundation for understanding the setting and participants involved in this study, which aims to explore the impact of Khan Academy Kids on elementary students' learning anxiety and problem-solving skills post-Covid-19.

3.3 Data Collection Instruments

In this study, qualitative and quantitative data were collected. Qualitative data were collected through two interviews with the teacher and classroom observations of students.

Quantitative data were collected through the Spence Children's Anxiety Scale (SCAS) survey completed by students at the end of the study. Each instrument is discussed below.

3.3.1 Interviews

1. In the initial part of the study, a face-to-face semi-structured interview was conducted with the teacher to gain insights into her perspectives on the integration of digital games in the classroom. The interview consisted of 4 open-ended questions (Appendix 1- Part A) and aimed to explore the teacher's prior experiences, beliefs, and attitudes toward using digital game-based learning platforms in the classroom. This strategy is consistent with educational research, emphasizing how important it is to comprehend instructors' viewpoints as they influence classroom practices (Ertmer et al., 2012). The researcher was able to understand the context and baseline perceptions before introducing the Khan Academy Kids application by conducting this interview at the beginning of the study.
2. A second and final interview with the teacher was done after the kids had used the Khan Academy Kids application for four weeks in order to explore her perceptions of the application's effects on the students' problem-solving abilities and anxiety levels. This interview was more specific, consisting of 15 open-ended questions (Appendix 1- Part B). The teacher shared any changes she had noticed in the level of anxiety, problem-solving skills, or involvement of the children as a result of their use of the digital platform. By conducting a second interview focused on the impact of the specific intervention, this study aligns with the research principles suggesting that post-intervention evaluations provide valuable insights into the effects and practical implications of educational interventions (Forman et al., 2009).

Both interviews took place during class time and were audiotaped with the teacher's permission. The first interview, which occurred before the study started, took approximately 10 minutes to complete. The second interview, conducted at the end of the study, took about 20 minutes to complete. This two-interview approach allowed for a more comprehensive understanding, with the first interview setting the context, and the second interview focusing on the specific experiences and impacts associated with the use of Khan Academy Kids.

3.3.2 Classroom Observations

Classroom observations were used as the main method of data collection in this study because they provided a clear and direct way to examine students' behaviour and interactions with the Khan Academy Kids digital platform. Observations offer the researcher the chance to observe students' movements, facial expressions, and levels of involvement in real-time, which is particularly helpful for analyzing non-verbal cues that can signify levels of anxiety or engagement (Angrosino, 2007). Moreover, through classroom observations, the researcher can capture the natural setting of learning, which may not be as effectively communicated through interviews or surveys. Therefore, classroom observations were essential for gathering firsthand information on students' experiences and behaviours.

I observed 10 elementary students while they played Khan Academy Kids during class time during eight sessions (two times each week, for 30 minutes each time, over four weeks) (Appendix 2). The observation checklist contains different aspects of anxiety and problem-solving skills. The checklists have been informed by the literature on problem-solving and learning anxiety (Chen et al., 2021; Coutu, 2002; Cooper, 2006; Heard & Jones, 2011; Nappi, 2017; Slavin, 2014).

For problem-solving skills along with challenges in these abilities, I was looking for the following:

- Critical thinking: I paid attention to whether students could apply the abilities they had learned in their classrooms, a component of critical thinking while participating in the games (Nappi, 2017).
- Critical thinking: Another aspect I observed was whether students could exercise judgment or make evaluations. This encompasses their ability to assess information and draw logical conclusions (Heard et al., 2020).
- Comprehensive Analysis: I was keen to see if students would consider all facets of the game, examine them analytically, and make logical decisions to resolve the problems they encountered (Nappi, 2017).
- Creativity: I observed whether students experimented with different strategies and employed creative thinking to have an advantage in the games (Chen et al., 2021).
- Teamwork - Group Management: I observed whether students could lead their teams well, coordinating their efforts and duties to create a more positive and successful team dynamic (Hughes & Jones, 2011).
- Teamwork - Communication and cooperation: I was also interested in whether communication and cooperation had an impact on how well the team got along. I observed the students to see if they were actively cooperating to solve the games (Slavin, 2014).

For learning anxiety, I was looking for the following:

- Not feeling afraid of doing new things: This involved checking whether students demonstrated a willingness to engage with Khan Academy Kid's games and experiment with new learning platforms in the classroom. A positive engagement would signify that they were not afraid of embracing new things (Coutu, 2002).
- Breaking away from habitual behaviour: In order to determine adaptability and openness to change, I was also curious to see if students were able to move away from their usual patterns and routines (Coutu, 2002).
- Not fearful of losing: Another critical consideration was observing if students were persistent in trying the same game repeatedly without anxiety of failure. According to Cooper (2006), this would signify resilience and a growth mentality.
- No nervousness: I monitored the emotional state of students to see if they remained calm while playing Khan Academy Kids' games. The absence of anxiety would indicate that the students were at ease and likely fully engaged in the learning process.

3.3.3 Survey

The decision to use a survey instrument in this research study is supported by several benefits associated with surveys in methods research. Surveys provide a structured and standardized approach to data collection, allowing for the efficient collection of data (Creswell & Poth, 2016). They provide a means of gathering self-reported data and offer perceptions of people's feelings, experiences, and thoughts (Rubin & Babbie, 2016).

The Spence Children's Anxiety Scale (SCAS) survey is used in this study for several reasons. First, it enables the measurement of first-grade children's anxiety levels

following four weeks of using the Khan Academy Kids learning platform in the classroom. The research can obtain standardized and reliable measures of anxiety dimensions by utilizing a validated and widely used survey instrument like the SCAS (Spence, 1998).

Research Question 2: "What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' anxiety?" is directly addressed by the SCAS survey. The survey has subscales for learning anxiety, panic/agoraphobia, obsessive-compulsive disorders, separation anxiety, and social phobia. The research can determine the effect of the digital platform on different aspects of anxiety that the students experience by examining their responses to these subscales.

Ten first-grade students aged 7 (5 girls and 5 boys) participated in the Spence Children's Anxiety Scale (SCAS) survey at the end of the study. The scale explored how students felt after four weeks of gameplay with the Khan Academy Kids learning platform in the classroom. (Appendix 3). The SCAS survey has 44-item scale and it was developed by Dr. Susan H. Spence (1997).

The SCAS-Child evaluates six anxiety dimensions, which are divided into six subscales: 1. Separation Anxiety, 2. Social Phobia, 3. Obsessive Compulsive Problems, 4. Panic/Agoraphobia, 5. Generalized Anxiety/Overanxious Symptoms, and 6. Learning Anxiety.

The modification of certain questions and the inclusion of new questions about learning anxiety allows for a more targeted investigation into anxiety related specifically to the learning process. This information will help answer the research question and advance knowledge of the pedagogical effects of the digital platform by providing insight into how the Khan Academy Kids digital platform affects students' learning anxiety.

I modified the following questions:

2: "I am scared of the dark."

8: "I worry about being away from my parents."

11. "I am popular amongst other kids my own age."

17. "I am not good at sports."

18. "I am scared of dogs."

23. "I am scared of going to the doctors or dentists."

25. "I am scared of being in high places or on lifts (elevators)."

28. "I feel scared if I have to travel in the car, or on a Bus or a train."

33. "I am scared of insects or spiders."

Additionally, I have developed some questions specifically pertaining to learning anxiety, as follows:

2: I am afraid of talking in school.

8. I worry about being away from my friends.

11. I am not popular amongst my classmates.

17. I am not good at playing digital games.

18. I'm afraid to come back to study during the COVID-19 pandemic.

23. I suddenly start to shake when I have a presentation in class.

25. I am afraid of losing a digital game.

28. I feel nervous when I can't solve the challenge of games.

33. I am afraid to join new groups in my classroom.

Therefore, The modified SCAS survey analyzed Separation Anxiety, Social Phobia, Obsessive Compulsive Problems, Panic/Agoraphobia, Generalised Anxiety/Overanxious Symptoms, and Learning anxiety.

As Table 1 illustrates, considering the elementary students' age group, the response options for the survey were modified to include emojis instead of text: 'strongly agree' is represented by a sad face, 'strongly disagree' by a happy face, and 'neutral' by a face with no expression. The incorporation of these emojis is designed to enhance comprehension and engagement as the students complete the survey (DeCoito, 2018).

Table 1: *Score Range Sample Distribution*

No	Not very much	A little bit	Yes
0	1	2	3
			

3.4 Ethical Approval

The participants in my study are an essential part of the research, and they need to be protected especially since the majority are children aged 7, thus collecting data to achieve the study's objectives required ethical approval. A research ethics application was submitted to the Non-Medical Research Ethics Board (NMREB) of Western University in order to facilitate ethical approval.

The purpose of the study, the significance of the study, the research questions, the research process, the privacy policy, the responsibility, and rights of the participants all the

essential things related to the research were defined with other supporting documents including the survey, observations checklists and interview questions. Following the criteria of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2), Western University NMREB's consent was required in order to go forward with the project.

To develop research at elementary schools I sent my Western University's ethics approval to the school board's external research committee. The committee needed to review the privacy/security assessment of the Khan Academy Kids application and review requests from external individuals and/or organizations applying to conduct research in schools. The purpose of the study, the significance of the study, the research questions, the research process, the privacy policy, the responsibility, and rights of the participants, the survey, observation checklists, and interview questions were defined by the school board's external research committee.

3.5 Procedure of the Research

After obtaining ethical approvals from Western University and the school board, principals of elementary schools in London were informed about the study via the verbal script letter that I had sent to the school board. The school board connected me via email to the principals interested in participating in my study. I sent the letter of information and consent form (Appendix 4) and the researcher's and principal investigator's contact numbers to the principals.

I selected one elementary school among schools where the principals signed the consent form. Then I invited the teachers of grades 1 and 2 by sending emails containing a verbal script letter and the letter of information with the consent form (Appendix 5).

I then requested that teachers interested in participating in the study invite parents of students by sending a verbal script letter and the letter of information with the consent form (Appendix 6). After that, I selected one class in which 10 parents signed the consent forms and expressed interest in their children's participation in the study. Then, I had a meeting with participating students and reviewed the letter of assent and clarified any questions (Appendix 7) to ensure their interest in participating.

Before starting data collection, I conducted a semi-structured face-to-face interview (Appendix 1- Part A) with the teacher. I asked 4 open-ended questions about using digital game-based platforms in the classroom. Then I created a teacher account and added class rosters within them and invited students to join with a class code to keep students' personal information in their usernames and app profiles private. I requested that the teacher choose for each session a few games related to the lessons.

The teacher asked students to use the Chromebooks on loan from Western University and play Khan Academy Kids games in groups of 3 or 4. I used observation checklists and noted the students' behaviours and reactions when using the new digital devices and playing with Khan Academy Kids games for students in their classroom.

At the end of playing with the Khan Academy Kids app (8 sessions), I had another face-to-face interview (Appendix 1- part B) consisting of 15 open-ended questions with the teacher about the impacts of the Khan Academy Kids application and using technology in her classroom.

Finally, students participated in the Spence Children's Anxiety Scale (SCAS) survey with 44 questions at the end of the study to explore Separation Anxiety, Social Phobia, Obsessive

Compulsive Problems, Panic/Agoraphobia, Generalized Anxiety/Overanxious Symptoms, and Learning Anxiety.

Data were processed and analyzed utilizing tools, such as SPSS software, and NVivo 12 transcribing software to determine the impact of digital games and the Khan Academy Kids' application on children's problem-solving skills and anxiety after the Covid-19 pandemic.

3.6 Data Analysis

Data analysis is a persistent activity as the researcher constantly considers the data during the whole study process (Creswell, 2009). The data examined the Khan Academy digital platform's effect on children's learning anxiety and problem-solving skills through the SCAS survey, teacher interviews, and classroom observations of students.

A mixed-method design includes three phases for data analysis. The qualitative database was first analyzed. Generally, the goal is to interpret text and visual data (Creswell & Creswell, 2018). The first step of analysis is organizing and preparing data. Data collecting and write-up of findings go hand in hand with data analysis in qualitative research, as other phases of creating the qualitative study (Creswell & Creswell, 2018). Due to the thick and rich nature of the text and visual data, qualitative research cannot fully utilize all available information (Guest et al., 2006). The second stage in analyzing qualitative data is coding, examining the data to get a basic understanding of it and to consider its overall meaning. Rossman and Rallis (2012) state that "coding is the process of organizing the data by bracketing chunks and writing a word representing a category in the margins" (as cited in Creswell & Creswell, 2018, p. 269).

Coding creates a description of the scene or the characters, as well as categories or topics for study, using the coding procedure. Coding entails using text or visual data gathered during

collecting data, categorizing phrases or images, and frequently assigning each category a word based on the participant's real language (Creswell & Creswell, 2018).

The qualitative data (audio-taped teacher interviews and observations) were entered into computer files and coded with the qualitative data analysis software NVivo 12. NVivo is a helpful tool for classifying, arranging and analyzing qualitative data since it can import and handle a variety of formats and data types (Dhakal, 2022). After coding, I generated a description and themes, which means creating a description of the scene or the characters, as well as categories or topics for study, using the coding procedure (Creswell & Creswell, 2018).

The quantitative database is analyzed in terms of statistical outcomes. For analyzing the quantitative data (survey with students), I used Statistical Package for the Social Sciences (SPSS) software. Cohen et al. (2018) asserted that quantitative data analysis is a potent research method, and it can be performed using software numerical analysis (SPSS program), descriptive, and inferential statistical analysis. SPSS is a program that streamlines and accelerates the researcher's work by carrying out complex statistical analysis on sizable quantitative datasets (Nagaiah & Ayyanar, 2016).

Additionally, descriptive statistics just describe and display data; they do not conclude or make predictions. Instead, they present what has been discovered. Because of this, it is possible to evaluate the collected data using the frequency distribution and percentage, arithmetic means as an average that represents the central tendency of observations, standard deviation as a measure of the dispersion of findings around the mean, and discovered correlations between variables (Cohen et al., 2013).

Scoring and interpretation of the SCAS responses were analyzed as follows: Scores consist of a total raw score (range from 0 to 114) and six sub-scale scores, with higher scores indicating greater severity of anxiety symptoms. A percentile score of more than 84 for any subscale score or the total SCAS score indicates clinically significant anxiety symptoms. Sub-scales are computed by summing the following items:

- Separation anxiety (items 5, 8, 12, 15, 44)
- Social phobia (items 6, 7, 9, 29, 35)
- Obsessive-compulsive (items 14, 19, 27, 40, 41, 42)
- Panic/agoraphobia (items 13, 21, 28, 30, 32, 34, 36, 37, 39)
- Learning anxiety (items 2, 10, 11, 16, 17, 18, 23, 25, 33)
- Generalized anxiety (items 1, 3, 4, 20, 22, 24)

Items that are not scored in either the total score or the sub-scale scores are: 26, 31, 38, and 43. They are not scored because they did not meet sufficient psychometric requirements. Finally, the quantitative and qualitative findings were compared and contrasted to explore the effect of Khan Academy Kids on elementary students' learning anxiety and problem-solving skills after the Covid-19 pandemic.

3.7 Summary

The third chapter of the thesis provided the methodology investigating if and how Khan Academy Kids digital platform affected primary children's anxiety and problem-solving abilities in the post-Covid-19 outbreak. The chapter provided a comprehensive overview of the research design, participants, data collection instruments, and procedures. The research design utilized a mixed-methods approach, combining qualitative and quantitative methods to gather data from

teacher interviews, classroom observations, and a survey using the Spence Children's Anxiety Scale (SCAS). Ten first-graders, their teacher, and the classroom setting at a school in London, Ontario were included in the study. Ethical considerations were addressed by obtaining approvals and consent from the relevant authorities and participants.

In Chapter 4 and 5, the emphasis will be on presenting the study's findings in light of the research questions. The chapter will include details on how the digital setting affects students' participation, anxiety, and problem-solving skills.

Chapter 4: Findings (Qualitative Data)

This study aims to identify the impact of the Khan Academy Kids learning platform on elementary students' learning process, especially their anxiety and problem-solving skills after the Covid-19 pandemic. Under this main objective, I also explored the importance of using digital games for elementary students and the views and attitude of an elementary school teacher toward using digital games, specifically the Khan Academy Kids application in their classroom. Finally, I provided suggestions for developing an engaging and practical curriculum and learning environment for elementary students.

This chapter, along with the subsequent chapter, highlights and discusses the study's findings in light of the following research questions:

1. How can digital games be used to engage children's learning process?
2. What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' anxiety?
3. What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' problem-solving skills?
4. What knowledge is most valuable when children are part of a crisis, such as the Covid-19 pandemic?
5. Which digital method of learning is more practical for elementary students?

This chapter delves into the qualitative findings stemming from classroom observations of student behaviors and in-depth teacher interviews.

4.1 Classroom Observations

This section presents the qualitative research findings from the observations of ten elementary students during eight gameplay sessions with the Khan Academy Kids digital games. The main goals of the observations were to evaluate students' problem-solving abilities, identify any gaps in them, and keep track of their anxiety levels throughout the sessions. The procedure entails a detailed assessment of problem-solving observations throughout the eight sessions to enable a seamless comparison. This is followed by a close study of behavioural patterns associated with anxiety from all sessions, such as restlessness, avoidance behaviour, irritability, or repetitive behaviour, as well as physiological signs of anxiety like trembling. The aim is to provide a comprehensive understanding of the students' behaviours and experiences during gameplay, shedding light on their problem-solving skills and anxiety levels in relation to the Khan Academy Kids digital platform.

4.2 Observing Problem-Solving Skills

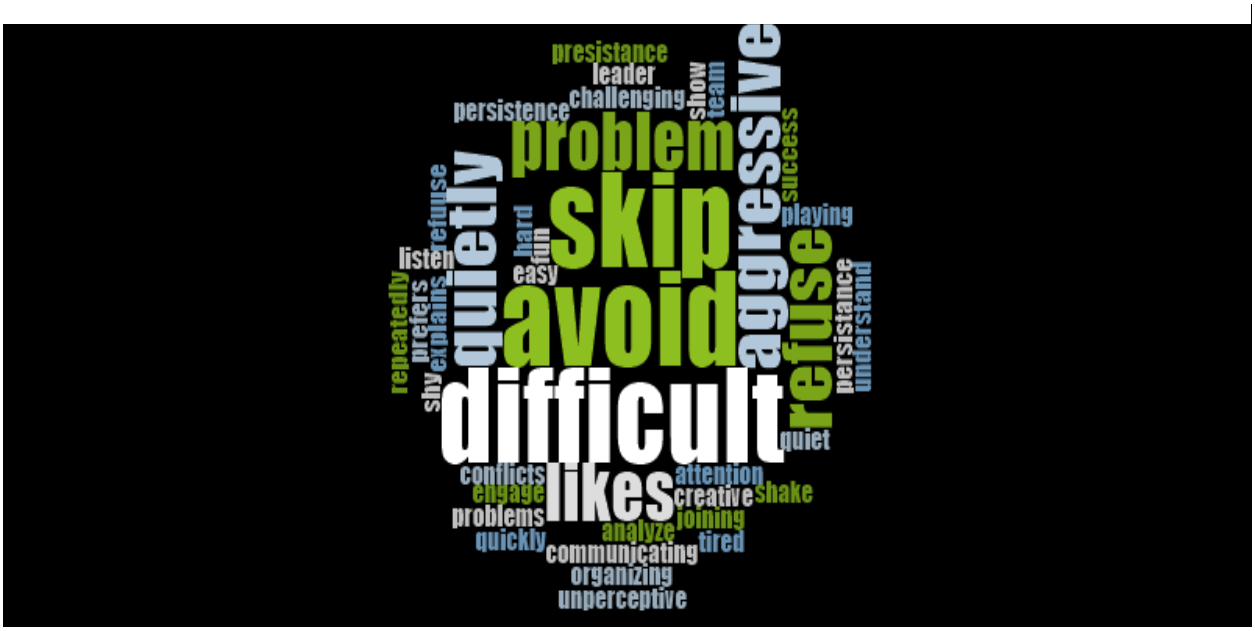
Problem-solving is a complex skill and it requires studying a situation, seeing difficulties or impediments, and coming up with workable solutions (Molnár et al., 2017). The observations of the students throughout each of the eight gameplay sessions focused on certain sub-skills that are important to problem-solving abilities, as well as the identification of any weaknesses in these abilities among the students. The observation protocol included concepts such as "apply skills learned or neglecting," "judge or evaluate or ignore," "try different ways to find answers or inflexibility," and "group management and team bonding or disruptive." These observations were conducted during the eight sessions of gameplay with the Khan Academy Kids digital platform. To facilitate a comparison between the sessions, I analyzed the problem-solving observations

from all eight sessions. By examining the students' behaviours and responses during gameplay, significant themes were identified using NVivo 12 software. These themes provided insights into the students' problem-solving skills and helped to understand any areas that may require further development. The analysis of problem-solving skills adds depth to the study's findings, contributing to a comprehensive understanding of the pedagogical impact of the Khan Academy Kids digital platform on elementary students' problem-solving abilities.

4.2.1 Problem-Solving Skills- Session 1

In the first session of game playing, I recorded written notes on students' problem-solving skills and weaknesses in these abilities. Figure 1 illustrates the frequency of the words mostly used as I observed during this session. The size of each word corresponds to how frequently it appeared in the researcher's notes, including "skip," "avoid playing," "refuse to play," "aggressive," "difficult," "likes," "quietly," and "problem." These words provide insights into the behaviours and challenges encountered by the students during their engagement with the game.

Figure 1: *Word Cloud of Session 1 Observation of Students' Problem-Solving Skills*



The word cloud shows the codes were developed based on students' behaviors and reflections while playing the Khan Academy Kids' digital games. The word size reflects most of the observations in session 1 illustrating students' avoidance to play and problems communicating in their groups. The common notes reflected in observations of problem-solving skills in session 1 include: *I cannot play today; I cannot understand how to start playing; I want to play another game; Student sits quietly in the group;* and *Student does not communicate with group members.*

Upon further analysis of observation of students in session 1, based on their problem-solving along with weaknesses in these abilities, behaviours, and reflections on playing digital games, several key themes emerged for each category, as illustrated below:

- *Apply skills learned or neglecting* – Cannot identify problems, Critical thinking, and Logical thinking.

- *Try different ways or inflexibility* - Persistence, Asking questions, Skipping problems, and No participation.
- *Group management and team bond or disruptive* – Leadership, Lack of communication, and No participation.
- *Judging and evaluating skills or ignoring* – Analyzing problems, Lack of participation, and Cannot identify problems.

Table 2 provides an in-depth analysis of students' problem-solving abilities observed during an initial gameplay session in a classroom setting. The various themes generated from each category, as illustrated above, underpinned by specific evidence and insights gathered during the initial gameplay session are included.

Table 2: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 1*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
1	Apply skills learned or neglecting	Cannot identify problems	- Students did not actively engage in group activities and avoided conversing with their peers while playing. - Students were observed quietly sitting in their groups without interacting with their group members and the researcher. - A student said, "I cannot play math games."
		Critical thinking	- A student explained to a friend how to play a counting math digital game.
		Logical thinking	- A student explained step-by-step to the teacher why they needed to subtract two apples when the question asked them to make a smoothie with four apples and one banana, and they already had six apples in the blender.
		Persistence	- persistence in figuring out how to answer questions and win the games was evident.

	Trying different ways or inflexible		- A student who repeatedly tried to perform their best by moving their fingers carefully on the touchpad to control the game characters.
		Asking questions	- A student asking the researcher whether they may click on the bear character to listen to the question again serves as an illustration of this theme.
		Skipping problems	- A student who found the game challenging and asked to move on to the next game. - A student who complained about a certain game and suggested playing music games instead.
		No participation	- A student who was silent and didn't seem interested in playing. - A student said, "I am tired today, I do not like to play."
	Group management and team bond or disruptive	Leadership	- A student demonstrated leadership skills by taking the initiative to start a group and start playing with their friends.
		Lack of communication	- Students quietly sitting in their groups without interacting with their group members and the researcher.
		No participation	- A student who bullied another child by pushing them to see the screen, thus preventing their friend from participating. - Students who refused to engage in group activities and who, when instructed by their teacher to seat with their group and start playing, ignored their fellow group members. - A student who declined their friend's invitation to begin the game.
	Judging and evaluating skills or ignoring	Analyzing problems	- For the Moose Juice game, a student dissected the question into smaller parts and said, "First, I need to add bigger fruits to the mixer, and then small fruits." - Another student demonstrated their ability to analyze by explaining to their friend what the game required of them.

		No participation	- Students declined to play and voiced a dislike for certain games. - A student's comment that "I do not like these games" in reference to the *Add Objects* game.
		Cannot identify problems	- Students who did not pay close attention to the questions provided. - Students who moved the game characters randomly without a clear purpose.

Table 2 highlights a comprehensive view of a range of behaviors, from active engagement and problem-solving strategies to interpersonal dynamics and potential disruptive behaviour, offering valuable insights into the students' capabilities, strengths, weaknesses, and potential areas for improvement.

4.2.2 Problem-Solving Skills- Session 2

Figure 2 illustrates the frequency of the most commonly used words observed during session 2 based on my written notes during game playing. The prevalent words include: "skip", "attention", "stress", "thinking", "talking", and "conflict".

Figure 2: *Word Cloud of Session 2 Observation of Students' Problem-Solving Skills*

Based on the word cloud and observations in session 2, it is evident that students had difficulty playing some of the games and using the Chromebooks as a new digital device in their classroom. Students were more communicative with their friends based on the size of words such as "Attention", "Thinking" and "Talking," compared to session 1. The most common observation notes about problem-solving and weaknesses in these abilities skills in session 2 include: *Student becomes aggressive and says it is not fun*; *Student says I cannot play this game; Student is talking with their friends; Student says I do not know;* and *Student pays attention to others' turns*.

Upon further analysis of observation of students in session 2 based on their problem-solving, along with weaknesses in these abilities, behaviours, and reflections on playing digital games, the following themes were identified:

- *Apply skills learned or neglecting* – Cannot identify problems, and Critical thinking.
- *Try different ways or inflexibility* – Persistence, Skipping problems, and No participation.
- *Group management, team bond or disruptive* – Collaboration, Conflict, Leadership, and Lack of communication.
- *Judging and evaluating skills or ignoring* - Analyzing problems, No participation, and Cannot identify problems.

Table 3 displays a variety of themes derived from each area of observation, along with evidence and insights collected during the second session of game playing.

Table 3: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 2*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
2	Apply skills learned or neglecting	Cannot identify problems	- A student who struggled to understand the question and couldn't explain it. - Another student who said that the games were challenging.
		Critical thinking	- A student confidently stating that they didn't need anyone to explain the games to them and proceeded to explain to the researcher how to play matching games and understand the game's questions. - A student instructing other children on how to play matching games while using their fingers to touch the screen.
	Trying different ways or inflexible	Persistence	- A student using their fingers multiple times to count the balloons and arrive at the correct answer.
		Skipping the problem	- Students who relied on their friends' answers rather than trying the problems themselves. - A student who didn't listen carefully and quickly wanted to skip games. - A student who expressed uncertainty and opted to move on to the next game.
		No participation	- A student said that they did not like playing since they found games and using the Chromebook difficult.
	Group management and team bond or disruptive	Leadership	- A student took over management of their group.
		Lack of communication	- Students remained silent and did not communicate with their friends during the game.
		Collaboration	- A student respectfully requested a friend to show how to move the characters. - A student called their friends' names and welcomed them to participate.

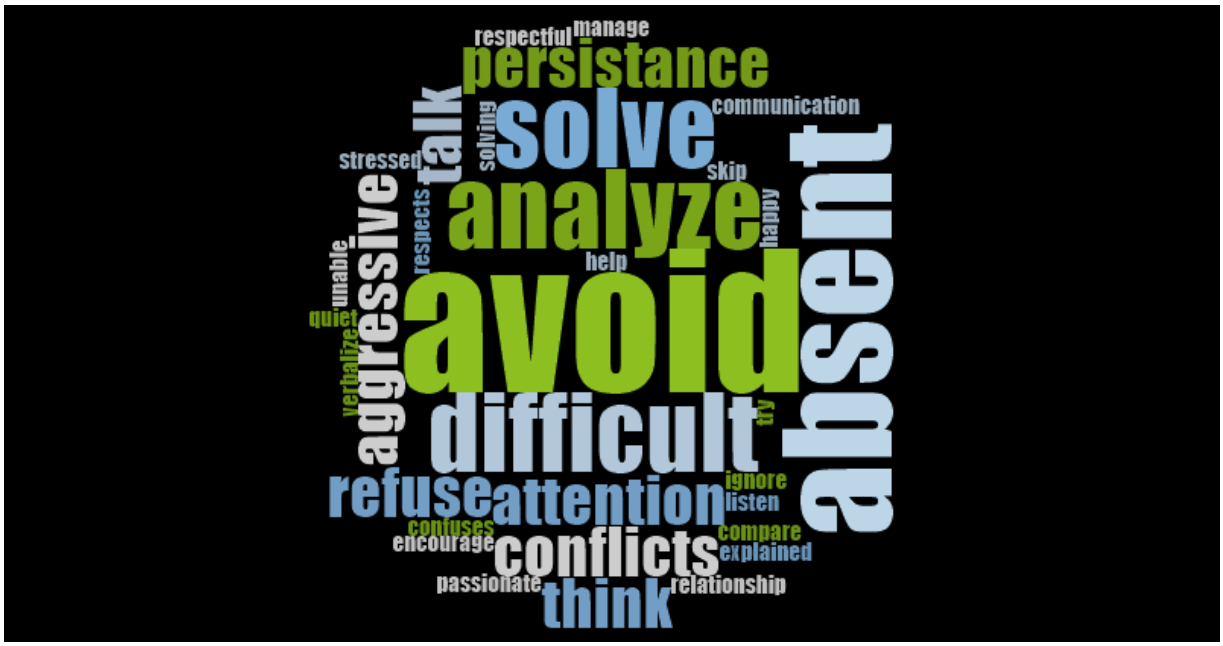
		Conflict	- A student who shouted and disregarded their friend's requests and insisted that they only wanted to play one particular game.
	Judging and evaluating skills or ignoring	Analyzing problems	- A student who asked about the relation of a matching game to the math game they played in the prior session. - A student who demonstrated to the teacher how to use both hands to operate the touchpad on the Chromebooks.
		No participation	- A student who opened her book and remarked that they would rather read a novel than play. - Another who showed dislike for playing. - A student who became angry and said it was not enjoyable.
		Cannot identify problems	- A student who had trouble understanding the rules of the game that required them to match a big monkey with a tiny hat.

Table 3 provides an overview of the problem-solving skills exhibited by students during the second gameplay session within a classroom environment. While it preserves the structural approach of Table 1, it introduces different themes, accompanied by new examples drawn from the specific observations made during this session.

4.2.3 Problem-Solving Skills- Session 3

Figure 3 depicts a word cloud based on session 3 observation notes. The most frequent phrases are "avoid", "analyze", "absent", "solve", "persistence", "difficult", "conflict", "aggressive", and "attention", "think", "talk", and "refuse".

Figure 3: *Word Cloud of Session 3 Observation of Students' Problem-Solving Skills*



These words emphasize the concept of avoiding playing and using new digital gadgets. Additionally, it highlights the difficulties some students have in communicating with others based on words such as aggressive, refuses, difficult and conflict. The observation notes from session 3 on problem-solving skills include: *Student is quiet and does not have strong communication with friends; Student does not encourage friends to play; Student says some games are difficult; Student asks the teacher to play another game;* and *Student expresses they know how to play a new game.*

The following themes were noted for the observation of 10 students in session 3:

- *Apply skills learned or neglecting* – Cannot identify problems, Critical thinking, logical thinking.

- *Try different ways or inflexibility* – Asking questions, Persistence, Skipping problems, and No participation.
- *Group management, team bond or disruptive* – Collaboration, Conflict, Leadership, and Lack of communication.
- *Judging and evaluating skills or ignoring* - Analyzing problems, No participation, Comparison and Cannot identify problems.

Table 4 lists different themes from each observed area, each supported by specific evidence and insights from the third gameplay session.

Table 4: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 3*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
3	Apply skills learned or neglecting	Cannot identify problems	- One student's claim, "I do not know how to play," serves as proof of this theme. - Another student shared a negative comment from their brother, saying, "My brother called me stupid. I cannot subtract numbers."
		Critical thinking	- A student who described to the researcher one of the games including related to adding numbers. - Another student showed that they were comfortable using the program and going through several games.
		Logical thinking	- A student who verbalized their strategy to an equations game and made it comprehensible. - Another student asserted, "I like this game, and I know how to play."
	Trying different ways or inflexible	Persistence	- A student verbalizing their thought process as they attempt to comprehend and resolve an addition equations game.

		Asking questions	- A student actively asked questions for the researcher about a digital game that included the subtraction of three digits.
		No participation	- A student's lack of interest in the game. - A student refused to accept their friends' invitations to participate.
		Skip problems	- A student pretending to sleep to avoid taking part in an addition equations game.
	Group management and team bond or disruptive	Leadership	- A student displaying management abilities by enthusiastically starting play, helping others find their seats, and promoting the start of playing games.
		Lack of communication	- Students that demonstrated limited verbal communication, a lack of encouragement for peers, and unkind behaviour while playing with group members.
		Collaboration	- A student who was considerate of others' turns. - Another who actively listened to comments, promoted a healthy group dynamic, and showed support via laughing and encouraging.
		Conflict	- A student who preferred playing alone, acted aggressively by pushing friends, and claimed exclusive turns.
	Judging and evaluating skills or ignoring	Analyzing problems	- A student who used a little paper clock on their table to solve a time-related puzzle in a digital game.
		Comparison	- A student's inquiry about whether a game was relevant to the material taught the day before.
		No participation	- A student requested to play different games instead of those in Khan Academy. - Another student expressed unfamiliarity with playing games. - A student asked to use their tablet instead of the Chromebook.

		Cannot identify problems	- A student who tried to use the touchpad on a Chromebook and became confused and ended up hitting all the buttons.

The observed behaviours illustrated in Table 4 vary from difficulty in identifying problems to showing persistence, asking questions, skipping problems, and even non-participation. A notable addition in this session is the theme of "comparison", reflecting a new dimension of students' analytical abilities. The examples also highlight changes in group dynamics, showcasing instances of both collaboration and conflict. Consequently, Table 4 presents a fresh perspective on the students' evolving problem-solving abilities and behavioural patterns, distinct from the first two sessions.

4.2.4 Problem-Solving Skills- Session 4

Figure 4 displays a word cloud of the most prevalent words recorded during session 4, including “analyze”, “difficult”, “attention”, “listen”, “leader”, “persistence”, “imagination”, “identify”, and “fun”. Firstly, the word "difficult" is similar in size when compared to session 3, indicating that some students still had difficulties and considered certain games to be challenging. But compared to session 3, the phrases "analyze”, and "attention" are more prevalent, based on size. Compared to earlier sessions, observations suggest that students analyzed games and showed higher persistence in developing strategies that were successful.

Figure 4: *Word Cloud of Session 4 Observation of Students' Problem-Solving Skills*

Observation notes from session 4 on problem-solving skills include: *Student knows to change games; Student can compare games together; Student is not joining the group; Student says game (memory game) is difficult; Student listens to group members and does not have any conflicts;* and *Student pays attention to the question*.

The following themes were noted for the observation of 10 students in session 4:

- *Apply skills learned or neglecting* – Cannot identify problems, analyze information, and logical thinking.
- *Try different ways or inflexibility* – Asking questions, Persistence, Skipping problems, and Imagination.

- *Group management, team bond or disruptive* – Collaboration, Leadership, and Lack of communication.
- *Judging and evaluating skills or ignoring* - Analyzing problems, Comparing and Cannot identify problems.

Table 5 showcases a range of themes from each observed area, each reinforced by specific evidence and insights garnered from the fourth gameplay session.

Table 5: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 4*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
4	Apply skills learned or neglecting	Difficulty identifying problems	- Two students expressed their inability to play a specific game due to its perceived difficulty.
		Analyze information	- A students demonstrated their ability to navigate through different game categories within the Khan Academy application. - A student demonstrated the analytical abilities by contrasting the two games and expressing his opinion, saying that the Monster sort game was more fun than the number match game. - Another student demonstrated competency by turning on the Chromebook independently, opening the game, and starting the game.
		Logical thinking	- A student who helped their friends play the Monster Sort game by offering directions and explanations on how to play.
	Trying different ways or inflexible	Persistence	- A student asking to hear the memory game question again to ensure accuracy. - A student verbally expressing the memory game question to researchers to try to understand the Monster Memory game properly.

		Asking questions	- A student asked about the guidelines of the Monster Memory game.
		Skipping problems	- A student who asked a buddy to play on their behalf.
		Imagination	- A student's suggestions for a different way to slice fruits and put them in the blender for the Moose Juice game. - A student's desire to enjoy the virtual smoothies while planning to optimize the space by adding two more apples.
	Group management and team bond or disruptive	Leadership	- A student took the initiative to take a walk around the class and help all the groups, demonstrating a leadership position.
		Lack of communication	- A student remained near the teacher and avoided conversation. - A student showed limited communication by only moving their head while avoiding social interaction.
		Collaboration	- A student who offered a helping hand to a buddy during a memory digital game. - Another who eagerly participated by helping the instructor arrange the Chromebooks on the tables.
	Judging and evaluating skills or ignoring	Analyzing problems	- One student served as an example by first having difficulty with the math game (Moose Juice) but finally realized the necessity to take four Strawberries out of the blender. - A student used self-talk, commenting that the blender was too tiny to fit two watermelons, and actively looked for solutions to the issue in the Moose Juice game.
		Comparing	- A student said that they preferred Moose Juice and Numbers and Balloons over the games they played in the prior session, finding them to be more fun.

		Cannot identify problems	- A Student complained that the Measure Length game was "stupid" and that they were unable to play it.

Table 5 depicts students' diverse behaviours and problem-solving abilities during the fourth gameplay session. Notably, this session displays an expanded range of behaviours, including increased analysis, creativity, and comparison skills, indicating progression in students' problem-solving capabilities.

4.2.5 Problem-Solving Skills- Session 5

Figure 5 illustrates a word cloud of the most prevalent words that occurred in session 5 observations, including "attention," "identify," "analyze," "compare," "laugh," "funny," and "smile". Students showed greater familiarity with the Khan Academy Kids program compared to the prior gaming session, as noted by their improved focus on the games based on the word "attention". They also showed increased enjoyment when playing, as seen by the frequency of the terms "laugh" and "smile."

Figure 5: *Word Cloud of Session 5 Observation of Students' Problem-Solving Skills*

Observation notes of session 4 included: *I know what the way is to solve this question; Student explain the next step of the game to the researcher; Student is happy when the researcher arrived at their classroom; Student pays attention to the questions and finds the answers quickly; Student laughing and says, "I am very good at logic games*"; and *Student likes to play all the games.*

The following themes were noted for the observation of 10 students in session 5:

- *Apply skills learned or neglecting* – Cannot identify problems and analyze information.
- *Try different ways or inflexibility* – Asking questions, Reinforcement/Scaffolding, Skipping problems, and Imagination.
- *Group management, team bond or disruptive* – Collaboration, Conversation, Encouragement, and Lack of communication.
- *Judging and evaluating skills or ignoring* - Analyzing problems, Comparing and No participation.

Table 6 lists a range of themes sourced from different observational areas, each backed by specific examples and understandings accrued during the fifth gameplay session.

Table 6: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 5*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
5	Apply skills learned or neglecting	Difficulty identifying problems	- One student's direct quote exemplifies this theme: "I just like to do it." This student was unable to provide a clear rationale for their choices during the Moose Juice game, highlighting their difficulty in identifying and explaining the underlying problems or reasons behind their actions.

		Analyze information	- A student said, "I am very good at Logic games because I know all the shapes, and my math is good." - A students easily navigated the Chromebooks and explored different games. - A student stated, "I can use the Chromebook easily and find different games to play."
	Trying different ways or inflexible	Reinforcement/ Scaffolding	- A student asking to hear the memory game question again to ensure accuracy. - A student verbally expressing the memory game question to researchers to try to understand the Monster Memory game properly.
		Asking questions	- A student actively sought advice from the teacher by asking how to play the Quick Directions game. - Another student asked for advice from her peers on how to succeed in the Colour or Type game, demonstrating a group effort to develop skills and knowledge.
		Skip problems	- A student requested to play a different game because they didn't like the one, they were playing. This student preferred skipping or avoiding specific problems within the game.
		Imagination	- A student's desire to play a certain game on their PlayStation 4. - A student tried to physically move the creatures in the game with their fingertips, attempting to engage with them by using innovative and inventive gaming.
	Group management and team bond or disruptive	Encouragement	- A student took the initiative to take a walk around the class and help all the groups, demonstrating a leadership position.
		Lack of communication	- A student remained near the teacher and avoided conversation. - A student showed limited communication by only moving their head while avoiding social interaction.

		Collaboration	- A student who organized a group of friends to sit closely together on the carpet and started a game. - A student showed competition and worked to improve the results for their team. To outperform the competition, they actively sought out other groups and pushed their own members to play more quickly.
		Conversation	- A student asked a buddy, "Have you ever played Memory games? It seems cool". This displays a desire to talk about and share personal game-related experiences, encouraging interaction.
	Judging and evaluating skills or ignoring	Analyzing problems	- A student who asked the researcher if a question meant finding similar shapes. - Another student who explained the game to their friend. - A student who provided instructions to the teacher regarding the steps of the Memory games.
		No participation	- Students stated their lack of interest in the games.
		Comparison	- A student discussed the different games available in the Khan Academy platform, their awareness of the game levels and difficulty, and their ability to discern the variations between games.

Table 6 presents a comprehensive overview of the student behaviours observed during the fifth gameplay session. It outlines the key themes, such as problem identification, analytical skills, and collaboration, demonstrating the complexities of student interaction and problem-solving abilities.

4.2.6 Problem-Solving Skills- Session 6

Figure 6 displays a word cloud of the most prevalent words recorded during session 6, including "attention", "compare", "explain", "analyze", "skip", "help", "ask", "identify", "communication", "encourage", and "avoid".

Figure 6: *Word Cloud of Session 6 Observation of Students' Problem-Solving Skills*

Observation notes from session 6 on problem-solving skills include: *Student explains to the teacher what the question asks them; Student explains to friends how to start the games; Student says, "Oh! I get it. It is so fun"; Student uses both hands on the touchpad; Student is not talking with friends; Student is laughing and says, "I am very good at logic games";* and *Student finds a funny way to play and encourages friends.*

The following themes were noted for observations in session 6:

- *Apply skills learned or neglecting* – Cannot identify problems, analyze information, and logical thinking.

- *Try different ways or inflexibility* – Persistence, Reinforcement/Scaffolding, Skipping problems, and Imagination.
- *Group management, team bond or disruptive* – Collaboration, Conversation, Encouragement, and Lack of communication.
- *Judging and evaluating skills or ignoring* - Analyzing problems, Comparing and Some participation.

Table 7 outlines an array of themes from each category observed, supported by specific evidence and insights gathered during the sixth gameplay session.

Table 7: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 6*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
6	Apply skills learned or neglecting	Difficulty identifying problems	- Two students had trouble using specific digital games. One instance is a student who didn't pay attention to the questions and tapped the touchpad quickly without accurately defining the issue or task at hand.
		Analyzing information	- A student who listened to the question carefully, took a moment to think, and then found a way to play.
		Critical thinking	- A student who admitted that he played the game wrong because the voice of the game character when you play the game wrong is funny.
	Trying different ways or inflexible	Reinforcement/ Scaffolding	- A student who said to her buddy, "I will play after you," closely observing their friend's games and imitating them.

		Persistence	- A student who requested friends to help memorize photos for the Memory Picture game. They thought that by supporting one another, they would be better able to recall every image, demonstrating perseverance in their approach to the game.
		Skip problems	- A student complained about a particular game and asked to go on to the next one rather than playing the Memory Monster game.
		Imagination	- A student laughed and said to a buddy, "I want to close my eyes and move my finger on the touchpad. Let's wait and see what happens. Can I or can't I win?" This shows the use of creative approaches to the game.
	Group management and team bond or disruptive	Encouragement	- When a group member won, a student jumped and screamed excitedly, demonstrating support and passion.
		Lack of communication	- A student who sat by themself at the back of the class, demonstrating a lack of social contact. - A student showed shyness in interacting with peers when the instructor asked them to question a buddy about the Memory Picture activities.
		Collaboration	- A student encouraged friends to sit closer together on the carpet and begin playing. - A student flipped the Chromebook to their friends' turns to make sure everyone got an opportunity to play. - A student cheered and grew joyful when their buddies won, thus motivating them.
		Conversation	- A student engaged in a chat with friends about which digital games they thought were more fun.
	Judging and evaluating skills or ignoring	Analyzing problems	- When playing the Numbers and Balloons game, a student said, "I think I have to catch all the red balloons first."

			- A student demonstrated their capacity for critical thought and problem-solving by discussing with peers about the tasks they needed to take for the 3Rules game.
		Some participation	- A student said, "I only want to play Memory games." This means that certain games could appeal to some pupils more than others, while others might be purposefully avoided.
		Comparison	- Students spoke about the different levels of difficulty of the games, with one saying, "Offline games seem easier than the ones that require internet to play." - A student expressed their preference, saying, "I enjoy Colour and Type games. They're a lot of fun."

Students apply learned skills, show flexibility, manage group dynamics, and judge or evaluate problems (Table 7). Examples demonstrate a variety of behaviors, from critical thinking and persistence to imagination and avoidance of play, highlighting the complexity of students' responses to in-game challenges.

4.2.7 Problem-Solving Skills- Session 7

A word cloud (Figure 7) illustrates prevalent words from session 6, including "like", "attention", "imagination", "help", "analyze", "laughing", "compare", "encourage", and "listen".

Figure 7: *Word Cloud Analysis of Session 7 Observation of Students' Problem-Solving Skills*

Observation notes during session seven include students' engagement with the games: *"I want to play all the games, I like them"; "I think if I move the screen (Chromebook) like the phone, I can move the game"; "Oh! I get it. It is so fun"; Student helps friends to play games; Student pays attention to others' turn to play; "I am very good at logic games";* and *"It is so fun".*

Table 8 illustrates various themes that emerged from each observation area during the seventh gameplay session, each supported by specific examples and insights.

Table 8: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 7*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
7	Apply skills learned or neglecting	Difficulty identifying problems	- A student who faced the Memory games became anxious and said, "I will play next time," demonstrating their inability to recognize and overcome the problems provided by the game.

		Analyzing information	- A student who listened to the question carefully, took a moment to think, and then found a way to play.
		Critical thinking	- A student who described to the researcher why they chose matching games over other games and went on to explain the gameplay to their peers. - A student showed that they understood the questions that were asked of them and knew how to play the games well.
	Trying different ways or inflexible	Persistence	- A student who carefully examined the screen, put his face close to it, and move his fingers several times on the touchpad to manage the characters.
		Skip problems	- A student said, "I am tired, I cannot play difficult games," expressing an eagerness to skip difficult games out of boredom.
		Imagination	- A student questioned if they should use the Chromebook like a laptop and switch it on by pressing the right bottom. - A student wanted to play by moving the Chromebook's screen around like a phone, displaying imaginative play and creative problem-solving skills.
		Asking questions	- Students actively seeking help to improve their gaming experience by asking the teacher for guidance on how to finish a Subtract Objects game.
	Group management and team bond or disruptive	Encouragement	- Students encouraging their friends via vocal encouragement and physical gestures.
		Lack of communication	- A student's inaction while watching their peers play and not actively participating.
		Collaboration	- Students helping peers play more quickly. - A student also inquired of their buddy, "Do you like to start first?"

		Conversation	- Students discussed games, took turns, and decided which type of games to play.
	Judging and evaluating skills or ignoring	Analyzing problems	- A student said that in order to use the touchpad efficiently, they needed to keep their left hand in the corner. - Some students watched the Moose Juice game closely to figure out what they needed to do. - Students began and completed several games on their own with ease.
		Cannot identifying problems	- Some students didn't pay attention and missed crucial instructions. - A student admitted to forgetting how to play games, demonstrating a lack of focus.
		Comparison	- A student's opinion that Logic games were more pleasant than Math games, demonstrates their capacity to compare and assess various game genres.

Table 8 summarizes the main themes from the seventh gameplay session and highlight students' problem-solving skills. Themes are classified according to observational criteria and are supported by particular pieces of evidence. A variety of student behaviours are illustrated, from struggling with game challenges to showcasing creative approaches to problem-solving, and group dynamics through examples of collaboration, encouragement, and conversation.

4.2.8 Problem-Solving Skills- Session 8

Figure 8 illustrates a word cloud of the eighth and final session of observations. The most prevalent words include "like", "attention", "compare", "question", "conversation", "encourage", "imagination", "avoid", "help", "fun", and "think".

Figure 8: *Word Cloud of Session 8 Observation of Students' Problem-Solving Skills*

In the last session of playing students paid more attention to other group members' turn to play, had conversations with their friends, and used their imagination. Observations notes in session 8 included: *Asks a friend a question about the game; pays attention to others' turns; helps friends; game is like homework;* and *I am tired I cannot play today*.

Table 9 illustrates themes that emerged during the last gameplay session, supported by specific examples and insights.

Table 9: *Themes Identified from Classroom Observations of Students' Problem-Solving Abilities in Session 8*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
8	Apply skills learned or neglecting	Cannot identify problems	- A student was unable to respond when the teacher asked why they wanted to add four more apples to the blender in the Moose Juice game.
		Analyzing information	- Students who displayed ease using Chromebooks and demonstrated ease navigating through various games on Khan Academy. - A student said to the researcher, "Look! I can move so fast because I can use both hands on the touchpad."
		Critical thinking	- Students expressed their plans for playing the Number Match games to the teacher and other students in their group.
	Trying different ways or inflexible	Persistence	- Students displayed persistence by carefully controlling the game characters and working to win.
		Skip problems	- A student played letter-related games and skipped the math. - Another student chose to leave the game and walked around the classroom when faced with the challenge of Subtracting 10-20 games.
		Imagination	- A student used creativity to find a solution. The student moved the Chromebook, guessing that they would be able to move the fruits in the Moose Juice game by doing so. - A student who requested a buddy for assistance using the touchpad and another who approached the instructor to ask how to play the Subtract 10-20 games.
	Group management and team bond or disruptive	Encouragement	- A student expressed joy and encouragement as her friend was playing by saying, "Yes, that's it! Let's go ahead!"

		Lack of communication	- Students ignored other group members when they tried to strike up discussion and only communicated with their particular buddy.
		Collaboration	- A student supported her peers in setting the Chromebook and starting playtime. - Students who played the games with great attention to detail, respecting each other's turns, and moving in to help and support when needed.
		Conversation	- A student who engaged in active discussion about games with friends, sharing ideas and experiences. - A student took part in conversations, particularly those focused on the difficulties players had in the Direction games.
	Judging and evaluating skills or ignoring	Analyzing problems	- A student talked to peers about the games and offered advice by stating, "Don't worry, this part of the True/False game is tricky, I need to use my fingers to find the answers." - A student analyzed the game elements and deduced a strategy, exclaiming, "Look! I think all the 'G' letters are in blue balloons in the Letters and Balloons game."
		Some participation	- Students who only focused on the Letters game and avoided the Math games.
		Comparison	- A student compared games from earlier sessions and claimed a preference, "I like Memory games more than games related to adding and subtracting." - A student spoke with the teacher, demonstrating their capacity to compare Add Equations games and how it was related to homework they had to do.

Table 9 summarizes the themes identified during the final classroom observation session focusing on students' problem-solving abilities. The table presents a comprehensive overview of

students' experiences, detailing how they applied skills, handled difficulties, showed creativity, requested help, and interacted with their peers. This includes situations where students struggled to identify problems and analyze information, showcased critical thinking, exhibited persistence, and used imaginative solutions. The table further highlights their group management skills, ability to encourage others, levels of communication, collaboration efforts, and engagement in conversations. Lastly, the table reveals their skills in analyzing problems, avoidance behaviours, problem identification difficulties, and abilities to compare various aspects of their experiences.

4.3 A Comparative Analysis of Themes Developed in Problem-Solving Skills During Game-Playing Sessions

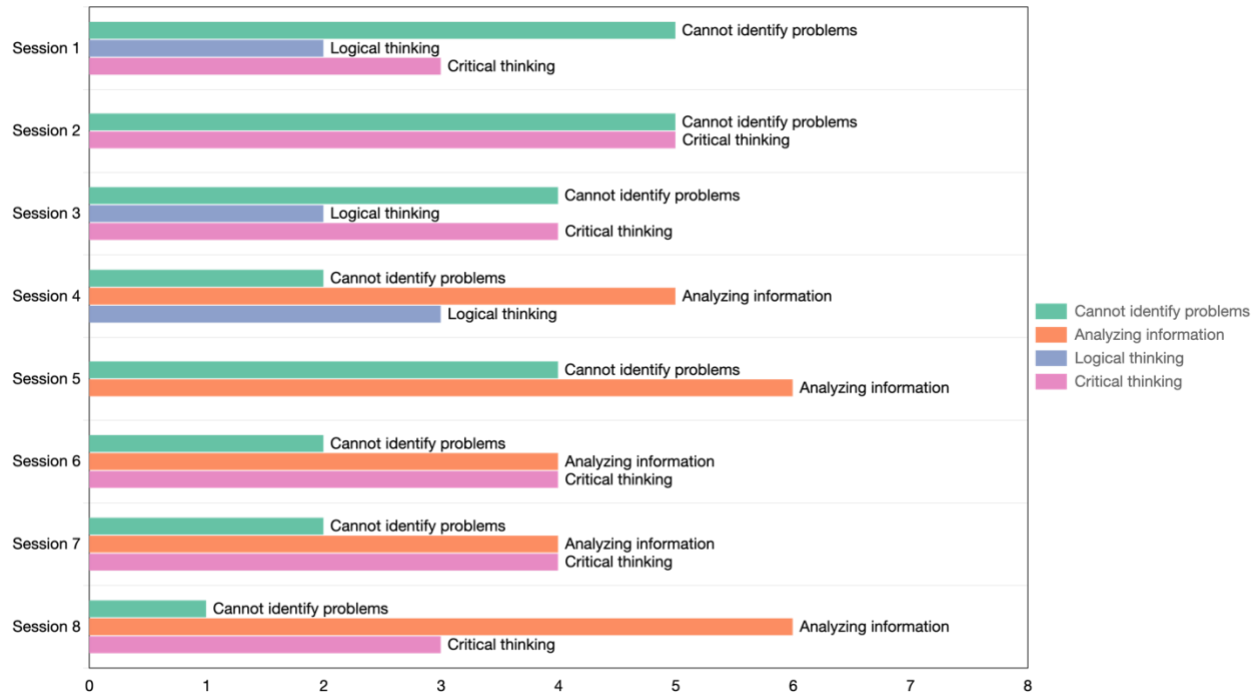
Four observation areas were identified for evaluating problem-solving skills: "Applying learned skills or neglection", "Trying different approaches or showing inflexibility", "Managing group dynamics and promoting team bonding or disruption," and "Judgment and evaluation skills or ignoring." What follows is a comparison of identified themes over eight sessions.

Themes Related to Applying Learned Skills or Neglecting

Figure 9 illustrates themes related to applying learned skills or neglecting developed in each session, along with the frequency of each theme. One can conclude that players' problem-solving abilities clearly improved over the game-playing sessions. In session 1, "Cannot identify problems" was a common theme with a high frequency (five occurrences), but by Session 8, it had drastically decreased (one occurrence), indicating a clear improvement in problem identification skills over time. "Critical thinking" showed an increased presence, starting with three instances in session 1 and increasing to five instances by session 2, demonstrating the growth of students' critical thinking abilities. From session 4, the theme "Analyze information"

emerged and increased notably, starting with five instances in session 4 and reaching six instances by session 8. This theme shows that students were developing their information analysis skills as they progressed through the sessions.

Figure 9: *Comparisons of Themes Related to Applying Learned Skills or Neglecting Over Eight Sessions*

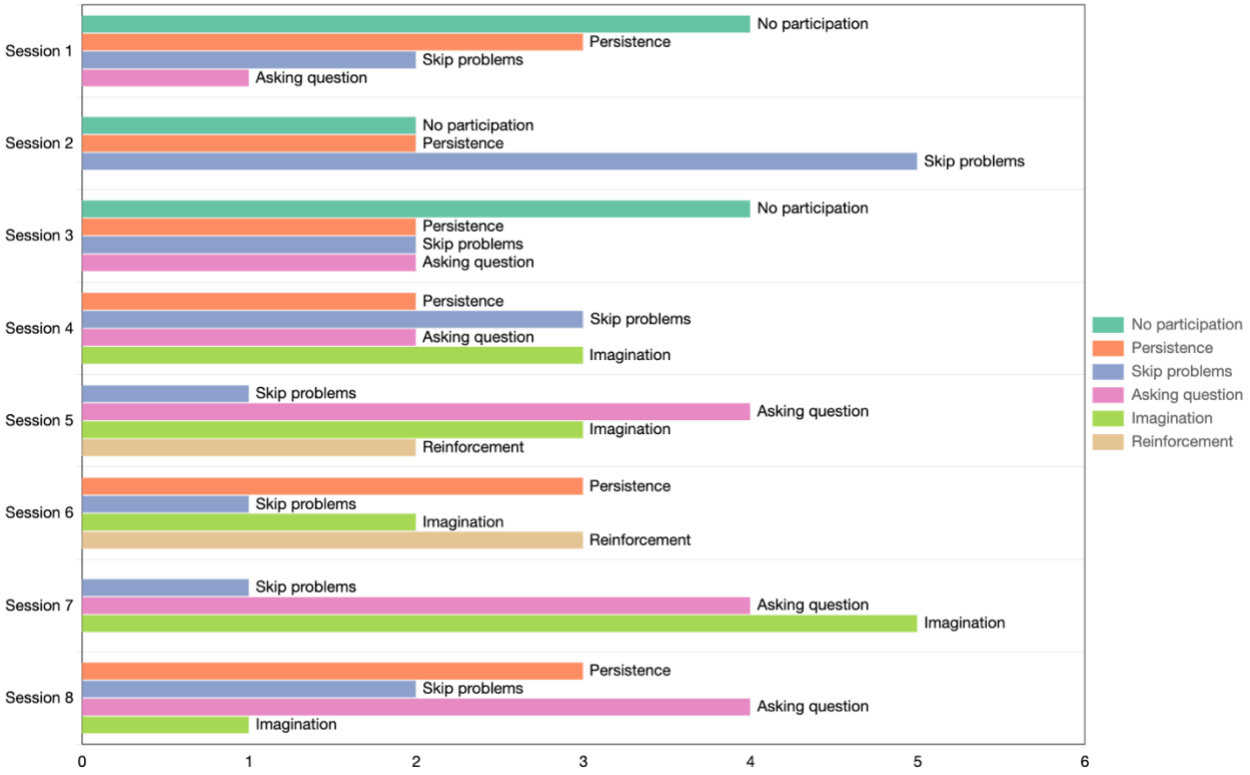


In conclusion, comparison of themes over the eight sessions shows a clear evolution in problem-solving abilities, with an observable shift from struggling with problem identification towards increased critical thinking and information analysis skills by the end of the sessions.

Themes Related to Trying Different Ways or Inflexible

Figure 10 presents the themes that emerged from the observation area "Trying Different Ways or Inflexible" during the eight sessions, along with the frequency of each theme.

Figure 10: *Comparisons of Themes Related to Trying Different Ways or Inflexible Over Eight Sessions*



Based on the data displayed in Figure 10 an evolution was noticed throughout the eight game-playing sessions. The theme "No Participation" initially dominated session 1 with four instances, followed by "Persistence" with three, "Skip Problems" with two, and "Asking Questions" with one. However, as the sessions continued, the frequency of "No Participation" gradually diminished, suggesting an increase in student engagement. The themes "Skip Problems" and "Persistence" were persistent, starting with two and three instances in session 1. The frequency of "Skip Problems" fluctuated across the sessions but notably decreased by session 8 (to one instance), indicating an improvement in engaging with problems. On the other side, "Persistence" remained largely unchanged, showing consistent effort from the students. New themes started to emerge after session 4, including "Imagination" which initially showed up

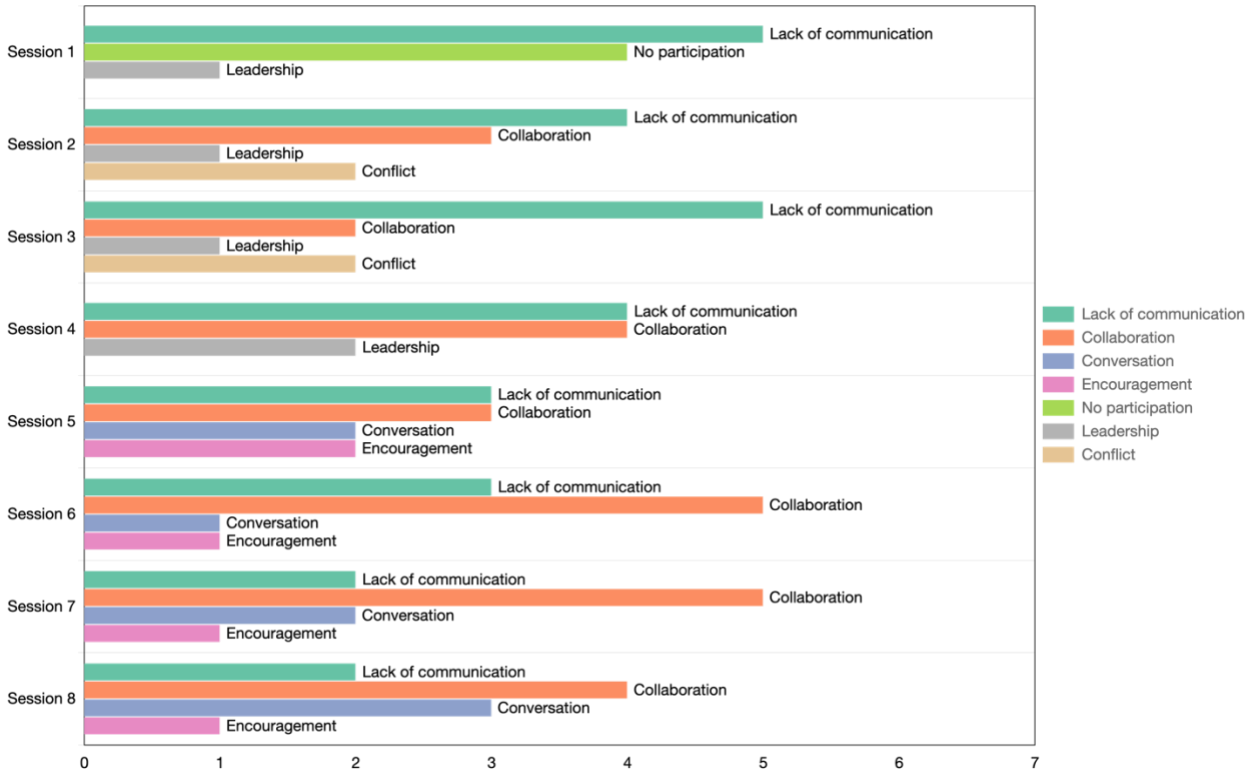
with three instances and developed gradually to five instances by session 7, showing the growth of innovative approaches to solving problems. The theme "Reinforcement/Scaffolding" emerged in session 5 and was intermittently present in sessions 6 and 7, reflecting a learning strategy employed by some students.

Lastly, the theme "Asking Questions" showed an upward tendency, increasing from one instance in session 1 to four instances by session 8. This increase reflected the fact that students became more proactive in seeking answers or clarifications during the game sessions. In conclusion, the analysis reveals a significant shift from initial non-participation and problem avoidance towards increased persistence, creativity (Imagination), and proactive problem-solving (Asking Questions) by the end of the sessions.

Themes Related to Group Management and Team Bond or Disruptive

Figure 11 illustrates the themes related to "Group Management and Team Bonding or Disruptive" across eight sessions, along with the frequency of each theme. Initially, in session 1, the theme "Lack of Communication" was apparent five times. But by session 8, it had significantly lessened in frequency, indicating that student behaviour had improved in terms of communication. However, "Collaboration" appeared from session 2 as a prominent theme and steadily increased, highlighting a developing focus on teamwork. From session 5 onward, the themes "Conversation" and "Encouragement" emerged, indicating a change towards a more engaged group environment.

Figure 11: *Comparison of Themes Related to Group Management and Team Bond or Disruptive Over Eight Sessions*

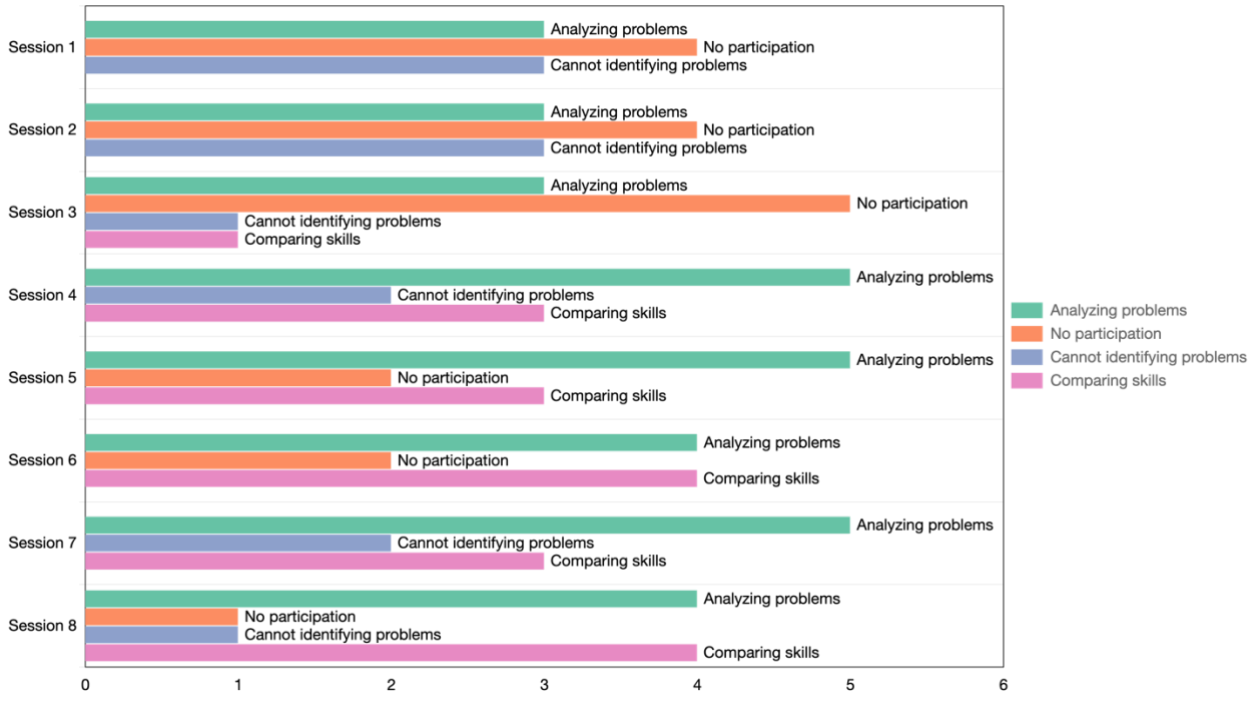


Themes Related to Judging and Evaluating Skills or Ignoring

Figure 12 illustrates the evolution of themes related to "Judging and Evaluating Skills or Ignoring" across the eight game-playing sessions. It also includes the frequency of each theme's occurrence, providing a clear depiction of their prominence and development across the sessions. Changes are observable in students' judging and evaluating skills across the eight game-playing sessions. In the beginning, "No Participation" appeared four times in session 1, showing a lack of engagement with the game. By session 8, however, the frequency had decreased to one incidence, indicating a gradual increase in involvement. The theme "Analyzing Problems" was

consistently prominent across all sessions. "Cannot Identify Problem" show a decrease from three instances in the first session to only one in session 8, indicating a growth in problem-identification capabilities throughout the game-playing sessions. The emergence and increase of the theme "Comparison" from session 3 onwards highlight the development of comparison skills as part of the judgment and evaluation process. By session 8, "Comparison" was noted in four instances, indicating that students had significantly improved in comparing different aspects of problems or solutions.

Figure 12: *Comparison of Themes Related to Judging and Evaluating Skills or Ignoring Over Eight Sessions*



4.4 Anxiety

In this study, the observations of students' anxiety levels and factors contributing to their nervousness were examined using NVivo 12 software. The sessions focused on observation criteria such as "fear of losing and fearlessness," "willingness to try new things and adherence to routine," "nervousness and calmness," and "engagement and disinterest" that were developed based on the literature (Cooper, 2006; Coutu, 2002). Key themes were identified by closely monitoring the students' behaviours and responses during gameplay to understand their experiences and reactions better. A word frequency query was conducted to further analyze the observations, along with a chart displaying the number of references to each theme, allowing for a comprehensive understanding of frequently observed terms documented in written notes.

4.4.1 Anxiety- Session 1

During the first session of observation, students' anxiety levels were closely monitored and analyzed. Using NVivo 12 analysis, several prominent words emerged including "avoid," "nervous," "interested," "uncomfortable," "unfamiliar," "happy," "restless," "participate," "passion," "surprised," and "aggressive." Based on observations around anxiety in session 1, it is evident that students' avoidance to play and their nervousness and discomfort were due to using new digital devices and new games in their classroom. Upon further analysis of the students' responses and behaviours during the first session, particularly concerning anxiety thoughts while playing digital games, several themes were identified. Table 10 showcases the themes that emerged from each observation criteria, focusing on students' anxiety during the first session of game playing. Each theme is supported by specific examples and insights gathered from the observations.

Table 10: *Themes Identified from Classroom Observations of Students' Anxiety in Session 1*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
1	Afraid of losing or fearless	Avoidance behaviours	- Students' complaints about math games and their avoidance of certain games. - Some students had trouble using the touchpad and Chromebooks, which contributed to their avoidance of certain games.
		Confidence	- Students stating confidently that they can play all the games available. - A student, who showed confidence and passion, said that they wanted to complete the Add Object game as soon as possible so they could play other games.
		Self-doubt	- Students asked the researcher to play another game. - A student made it clear that they didn't think they were very competent at playing digital games.
	Engagement or disinterest	Participation	- Students who paid close attention to what the researcher and teacher had to say. - A student demonstrated active attention and engagement by listening to the researcher's explanation and asking a question for further clarity.
		Distraction	- Students who ignored the researcher's directions on how to play the games. - Students displayed a preference for specific games and did not show interest in playing all of them, reflecting a distraction from certain activities.

		Curiosity	- Students that joined in with the activity quickly paid close attention to the teacher and formed their own groups. - A student said, "I really like to play with the tablet and computer." - A student expressed their interest and involvement in the study by asking questions of the researcher regarding the games.
	Nervous or Calm	Happiness	- Students looked at the researcher and the Chromebooks with surprise and enthusiasm. - Students began to laugh, started jumping, and show strong interest in playing the games, emphasizing their positive reactions.
		Physical symptoms	- Students who chewed their nails when instructed to begin playing may have been feeling anxious or apprehensive. - A student who appeared uncomfortable and displayed signs of unease said they didn't want to keep playing.
		Separation issues	- Students who wanted to remain close to the teacher and showed uneasiness and discomfort in the presence of the researcher and new digital devices in the classroom
	Try new things or Routine	Eagerness	- Students who liked playing digital games in the classroom. - A student expressed interest in learning more about and playing the many kinds of games that are offered in the Khan Academy Kids application.
		Generalized anxiety	- Students chewing their nails. - A student had an unhappy face and showed uncertainty or concern while playing difficult games like the Add and Subtract games.
		Avoidance behaviours	- Students who expressed reluctance to begin playing in their group initially, saying things like "I will play after my friend." - A student who said they didn't enjoy Add games.

Table 10 highlights various themes identified in relation to students' behaviour, engagement, confidence, self-doubt, and their responses to gameplaying. The table clarifies the different ways in which students expressed their anxiety and engagement during the first session of game playing, offering valuable insights for understanding their emotional responses and preferences in relation to game playing.

4.4.2 Anxiety- Session 2

In session 2, students' behaviours and anxiety while playing Khan Academy digital games were observed based on fear of losing, trying new things, nervousness, and engagement in the game, as in session 1. The most prevalent words in session 2 include: "difficult", "happy", "avoid", "nervous", "interested", "uncomfortable", and "restless". Observations in session 2 show that using a new digital device and playing digital games were challenging for children and some of them found it difficult. Hence, some students avoided the activity and were upset with Khan Academy Kids games. Table 11 illustrates the themes derived from the observation of students' anxiety during the second game-playing session. It includes specific examples and insights that support each theme, providing a concise overview of their behaviors and reactions.

Table 11: *Themes Identified from Classroom Observations of Students' Anxiety in Session 2*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
2	Afraid of losing or fearless	Avoidance behaviours	- Students explicitly stating their inability to play, requesting others to play on their behalf, and expressing difficulty in using the Chromebooks and engaging with math games.
		Confidence	- Students' requests to play various games and their interactions with the researcher during conversations on various Khan Academy kid games kinds.

	Engagement or disinterest	Participation	- Students showed active participation in the game as well as attentive listening.
		Distraction	- A student who sat quietly and refused to respond to inquiries.
		Curiosity	- A student asked the researcher to visit their class every day and play different games.
	Nervous or Calm	Happiness	- Students who laughed, smiled and jumped excitedly when the researcher entered the classroom and during the game.
		Physical symptoms	- One student expressed frustration by pushing the Chromebook, while other students demonstrated their opposition to playing the games by walking around the class and stating their disapproval.
		Generalized anxiety	- Students became angry and expressed their dislike for the game through aggressive body language.
		Separation issues	- A student preferred to stay close to the teacher and expressed a desire to be in their presence rather than actively participating in the gameplay when prompted.
	Try new things or Routine	Eagerness	- Students expressed their enjoyment and asked to play more games.
		Generalized anxiety	- Students showed signs of nervousness while playing the game. - A student was walking around the class saying "I do not like to play today."
		Participation	- A student inquired about downloading games on their own devices or seeking guidance on how to access new games.
		Avoidance behaviours	- A student said that they only like to play match games.

Similar to the first session, students displayed avoidance behaviours by expressing difficulty in playing certain games or requesting others to play on their behalf. However, there was also evidence of increased confidence and engagement, with students actively listening,

showing curiosity, and participating in conversations about different games. Some students exhibited physical symptoms and generalized anxiety, while others demonstrated an eagerness to explore new games.

4.4.3 Anxiety- Session 3

In session 3, the researcher observed students' actions and levels of anxiety while they played the Khan Academy Kids digital games. The most frequently used words include: "eager", "participate", "stress", "anxiety", "confidence", "afraid", "distracted", "nervous", "relaxed", and "happy". Table 12 presents the themes identified from students' anxiety during the third session of game playing, with specific examples and insights that support these themes.

Table 12: *Themes Identified from Classroom Observations of Students' Anxiety in Session 3*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
3	Afraid of losing or fearless	Avoidance behaviours	- A student expressed their inability to participate in math games. - A student pretended to be asleep to avoid challenging games. - A student brought up reasons like being unwell to get away from activities.
		Confidence	- Students' expressions of satisfaction with the games, their active participation in each of them, and their self-sufficient use of the Chromebook are evidence of this theme.
	Engagement or disinterest	Participation	- A student assisted the researcher with opening all of the Chromebooks, turning them on, and directing other students to their appropriate groups.
		Distraction	- Students did not pay attention to the questions and instead talked with friends. - A student ignored directions and touched the screen with her hand rather than the touchpad.

		Curiosity	- Students expressed their enthusiasm for computers, asked their parents to download games, and requested to play more games.
	Nervous or Calm	Happiness	- A student looked comfortable, established eye contact with the researcher, and smiled. - Students laughed and talked with group members.
		Physical symptoms	- A student broke down crying when presented with a challenging game. - A student exhibited physical symptoms of anxiety, such as shaking their legs while playing a challenging game. - A student experienced stomachache when asked to play the Memory Picture game.
	Try new things or Routine	Eagerness	- A student's expression of satisfaction and willingness to play the games both at home and in class. - A student wanted to teach other children how to play. It illustrates the enthusiasm and favorable views about digital game playing.
		Generalized anxiety	- A student exhibited physical symptoms of anxiety, such as shaking their legs while playing a challenging game. - A student experienced stomachache when asked to play the Memory Picture game.
		Avoidance behaviours	- Students' comments of their dislike of using digital devices and find them challenging to use.

As illustrated in Table 12, students expressed their inability to participate in math games, exhibited self-sufficiency in using the Chromebook, showed curiosity and enthusiasm for games, displayed physical symptoms of anxiety, and expressed a dislike for digital devices.

4.4.4 Anxiety- Session 4

NVivo 12 analysis of observations of anxiety in session 4 indicate prevalent words such as "relax", "nervous", "comfortable", "anxiety", "avoid", "eager", "laughing", and "happy". Table 13 illustrates themes of student anxiety during the fourth session of game-playing. These themes provide insights into the different levels of comfort and anxiety experienced by students when engaging with digital games.

Table 13: *Themes Identified from Classroom Observations of Students' Anxiety in Session 4*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
4	Afraid of losing or fearless	Avoidance behaviours	- A student expressed their disinterest in participating in the activities. The student walked into the room and immediately said, "I do not like to play today."
		Confidence	- A student confidently went through all the games without hesitation. - A student expressed their enjoyment of the Khan Academy games and asked to play all games, demonstrating confidence in their gaming skills.
		Self-doubt	- some students indicated doubt and lack of confidence in their skills by saying things such as, "I am not good at math games," and "I will do badly."
	Engagement or disinterest	Participation	- A student assisted the researcher with opening all of the Chromebooks, turning them on, and directing other students to their appropriate groups.
		Distraction	- Students did not pay attention to the questions and instead talked with friends. - A student ignored directions and touched the screen with her hand rather than the touchpad.

		Avoidance behaviours	- Students expressed their enthusiasm for computers, asked their parents to download games, and requested to play more games.
	Nervous or Calm	Happiness	- Students who were seen relaxing on the carpet or in their seats while playing the games provide evidence in support of this theme. - Students body postures and facial expressions indicated a sense of happiness and contentment.
		Physical symptoms	- A student demonstrated leg and hand motions while playing a game. - A student began to circle the room as a sign of exhaustion. - A student clicked on the buttons forcefully and expressed frustration by asking aggressively, "Why doesn't it move?"
		Fear of failure	- A student expressed concern about making errors and doing badly and asked the teacher to remain close and provide support.
	Try new things or Routine	Eagerness	- A student enthusiastically requested to play all the games and showed happiness.
		Generalized anxiety	- A student asked the teacher to stand by them in order to provide comfort and support. - A student said, "Can I just watch a video? I believe I am unable to play arithmetic games", expressing his sadness and dissatisfaction.
		Participation	- A student asked the researcher to use a mouse rather than a touchpad because they thought it would be more fun.
		Avoidance behaviours	- Students' perceptions that they are unable to play certain digital games. This implies a lack of self-assurance or a reluctance to participate in certain digital games.

4.4.5 Anxiety- Session 5

According to analysis of observations of anxiety notes, the words most often used in session 5 were "eager", "explore", "fun", "smile", "avoid", "anxiety", and "angry". Table 14 illustrates themes of student anxiety during the fifth game-playing session, supported by specific examples and insights.

Table 14:*Themes Identified from Classroom Observations of Students' Anxiety in Session 5*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
5	Afraid of losing or fearless	Avoidance behaviours	- A student expressed their dislike for Direction games by saying, "Oh no, I do not like Direction games." - A student demonstrated their avoidance of the activity by turning their attention to something else when they found a specific game difficult.
		Confidence	- Students expressed their satisfaction with playing all of the games. - A student offered help to a classmate by stating, "If you cannot play, I will do it for you," thus displaying confidence. - A student expressed their desire to keep participating in the activities by asking the researcher if they may play another digital game after finishing the one they were currently playing.
		Self-doubt	- A student asked their friend to play instead of them, stating, "I am not good at Directions," indicating their lack of confidence in their own skills.
	Engagement or disinterest	Participation	- A student who eagerly waited outside the door for the researcher to invite them inside and begin the activities.

			- Students were seen seated in their groups and seemed ready and eager to participate in the gameplay.
		Distraction	- A student was quiet and disinterested in playing, stating, "No thanks, I do not like to play." - Another student was seen starting to read a book after playing two games, demonstrating a change in attention away from the digital activities.
	Nervous or Calm	Happiness	- Students were seen smiling and laughing while playing the games. - Students had a relaxed posture, whether they were sitting happily on chairs or on the carpet.
		Physical symptoms	- A student punched his chair in frustration when he was having problems. - A student expressed anger and said how much they hated the Monster digital games.
		Fear of failure	- Two students displayed nervousness and sought reassurance from the teacher by asking questions like "Are we right?" and "Is it correct?"
	Try new things or Routine	Eagerness	- Students' expressions of satisfaction when playing digital games and their happiness as they eagerly played. - A student quickly grabbed the researcher's Chromebook and encouraged their group to begin playing.
		Generalized anxiety	- A student screamed, "Let's move!" - A student expressed frustration and feelings of anger when encountering a problem while attempting to play the Add 10-20 game.

		Participation	- A student expressed curiosity and enthusiasm in learning about new digital games by asking to play more. - A student inquired about the number of games available on the Chromebook, expressing a willingness to engage and explore the options.

In comparison to the previous sessions, session 5 showcases students expressing their satisfaction with playing games, offering help to others, and eagerly waiting to participate. However, self-doubt and avoidance behaviours are still evident, indicating varying levels of lack of confidence among students. Students display happiness, but also physical symptoms of frustration and anger. Overall, this session highlights a mix of positive and negative experiences, reflecting the complex nature of student anxiety during game-playing sessions.

4.4.6 Anxiety- Session 6

The words most often used in session 6 observations around anxiety were "explore", "eager", "laughing", "comfortable", "listening", "quietly", "smiling", "punch", "skip", and "avoid". Table 15 showcases themes of student anxiety during the sixth game-playing session, providing insights into their comfort levels and varying levels of anxiety when engaging with digital games.

Table 15:*Themes Identified from Classroom Observations of Students' Anxiety in Session 6*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
6	Afraid of losing or fearless	Avoidance behaviours	- Two students requested to skip the Subtract-objects games.

		Confidence	- Students helped their peers in various groups and created a friendly atmosphere. - Students demonstrated a sense of humor, which made their groupmates smile. - Students expressed a desire to play all the games, showing enthusiasm and a positive attitude towards the digital games.
		Self-doubt	- A student's statement that "I can only add numbers, subtract games are difficult for me". - A student copied the activities of other groups after seeing them, demonstrating a lack of confidence in their ability.
	Engagement or disinterest	Participation	- Students smiled when the researcher visited their class. - Students paid attention to the researcher's descriptions of the games and actively participated in questions regarding the games.
		Distraction	- Two students quietly sat in their groups while paying no attention to the researcher and games.
	Nervous or Calm	Happiness	- Students' enthusiasm, laughing, smiles and desire to engage are examples of evidence. - A student jumped in celebration after winning the Moose Juice game to express joy.
		Physical symptoms	- A student who seemed restless or unsettled sat on the edge of their chair and moved their body constantly. - A student frequently looked at the teacher and sometimes biting their nails.
		Avoidance behaviours	- A student avoided speaking with the researcher. When the researcher encouraged the student to join their group and begin the Subtract Equations game, they avoided eye contact and tried to hide.

	Try new things or Routine	Eagerness	- Students eagerly grabbed the Chromebooks and immediately began playing games. - A student expressed interest in the digital games and begged the researcher directly for additional time to play them. - A student joyfully jumped and said, "Yes! Playing again."
		Generalized anxiety	- A student said sadly, "I do not like to play."
		Participation	- One student's request to play additional games as a sign of their interest. - A student touched the Chromebooks' buttons to show that he was curious about how the game's bear character could jump. - A student said, "I like to play all the Word Search games," demonstrating a desire to explore other games.

In comparison to previous sessions, this session 6 highlights students' increasing confidence and eagerness to participate in the games. There is also evidence of self-doubt and avoidance behaviors, indicating that some students still experience anxiety when faced with certain game activities.

4.4.7 Anxiety- Session 7

The most prevalent words emanating from observations of anxiety in session 7 are "smile", "like", "eager", "explore", "excited", "relaxed", and "help". Table 16 illustrates the themes of student anxiety during the seventh game-playing session and provides evidence to support these themes. The themes include confidence, self-doubt, engagement or disinterest, curiosity, avoidance behaviors, nervousness or calmness, fear of failure, and eagerness.

Table 16: *Themes Identified from Classroom Observations of Students' Anxiety in Session 7*

Sessions	Observation Criteria	Themes Identified	Examples from Observation Data
7	Afraid of losing or fearless	Confidence	- A student provided assistance to friends, demonstrating confidence in their own understanding of the games and their ability to help others. - A student said, "I am ready to play."
		Self-doubt	- A student asked for assistance after expressing doubt: "I don't know how to play this game (Base Ten Add 10 games), please help me." - A student said, "I do not like (Group 10 & More games), I've already said that I dislike math and numbers."
	Engagement or disinterest	Participation	- Students who collaborated with one another while playing in their groups. - Students actively participated in digital games by starting them with joy and passion.
		Curiosity	- Two students looked at all the games and attempted various strategies to play.
		Avoidance behaviours	- Students stayed silent and did not actively participate in their groups.
	Nervous or Calm	Happiness	- A student danced after every win in the games.
		Fear of failure	- A few students showed indicators of worry and failure-related anxiety. They displayed these symptoms while they looked nervously at the teacher and the researcher, asking questions to check game comprehension and performance.
		Avoidance behaviors	- A student demonstrated disinterest in the Add & Subtract and Equal Sign games when they were introduced by the teacher.
	Try new things or Routine	Eagerness	- Students assisted their group members in playing.

		Avoidance behaviours	- A student declined to participate in the game and expressed their dislike by saying, "I do not want to talk to you or play."
		Participation	- Two students expressed their eagerness to play more games and explore new ones. These students actively sought opportunities to engage in various games, showcasing their interest in discovering and enjoying a wide range of gaming options.

4.4.8 Anxiety- Session 8

The most often used phrases in observation notes of the final session include "like", "eager", "help", "explore", "relaxed", "avoid", "smile", "laughing", "actively", and "listen". Table 17 illustrates the themes of student anxiety during the last session of game-playing, along with the evidence to support these themes.

Table 17: *Themes Identified from Classroom Observations of Students' Anxiety in Session 8*

Sessions	**Observation Criteria**	**Themes Identified**	**Examples from Observation Data**
8	Afraid of losing or fearless	Confidence	- Students displaying independence by requesting to operate the Chromebook themselves. - A student admitted to playing the game incorrectly but finding it enjoyable and laughing about it showcases their sense of fun. - Students assisting their group members in transitioning between games highlights their willingness to lend a helping hand.
		Self-doubt	- Students expressing their inability to play Match games demonstrates a lack of confidence or uncertainty in their abilities.
		Avoidance behaviours	- Students asked to play different games.

	Engagement or disinterest	Participation	- A student enthusiastically expressed their love for the games by jumping and assisting the researcher in setting up the Chromebook. - Students actively engaged in assisting their peers to play different games, exemplifying their eagerness to participate and collaborate within their groups.
		Curiosity	- Two students demonstrated attentive listening by carefully paying attention to the directions and actively asking questions to enhance their understanding.
		Distraction	- Students displayed a lack of concentration and engagement by paying attention to someone outside the classroom instead of focusing on the teacher.
	Nervous or Calm	Happiness	- Students were observed playing games while in a relaxed position, either sitting or lying down on chairs. - Students who laughed and appeared to be enjoying themselves with their peers in their respective groups also exhibited this behavior.
		Separation issues	- A student expressed a desire to play a game that was unrelated to math, citing their lack of confidence in math-related activities. - Another student displayed disappointment upon hearing that the teacher intended to play the Direction games and expressed their dislike for them.
		Avoidance behaviors	- Students demonstrated a refusal to follow the teacher's instructions and solely engaged in playing the Words game (Vowels games) instead of actively participating in the Direction games.
	Try new things or Routine	Eagerness	- Students exhibited joy and excitement upon the researcher's arrival in their classroom. They expressed their eagerness for the researcher to stay longer so they could continue using the program and play more

			games, demonstrating their strong desire to engage in additional gaming activities.
		Avoidance behaviours	- A student expressed their preference for painting over participating in game playing when prompted by the researcher.
		Participation	- Students actively explored the program, browsing for new and exciting games. They even showed interest in upgrading the Khan Academy program on their tablets, demonstrating their curiosity and eagerness for further exploration and engagement with the digital learning platform.

Table 17 illustrates the themes of student anxiety during the last session of game-playing. The themes identified include confidence, self-doubt, engagement or disinterest, nervousness or calmness, fear of failure, avoidance behaviors, and eagerness. The examples from the observation data provide evidence for these themes, such as students displaying independence, assisting their peers, expressing love for the games, demonstrating attentive listening, showing distractions, exhibiting relaxation and happiness, expressing preferences, and actively exploring the program. Compared to previous sessions, this final session highlights students' growing confidence and eagerness to participate, as well as their continued struggles with self-doubt and avoidance behaviors.

4.5 A Comparative Analysis of Themes Developed in Anxiety Levels During Game-Playing Sessions

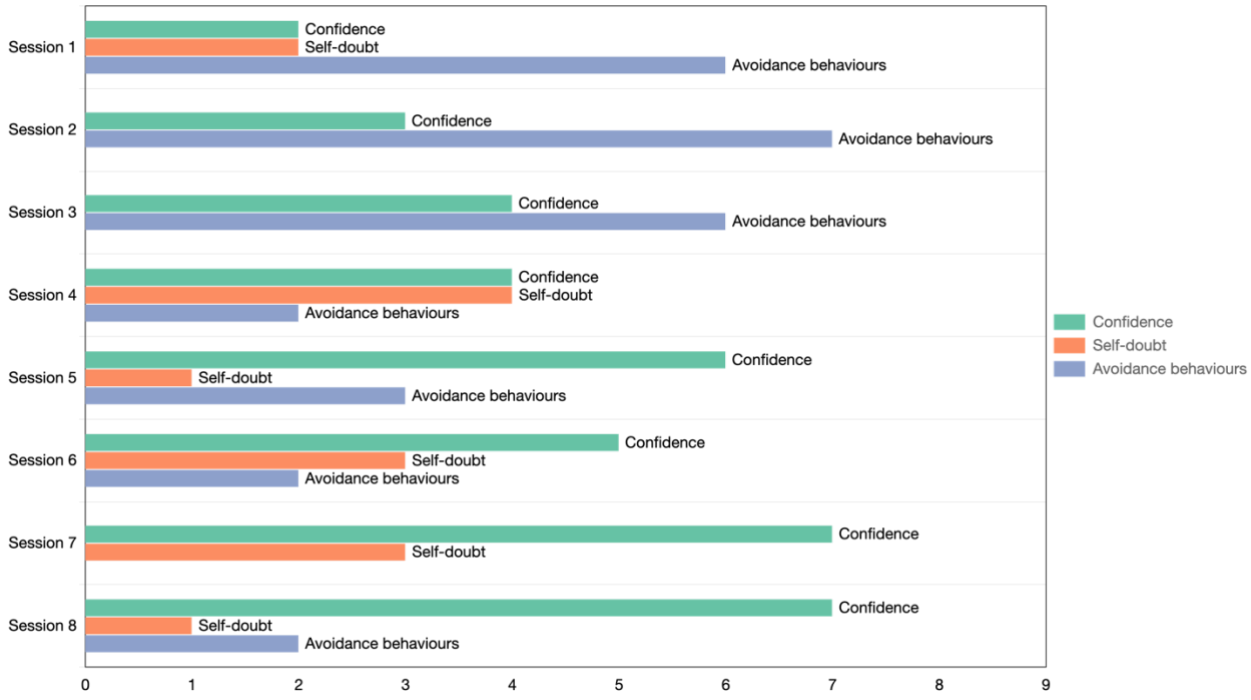
Four observation areas have been identified for evaluating anxiety levels: "Fear of Losing or Fearlessness", "Engagement or Disinterest", "Nervousness or Calm," and "Try new things or

Routine". Themes that developed in each game-playing session based on these observation areas will be compared over the eight sessions.

Themes Related to Afraid of Losing or Fearless

Figure 13 illustrates the themes that emerged from the observation category "Afraid of losing or fearless" over the eight sessions, along with the frequency of each theme.

Figure 13: *Comparison of Themes Related to Afraid of Losing or Fearless Over Eight Sessions*



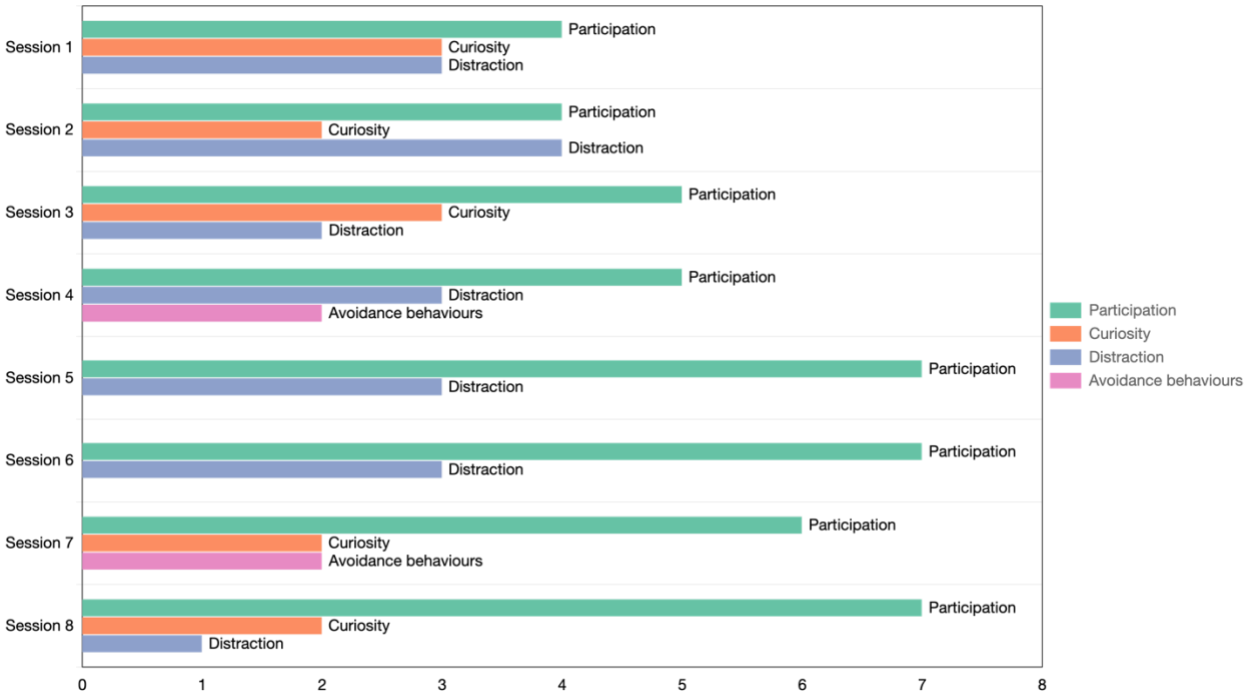
From the observation area "Afraid of Losing or Fearless," three main themes emerged across the eight game-playing sessions: "Avoidance behaviours," "Confidence," and "Self-doubt." In the first sessions, "Avoidance behaviours" was the most dominant theme, indicating high levels of fear or anxiety among students. The frequency of 'Avoidance behaviours" reduced from six occurrences in session 1 to two by session 8, demonstrating a gradual decrease in fear-based

behaviours over time. The "Confidence" theme increased progressively from session 1, with only two occurrences, to a peak of seven occurrences by sessions 7 and 8. This growth suggests an enhancement in self-confidence as the sessions continued. Theme of "Self-doubt" remained relatively stable throughout the sessions, slightly decreasing towards the end. In conclusion, the observation suggests a trend toward decreased anxiety over the course of the game-playing sessions. The game-playing environment potentially fostered a safe space for students to navigate and gradually overcome their fears.

Themes Related to Engagement or Disinterest

Figure 14 outlines the themes that surfaced from the observation category "Engagement or Disinterest" across the eight game-playing sessions, along with the frequency of each theme.

Figure 14: *Comparison of Themes Related to Engagement or Disinterest Over Eight Sessions*

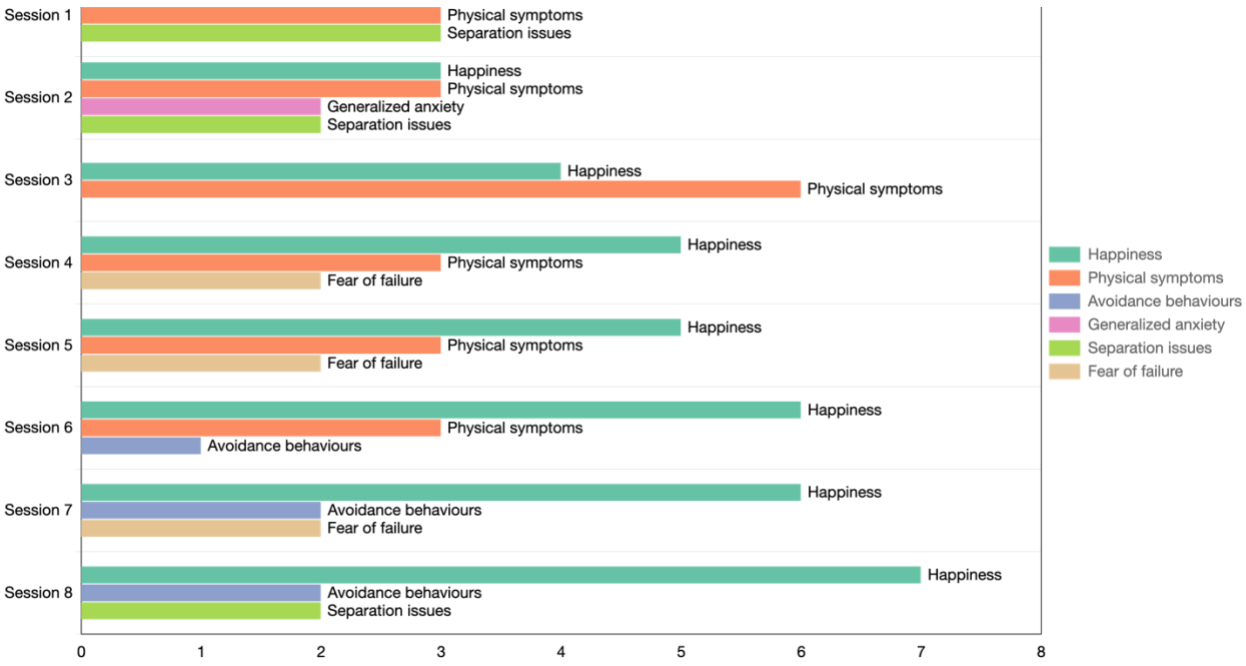


Based on the themes developed in the observation category "Engagement or Disinterest," an evolution in student behaviour is evident. Students engaged in "Participation," "Distraction," and "Curiosity" behaviours in session 1. Even though "Participation" was present throughout each session, its frequency significantly increased to a peak of seven times by session 8, indicative of greater student engagement over time. The frequency of "Distraction" decreased, from three instances in the first session to just one by the eighth session, implying a reduction in disinterest as students became more immersed in the game-playing process. At the same time, the theme of "Curiosity" changed, but it was present in both the first and last sessions, indicating a consistent sense of curiosity.

Themes Related to Nervous or Calm

Figure 15 illustrates the themes that surfaced from the observation category "Nervous or Calm" across the eight game-playing sessions, specifying the frequency of each theme.

Figure 15: *Comparison of Themes Related to Nervous or Calm Over Eight Sessions*

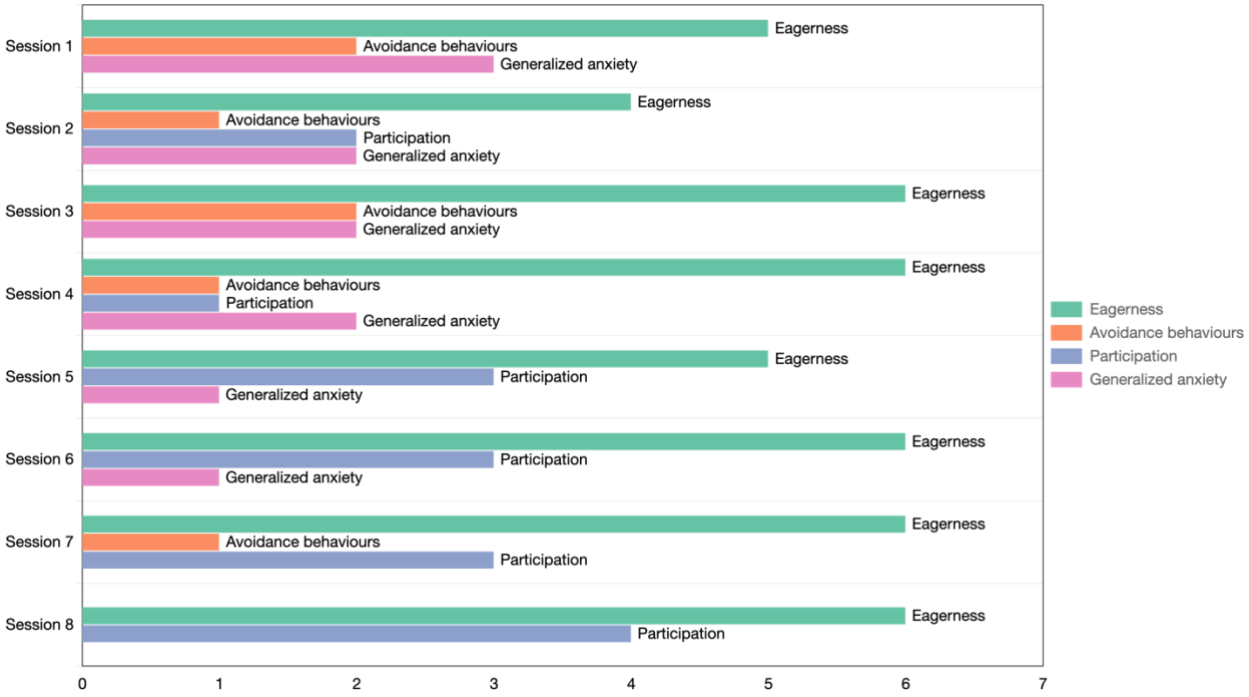


The theme "Happiness" was continually present throughout each session, showing that the gameplay had a generally positive effect on students. The issue of "Physical Symptoms," indicative of anxiety or nervousness, was prominent at the beginning, with three instances in session 1. It peaked in session 3 with six instances and gradually decreased in frequency, suggesting a decline in physical manifestations of anxiety over time. The theme of "Separation Issues" appeared less frequently as the sessions progressed, being present in the first, second and final sessions but absent in between these sessions. This could be interpreted as the students becoming more comfortable with the game-play environment. Intermittent themes like "Fear of Failure" and "Generalized Anxiety" suggested that students felt various levels of anxiety during the sessions. The fact that the theme "Avoidance Behaviour" is still present in the final sessions is significant because it shows that certain students continue to exhibit this behaviour.

Themes Related to Trying New Things or Routine

Figure 16 details the themes that emerged from "Try New Things or Routine" throughout the eight game-playing sessions, along with the frequency of each theme. The theme "Eagerness" does appear to have been a major presence in the first sessions and to have remained consistently high throughout all of the sessions. "Avoidance Behaviours", although present initially, showed a declining trend, which indicates that as the sessions progressed, students were less likely to avoid trying new things. From session 5 onward, the theme of "Generalized Anxiety" dramatically dropped, indicating that anxiety levels associated with trying new things decreased over time. On the other hand, "Participation" increased steadily, from twice in session 2 to four instances in the last session. This implies that students may become more actively involved in trying new things as the sessions progress.

Figure 16: *Comparison of Themes Related to Trying New Things or Routine Over Eight Sessions*



4.6 Interview Findings

Initial Interview

The findings from the first interview with the teacher about their opinions on digital gaming and digital learning applications in the classroom are related to the four questions: 1. What are your views about digital games? 2. How can digital games engage in the learning process? 3. How do you use digital games in your classroom? 4. What are your expectations of using Khan Academy Kids in your class? NVivo 12 software was used to analyze responses in order to find key themes. The most commonly used words in the interview were also determined using a word frequency query. This interview provided insightful information about the use of digital games and learning applications in the classroom, which are related to addressing the

research questions of how digital games can engage children's learning processes and which digital method of learning is more practical for elementary students. The teacher's opinions and ideas shed light on these queries.

The analysis of the teachers' responses identified a number of key themes and frequently used terms pertaining to their opinions of digital games, the role that these games play in the learning process, and how digital games are used in the classroom. Based on NVivo analysis of the interview, the most frequently used words are "fun," "enjoy," "engaged," and "school board." According to the teacher's responses, digital games were viewed positively and demonstrates that the teacher realized how engaging and fun learning experiences for students may be facilitated by using digital games. The emphasis on "fun" suggests that the teacher recognized the importance of incorporating elements of play and enjoyment into the learning process, as illustrated in the following teacher quotes:

> *Games are so much fun and they can improve interactive experiences that engage children and make learning enjoyable. I think that the kids really like playing games and digital is another way to play a game. I strongly think that learning should be fun and interesting. Children are more likely to be motivated and excited about learning while they are having fun.*

In response to how digital games could improve learning, the teacher emphasized the importance of games in encouraging active student participation and maintaining student interest. The term "engaged" was frequently used, indicating that the teacher believed that digital games have the ability to capture students' attention and maintain their focus on learning content. This

implies that using digital games to engage and motivate students in their studies can be a successful strategy.

Analysis of teacher's comments about using digital games, revealed several themes including "expand learning," "interactive," "limitations," "motivation," "personalized," "reduce stress," and "support learning." The themes "motivation" and "limitation," were most frequently mentioned, and it can be deduced that the teacher expressed a belief that digital games are fun and engaging for students. The teacher also recognized the limitations of utilizing new technology and apps in the classroom. The theme of limitations is supported by the teacher's comments:

> *We don't use a lot of other apps in the classroom partly because they need to be on the approved digital list from the board.*
>
> *I would like to use more learning applications and use tablets for all students but the limitation of having the devices for students is what is holding us back. We only have five AP iPads, and we just got those five iPads for the whole class. So that makes it difficult for the students to play games on a regular basis.*

The teacher believes that digital games serve several purposes, aside from personalizing learning:

> *Some digital games provide additional practice, reinforcement, or extension activities to enhance children's understanding. Also, I think digital games adjust the difficulty level of games based on what students need and it can be personalized learning for each student.*

Overall, the information obtained from the teacher's interview offers insightful viewpoints on the application of digital games in elementary education. The teacher's understanding of the potential

benefits of digital games in engaging students and supporting their learning process aligns with the research questions of how digital games can enhance children's learning experiences and which digital learning methods are practical for elementary students. These results help to advance knowledge of successful educational strategies and guide the creation of curriculum for using digital games to improve student engagement and learning outcomes.

Final Interview

The end of the study interview addressed two main research questions: What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' anxiety? and What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' problem-solving skills?

The Impact of Khan Academy Kids Application on Student Anxiety

Out of 15 questions, seven questions were specifically designed to gather information about the students' anxiety levels: *Are your students open to trying something new in the classroom? Do your students fear doing something that they think will be too difficult? Can your students separate from old habits that have worked for them? Can your students learn something new that can put them in new groups? How eager were your students to play games on the Khan Academy platform? Does Khan Academy use in your classroom cause significant differences in students' motivation? Does Khan Academy use your classrooms causes a significant decrease in students' attitudes towards study?*

The teacher's responses were analyzed using NVivo 12 software, which helped identify significant themes. Furthermore, a word frequency query was conducted to determine the most frequently mentioned words in the final interview. The most often used phrases, like

"motivated," "excited," "eager," "like," "enjoy," and "fun," indicate that the Khan Academy Kids application has a positive effect on children's anxiety levels. These statements imply that the students' motivation, excitement, and eagerness increased as a result of using the application in the classroom. It suggests that the digital learning environment created a supportive and engaging environment that helped alleviate anxiety and fostered a positive attitude toward learning.

A thorough analysis of final interview data about the anxiety levels of the children generated the following themes: "Openness to try new things," "Eagerness," "Anxiety," and "Enjoyment." Based on the analysis, it was found that the themes "enjoy" and "eager" were the most frequently mentioned. This suggests that children were enthusiastic and interested in playing digital games on the Khan Academy Kids app. The teacher emphasized the game-based learning experiences' fun and motivational elements:

I find as a teacher that it can be easy and enjoyable to facilitate if you are consolidating their learning through games.

If students are doing something that they perceive as kind of like work, it doesn't have the fun elements of game-based learning. It can be difficult to get students to complete that because they are not enjoying it.

Students were always excited to have you come in and play games.

Regarding the theme of anxiety, the teacher acknowledged that while some students may have anxiety when trying something new in the classroom, the games provided by Khan Academy Kids are designed to be age-appropriate and do not introduce excessive difficulty or

induce anxiety in children. In addition, the teacher noted that most of the students were willing to experiment and participate in the digital learning environment:

> *I think kids would not be excited about some games if they perceive it to be too difficult that could result in some anxiety.*
>
> *They really enjoyed Khan Academy Kids. Students are always motivated to play those games.*
>
> *They are always really excited to play the games and only some may have anxiety to try something new in the classroom.*

Overall, the findings from the final teacher interview demonstrate that the Khan Academy Kids application positively impacts students' anxiety levels by fostering motivation, excitement, and a willingness to try new things. These insights address the research question on the pedagogical impact of the Khan Academy Kids digital platform on elementary students' anxiety levels.

The Impact of Khan Academy Kid Application on Student's Problem-Solving Skills

During the final interview with the teacher, eight of 15 questions were created to collect data on the students' problem-solving abilities:

1. How can Khan Academy's digital games experience affect children's thinking abilities?
2. What aspects of the Khan Academy platform interface assisted with the learning?
3. Regarding using digital games, are any aspects of experience stand out for you as different from traditional ways of teaching?
4. How well did children solve challenges while playing Khan Academy?

5. Do you view the digital game-based format of Khan Academy as a way of learning different from other classroom activities? If so, in what ways do you find this kind of feedback to be different and helpful for your students?
6. Are your students able to analyze new situations?
7. Could your students find a way to solve their problems quickly and effectively?
8. Does Khan Academy use in your classroom cause a significant difference in students' teamwork in the classroom?

Teacher responses were analyzed using NVivo 12 software, which assisted in identifying significant themes. Based on the analysis, the most frequently used words in the teacher's responses include "fun", "analyze", "challenging", "motivated", and "interesting". These findings suggest that the Khan Academy Kids application positively influences students' problem-solving skills by providing engaging and challenging learning experiences that are both motivating and interesting.

Analysis of the teacher's insights into students' problem-solving abilities as they relate to games-based learning revealed the following themes: "Analyze situations," "Communication," "Find a way," "Fun", "Make friendship bond", and "Motivation". Based on the prevalence of the theme "Fun" it can be concluded that the teacher's responses overwhelmingly indicated a high level of excitement and interest among the children towards playing digital games. These themes are further supported by the teacher's notes, which record instances of students' anticipation and delight throughout their gaming experiences, as well as instances of their passionate participation and responses. According to the teacher,

The Khan Academy games were really fun for students. I find that digital game helps them to have a lot of fun and to bond and to create.

Khan Academy games include fun activities in language, math, and other curriculum areas.

Based on the analysis, particularly focusing on the prevalence of the theme "communication," it can be deduced that the teacher's comments strongly suggested a significant level of cooperation and communication among the students when they were playing digital games. The frequency of this theme indicates that while playing the games, the students engaged in active cooperation and interpersonal interaction. This conclusion is further supported by the teacher's notes:

Khan Academy creates a moment for students to interact with their peers in a positive way. They worked together to try to figure out how to use the Chromebook and doing games.

I was able to see the dynamic between the teammates who were participating and working together.

The theme "explore" is supported by interview data. According to the teacher,

I think the main problem-solving for them wasn't necessarily in the games that they were playing, it was how to navigate Khan Academy to find a new game or find a game you play before and also with a Chromebook to navigate, but they finally did a great job.

I found playing games and using Chromebooks interesting for students to just figure out how to use that little mouse pad.

For the theme "Make a relationship bond", the teacher commented:

I find that students help each other and had nice communication.

> *It was interesting for me to go around and see the group work that was happening in the social skills that they were working on like they did some really great turn-taking.*

Similarly, the theme "motivation" was supported in the teacher's response:

> *The Khan Academy application was very engaging. Students were motivated to try to solve game problems. They are motivated to try to figure out how they get this most kind of work.*

The theme "analyze situations" was supported by the teacher in the following quote:

> *After playing Khan Academy, I noticed a breed of growth in their ability to analyze the situation so they would be able to make a direct connection between gameplaying and improving skills such as problem-solving.*

Students found the digital games on the Khan Academy Kids platform enjoyable and engaging, contributing to their motivation and eagerness to solve challenges, as supported by the teacher's insights. The teacher's notes further support this, highlighting moments of anticipation, delight, and enthusiastic participation during their gaming experiences. As students play digital games, the theme of "communication" also becomes apparent, indicating a high level of cooperation and interpersonal relationships. The teacher's observations highlight pupils' effective collaboration and communication skills. Additionally, the theme of "exploration" reflects the students' ability to navigate the Khan Academy platform and adapt to new technologies. The teacher's notes mention the students' problem-solving skills and their motivation to overcome challenges.

Overall, the results indicate that the Khan Academy Kids app offers an effective learning environment that encourages communication, exploration, motivation, and analytical thinking

among the students, helping to build their social skills and problem-solving abilities.

Chapter 5: Findings (Quantitative Data)

5.1 Quantitative Findings

The Spence Children's Anxiety Scale (SCAS) Survey

This chapter presents the quantitative data derived from the SCAS survey. The Spence Children's Anxiety Scale (SCAS) survey was used in the study to assess the anxiety levels of students after they participated in eight sessions of game playing with the Khan Academy Kids learning application. At the end of the study, the SCAS survey was completed by all 10 participants. The primary purpose of the SCAS is to assess the presence and intensity of anxiety symptoms experienced by children. Six anxiety areas are included – generalized anxiety, panic/agoraphobia, social phobia, separation anxiety, obsessive-compulsive disorder, and learning anxiety. It is crucial to remember that the SCAS is not intended to be a stand-alone diagnostic tool but provides valuable guidance for the process of evaluation.

5.2 Scoring and Interpretation

The SCAS survey has a total of 44 items, six of which are questions with no answers that are not included in the score. For scoring, only 38 questions related to anxiety are utilized. On a range from 0 to 3, participants respond to these questions on a 4-point scale (Kim et al., 2010), where 0 represents "no," indicating the absence of the symptom; 1 represents "not very much," indicating a low frequency or intensity of the symptom; 2 represents "a little bit," indicating a moderate frequency or intensity of the symptom; and 3 represents "yes," indicating a high frequency or intensity of the symptom. The SCAS survey has a maximum score of 114, which reflects the highest level of anxiety symptoms (Kim et al., 2010).

Children were asked to rate the frequency of each symptom using a 4-point scale (0 = no, 1 = not very much, 2 = a little bit, and 3 = yes). Each of the response options ("yes," "not very much," "a little bit," and "no") is represented by a different emoji (See Appendix 3). These emojis were used to make it clearer and more engaging for the elementary students while completing the survey (DeCoito, 2018).

The total score is calculated by summing the scores of specific items, including items: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, and 44.

If there are no missing items, the Total Score may also be calculated by summing together all the subscale scores. Based on Table 18, the subscale scores are calculated by summing the individual item scores for the respective set of items, as follows:

Table 18: *Sub-Scale Scores Distribution Table: Distribution of Scores for Each Sub-Scale*

Subscale	SCAS items								
Separation anxiety	+5	+8	+12	+15	+16	+44			
Social phobia	+6	+7	+9	+10	+29	+35			
Obsessive-compulsive	+14	+19	+27	+40	+41	+42			
Panic	+13	+21	+28	+30	+32	+34	+36	+37	+39
Learning anxiety	+2	+18	+23	+25	+33				
Generalized anxiety	+1	+3	+4	+20	+22	+24			

Scores should be interpreted in accordance with demographic norms for the relevant age and gender groups (Spence, 1998). This approach was chosen since mean scores often varied

between males and females as well as across age groups (Spence, 2018). As per Table 19, both the total scores and the sub-scale scores are computed to assess the overall anxiety levels for each of the 10 students. Following that, these results were compared to percentile scores and T-scores based on children's age and gender. T-scores and percentile scores were used to acquire a more thorough grasp of the participants' anxiety levels compared to other kids the same age and gender.

T-scores are standardized scores that are often used for psychological and academic evaluations. It is a statistical measurement, stated in terms of standard deviation units, that shows how far a person's score deviates from a reference population's mean (average) score (Yim et al., 2010). T-scores are often used in psychological evaluations to compare an individual's scores to the results of a normative sample that reflects the whole community (Wetzels et al., 2011).

According to previous research by Zheo et al. (2012) and information provided on the SCAS website, clear guidelines are available for interpreting T-scores and percentiles. In the SCAS survey, a T-score below 60 or a percentile score below 85% is considered within the "normal" range, indicating anxiety levels that are average for the general population.

A T-score of 60 or above, which represents the top 15% or more of scores, on the other hand, indicates excessive levels of anxiety. It's crucial to remember that this rise does not always signify clinically significant worry. Rather, it acts as a sign of elevated anxiety levels compared to what is generally seen in the general population. The phrase "elevated" anxiety is used in this context. A T-score of 65 indicates that the child's score is in the top 6% of scores, which is higher up the range of scores. Lastly, a T-score of 70 indicates that the child's score is inside the

top 2% of scores. In comparison to their peers, this indicates a noticeably higher degree of anxiety, which indicates a notable presence of anxiety symptoms.

The cut-off values for the SCAS survey's total score, which was created exclusively for girls between the ages of 8 and 11, are shown in Table 5. Similarly, Table 6 provides the corresponding cut-off values for boys in the same age range. Notably, Zhoa (2012) contends that children as young as 7 can apply these cut-off values. Additionally, the table presents the corresponding T-scores and percentiles for each score, offering a comprehensive overview of the distribution of scores. The cut-off values for each sub-scale are also included in the table, which adds further context to the evaluation of certain anxiety domains.

Table 19: *Student Scores of SCAS Survey: Total Score and Subscale Scores Distribution*

Participant ID	Gender	Separation anxiety	Social phobia	Obsessive-compulsive	Panic	Learning anxiety	Generalized anxiety	Total SCAS
B001	B	9	5	3	1	6	6	30
G002	G	8	3	0	1	4	5	21
B003	B	8	7	2	4	3	4	28
G004	G	6	4	0	2	4	1	17
G005	G	11	4	1	10	9	9	44
G006	G	8	6	3	5	7	5	34
B007	B	5	5	2	4	4	5	25
G008	G	10	10	5	8	9	8	50
B009	B	6	3	2	2	4	4	21

B010	B	3	6	1	1	3	0	14

The results of the SCAS survey, including the total SCAS score and the results for each subscale, are displayed in Table 19. The scores are presented for 10 participants, identified by their participant ID and gender. Following score analysis, a number of observations can be made. The Total SCAS scores range from 14 to 50, showing variation in the participants' overall levels of anxiety. A significantly higher level of anxiety is indicated by Participant G008's highest Total SCAS score of 50, while Participant B010's lowest score of 14 indicates a substantially lower level of anxiety.

When examining the scores for each subscale, it is notable that participants display varying levels of anxiety across different domains. For instance, participant G008's scores are generally high on each of the subscales, indicating elevated levels of anxiety in multiple areas. On the other hand, participant B010 has low scores across most subscales, indicating lower levels of anxiety in general.

These ratings should be evaluated in accordance with the demographic norms for the ages and gender categories. T-scores and percentile scores might indicate participants' anxiety levels compared to peers of their age and gender. These results aid in determining if the participants' anxiety levels are "normal" or indicate elevated anxiety.

Overall, Tables 20 and 21 offer valuable insights into the distribution of scores for the SCAS survey, emphasizing the differences in participant anxiety levels and showing the importance of considering demographic norms for accurate interpretation.

Table 20: *T-Score Analysis of SCAS Survey for Girls Aged 8-11*

SCAS – Girls Aged 8-11

OCD	Social Phobia	Panic Agoraphobia	Separation Anxiety	Physical Injury Fears	Generalised Anxiety	Total SCAS	T-Score	Percentile
≥15	≥15	≥16	≥14	≥10	≥14	≥74	≥70	≥98%
14		15	13			71-73	69	97%
13	14	14	12	9	13	68-70	68	96%
		13				65-67	67	95%
						62-64	66	94%
12	13	12	11	8	12	59-61	65	94%
11	12	11				57-58	64	91%
		10	10	7	11	55-56	63	89%
						54	62	88%
						52-53	61	85%
10	10-11	9	9	6	10	50-51	60 **Elevated**	84%
9		8	8			48-49	59	82%
					9	46-47	58	78%
	9	7				44-45	57	76%
						43	56	74%
7-8	8	6	7	5	8	41-42	55	70%
			6			39-40	54	67%
	7	5			7	37-38	53	63%
						35-36	52	59%
						33-34	51	55%
6	6	3-4	5	4	6	31-32	50	50%
5			4	3		29-30	49	45%
						28	48	43%
						27	47	40%
						26	46	37%
4	5	2	3	2	5	25	45	32%
	4				4	23-24	44	29%
3						21-22	43	23%
						19-20	42	19%
						18	41	18%
≤2	≤3	≤1	≤2	≤1	≤3	≤17	≤40	≤16%

Table 21: *T-Score Analysis of SCAS Survey for Boys Aged 8-11*

SCAS – Boys Aged 8-11

OCD	Social Phobia	Panic Agoraphobia	Separation Anxiety	Physical Injury Fears	Generalised Anxiety	Total SCAS	T-Score	Percentile
≥14	≥14	≥14	≥12	≥10	≥13	≥69	≥70	≥98%
13	13	13	11	9	12	63-68	69	97%
	12	12	10	8		60-62	68	96%
12		11				58-59	67	95%
						54-57	66	94%
	11	10	9	7	11	50-53	65	94%
11	10	9		6	10	49	64	91%
		8	8			46-48	63	90%
10	9					43-45	62	88%
9			7			42	61	86%
	8	7		5	8-9	40-41	60 **Elevated**	84%
		6	6			39	59	82%
8	7			4		36-38	58	80%
					7	34-35	57	77%
7			5			33	56	73%
	6	5		3	6	32	55	70%
						30-31	54	67%
6		4	4			29	53	65%
						26-28	52	57%
						25	51	54%
5	5	3	3	2	5	23-24	50	50%
						22	49	46%
		2				21	48	43%
						20	47	40%
						19	46	36%
4	4	1	2		4	18	45	32%
3	3				3	16-17	44	28%
						15	43	26%
						14	42	22%
						13	41	20%
≤2	≤2	0	≤1	≤1	≤2	≤12	≤40	≤16%

In order to assess the participants' levels of anxiety, the research attempted to compare the sum scores of participants with the SCAS cut-off scores. The analysis focused on both the total SCAS scores and the sub-scores within specific anxiety domains. According to the boys' total SCAS, none of the five participants had a high degree of anxiety. Student B001 had the highest total SCAS score of 30, which equates to a T-score of 54 and puts him in the 67th percentile based on Table 21. This indicates that he scored higher than 67% of the norm group, positioning him in the top 33%. Student B003 received a final score of 28, bringing his total score to 52 and putting him in the 57th percentile. With a total score of 25 and a T score of 51, student B007 was ranked in the 54th percentile. Student B009 placed in the 43rd percentile with a total score of 21, a T-score of 48, and a position. Lastly, student B010 placed with a total score of 14, a T-score of 42, and in the 22nd percentile.

Given that the study aimed to compare survey results with final observations, particular attention was paid to the sub-scores that fell into the elevated anxiety group according to Table 21. Student B001's separation anxiety score was 9, putting him in the 94th percentile for elevated anxiety. His separation anxiety is more than 94% of the norm group, according to the table. His learning anxiety score was also 6, placing him in the 91st percentile. Similarly, student B003 exhibited an elevated level of separation anxiety with a score of 8, which fell within the 91st percentile. As a consequence, the SCAS survey findings for two of the boys showed higher levels of separation anxiety, while one student also showed elevated levels of learning anxiety.

In comparing the total SCAS of five students with the SCAS cut-off scores in Table 20 it was noted that one student had high levels of anxiety. Student G008 had a T-score of 60 on the SCAS, placing her in the 84th percentile with a total score of 50. This indicates that she scored

higher than 84% of the norm group, placing her in the top 16%. Student G005 also received a total score of 44, putting her in the 76th percentile with a T-score of 57. With a total score of 34 and a T-score of 51, student G003 was in the 55th percentile. Student G002 had a total score of 21, a T-score of 43, and fell within the 23rd percentile. Lastly, student G004 earned a total score of 17, a T-score that was <40 and was in the percentile <16%.

The high anxiety sub-scores were also evaluated based on Table 20, similar to the previous analysis. The separation anxiety score for student G008 was 10, putting her in the 89th percentile for elevated anxiety. Her separation anxiety is greater than 89% of the norm group, according to Table 20. She had a social phobia score of 10, which places her in the 84th percentile. She also scored 9 on the learning anxiety scale, placing her in the 96th percentile. With a score of 11, student G005 showed signs of elevated separation anxiety, which is within the 94th percentile. Her panic total score was 10, which put her in the high panic category with an 89th percentile. She also scored 9, placing her in the 96th percentile for learning anxiety. Therefore, according to the findings of the SCAS survey, two female students showed high levels of separation anxiety, two showed elevated levels of learning anxiety, one showed elevated levels of panic, and one showed elevated levels of social phobia.

Based on the qualitative data, two boys displayed elevated levels of separation anxiety. One of the boys also showed higher levels of learning anxiety. The study found that among the girls, two had elevated separation anxiety, two had elevated learning anxiety, one had elevated symptoms of panic, and another had elevated social phobia. Based on these results, it can be concluded that 40% of the participants, or 4 out of the 10 students that participated in the survey, showed signs of separation anxiety. Similarly, two (20%) of the students showed symptoms of

learning anxiety, one (10%) showed indications of panic, and another (10%) demonstrated symptoms of social phobia.

Overall, an analysis of the SCAS survey results provided important information about the participants' levels of anxiety. Based on the overall SCAS scores, none of the male students demonstrated high levels of anxiety, but some showed elevated levels in specific anxiety domains such as separation anxiety and learning anxiety. On the other hand, one female student had high levels of anxiety based on the total SCAS score, with elevated scores observed in separation anxiety, social phobia, panic, and learning anxiety. These results underline the importance of considering each specific anxiety domain in addition to the overall result.

5.3 Comprehensive Analysis of Qualitative Data and Quantitative Data

This comparison examines the qualitative results from the final game-playing sessions (session 8), the teacher interview that was conducted at the end of the research, and the quantitative results from the SCAS survey. By analyzing these different sources of data, a comprehensive understanding of the impact of the Khan Academy Kids application on students' anxiety levels can be obtained.

The qualitative data from the final session of game playing identified several themes. The most prevalent theme that emerged from the teacher interviews was the students' enjoyment and eagerness to play digital games. This is aligned with the qualitative information gathered through student observations, in which 60% of the observations revealed kids' eagerness to play and explore. Along with the teacher interviews, the quantitative information from the SCAS survey showed that 40% of the students (or 4 out of 10) also experienced separation anxiety. This result is consistent with the qualitative information, where 20% of the observations revealed avoidance

behaviour while doing certain activities. This avoidance behaviour observed in the qualitative data corresponds to the prevalence of separation anxiety indicated in the quantitative data.

Additionally, the quantitative data showed that 3 out of 10 students, or 30% of the participants, struggled with learning anxiety. The qualitative evidence gathered from teacher interviews and observations, where unadventurous behaviour and fear of failure were noted, may corroborate this finding. Ten percent of the classroom observations also showed instances of self-doubt, which is connected to learning anxiety. These qualitative observations support the prevalence of learning anxiety indicated in the quantitative data.

Connections were created and an in-depth understanding of the effect of the Khan Academy Kid application on students' anxiety levels was developed by considering qualitative results from the last game-playing session, teacher interviews, and quantitative data from the SCAS survey. This comparison highlighted similarities between the qualitative and quantitative findings, offering insight into student's experiences and the potential benefits of the Khan Academy Kid application in reducing anxiety and fostering engagement among the students.

Chapter 4 and 5 of this study focused on findings, derived from analyzing data collected from interviews, surveys, and observations to examine the impact of the Khan Academy Kids learning application on students' problem-solving skills and anxiety levels. Teacher interviews provided insightful information about how digital games can improve children's abilities for problem-solving and reduce their anxiety. The SCAS survey made it possible to assess students' levels of anxiety and indicated variations among the participants. The observations revealed areas of strength and weakness in the students' problem-solving abilities and their anxiety levels in real-time.

In Chapter 6, the findings from the study will be discussed in relation to the literature and research questions and offer in-depth discussion of the pedagogical effects of the Khan Academy Kids application on children's learning and anxiety levels.

Chapter 6: Discussion

This research explores the effect of the Khan Academy Kids digital platform on elementary students' anxiety and problem-solving skills after the Covid-19 pandemic. In this chapter study findings based on the literature and the research questions are discussed.

1. How can digital games be used to engage children's learning process?
2. What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' anxiety?
3. What is the pedagogical impact of the Khan Academy Kids digital platform on elementary students' problem-solving skills?
4. What knowledge is most valuable when children are part of a crisis, such as the Covid-19 pandemic?
5. Which digital method of learning is more practical for elementary students?

6.1 Enhancing Children's Learning Process through Interactive Digital Games

The first research question examined how digital games can be used to engage children's learning process. The results of this study offer evidence of how effectively digital games may encourage students' involvement in the learning process. This idea is increasingly being explored in contemporary educational research (Gee, 2003; Hamari et al., 2016; Pivec, 2009).

Firstly, enjoyment and motivation were frequently mentioned in the teacher's interview data. The frequent use of phrases like "enjoy", "eager", "fun", and "motivation" suggests that digital games contribute to fostering an enjoyable and stimulating learning environment, which in turn stimulates students to actively participate in the learning process. As the teacher stated,

"Games are so fun and they can improve interactive experiences that engage children and make learning enjoyable" and "Children are more likely to be motivated and excited about learning while they are having fun." Moreover, the observational data collected during the study further underline these points. Instances such as "Students began to laugh, started jumping, and showed strong interest in playing the games" emphasized their positive reactions. Another telling example was a student who "jumped in celebration after winning the Moose Juice game," reinforcing the impact of game-based learning on student motivation. These direct quotes from the teacher, along with the observational data, provide evidence to support the findings that digital games enhance enjoyment and motivation in the learning process, and are aligned with the literature, which indicates that the intrinsic motivation provided by digital games promotes higher levels of engagement (Clark et al., 2016; Hamari et al., 2016). Clark et al.'s (2016) study demonstrated the ability of digital games to support conceptual understanding, process skills, and practices, epistemological understanding, and students' attitudes, identity, and engagement. In addition, Mayer (2005, 2014) noted that the fun and engaging learning environment produced by game-based learning can support cognitive processing in a variety of ways, including learning transfer, scaffolding, and feedback.

Additionally, study findings indicated that playing digital games significantly improves students' ability to collaborate and communicate. According to findings from the teacher interviews and observations of students' behaviours, the words "communication" and "collaboration" are frequently used. Evidence to support these findings is provided by direct quotes from teachers, such as "Khan Academy creates a moment for students to interact with their peers in a positive way," "They worked together to try to figure out how to use the

Chromebook and doing games," and "I was able to see the dynamic between the teammates who were participating and working together." These quotes highlight the positive impact of digital games on collaboration and communication skills. These findings align with the works of Clark et al. (2016) and Hamari et al. (2016), who suggested that the intrinsic motivation provided by digital games promotes higher engagement. Further underlining the significance of enjoyment and motivation in digital game-based learning, Mayer (2005, 2014) emphasized how the fun and engaging learning environment can support cognitive processing.

Furthermore, the teacher mentioned, "It was interesting for me to go around and see the group work that was happening in the social skills that they were working on like they did some great turn-taking" and "I find that students help each other and had nice communication." These observations further support the notion that digital games foster an interactive atmosphere that improves social skills and teamwork. These findings are aligned aligned with the research (Chen & Law, 2016), that demonstrate how effectively digital games may foster collaboration and cooperative learning. Digital games have the potential to develop a range of crucial social and cognitive abilities by promoting player coordination for common milestones. According to Chen and Law (2016), digital games can build a variety of crucial social and cognitive abilities by encouraging players to collaborate towards accomplishing joint aims. Digital games improve cooperative learning by encouraging players to create plans, share resources, and resolve conflicts cooperatively, all of which are essential components of effective interaction (Chen et al., 2018).

The study identified instances that resonated with the Scaffolding Theory of Learning under the theme "Reinforcement/Scaffolding". This was exemplified by students who stated to their peers, "I will play after you," demonstrating a tendency towards learning through observation of others' experiences. Furthermore, the act of students attentively observing their friend's gaming strategies and subsequently replicating them, or "a student vocalizing a memory game question to the researchers to gain a deeper understanding of the Monster Memory game," also emphasized this theme. Such behaviours illustrate the students' proactive pursuit of reinforcement or scaffolding to confirm their comprehension. This phenomenon underscores how digital games can effectively emulate the dynamics of learning, promoting peer-to-peer learning and supporting step-by-step knowledge construction through interactive and constructive strategies. Such features are fundamental principles within the Scaffolding Theory of Learning, highlighting the critical role of support when first engaging with new learning concepts or skills (Van Der Stuyf, 2002).

The study also emphasized that playing digital games might enhance students' problem-solving abilities. Findings emanating from teacher interviews and classroom observations such as "analyzing information" and "comparison" indicate that students actively engage in critical thinking and strategic decision-making. Observational instances include situations like "A student analyzed the game elements and deduced a strategy," and "A student who listened to the question carefully, took a moment to think, and then found a way to play." These instances, along with students discussing "the different levels of difficulty of the games," reinforce this observation. These findings are supported by Clark et al. (2016) meta-analysis of studies on the use of digital games in education, which indicated that these games enhanced students' cognitive

abilities, especially their capacity for problem-solving. Cai et al. (2022) also stated that digital game-based learning can significantly enhance the problem-solving process. According to the Green and Bavelier (2003) study, digital games can be effective training aids for developing cognitive skills including reasoning, memory, and perception, all of which are essential to problem-solving abilities. By creating tasks that require players to remember complex sequences, recognize patterns, or reason through difficult challenges, games can improve cognitive training and problem-solving skills.

An additional significant finding from this study pertains to the effect of digital games on students' anxiety levels. Specific anxiety aspects among the students were identified in findings generated from the SCAS survey. On the subscales for panic, learning anxiety, and social phobia, it was noted that a small number of students had anxiety. On other subscales, no students demonstrated anxiousness. This suggests that playing digital games can help to establish an environment where some types of anxiety can be decreased. This reflects the research done by Li et al. (2023), Budury et al. (2020), and Wang et al. (2019) which emphasized the anxiety-reducing effects of digital games.

Interestingly, while some types of anxiety were mitigated, the survey illustrated that 40% of students had separation anxiety. This suggests that while digital games may have a positive impact on reducing certain forms of anxiety, they may not significantly affect all anxiety types, such as separation anxiety. It also raises the question of whether the duration of the intervention - in this case, eight sessions - was sufficient to impact this level of anxiety.

Qualitative findings also support findings from classroom observations. By comparing the first sessions of observations and the last game-playing session, the words "relaxed body" and

"confidence" were frequently used, suggesting that the gaming environment helped students relax and build confidence. Such an environment enables students to concentrate more on the educational process, which helps them achieve cognitive results more easily (Mayer, 2005, 2014).

6.2 The Pedagogical Impact of the Khan Academy Kids Application on Students' Anxiety

The second research question explored the pedagogical impact of the Khan Academy Kids platform on elementary students' anxiety level. Both the qualitative and quantitative findings of this study support the hypothesis that the Khan Academy Kids platform may have a positive effect on reducing anxiety among elementary students. This study shows that Khan Academy Kids digital games can play a role in reducing the anxiety that students experience in learning environments. This finding supports previous research that investigated the broader topic of digital learning platforms and their impact on students' emotional states (Borup et al., 2014; Kebritchi et al., 2010). According to Vnucko and Klimova (2023), digital games may reduce stress experienced by students, foster an effective learning environment, and boost motivation.

Findings from the teacher's final interview provide evidence that the Khan Academy Kids app effectively decreases kids' anxiety levels by increasing their enthusiasm, interest, and eagerness to try new things. Teacher quotes such as "I find as a teacher that it can be easy and enjoyable to facilitate if you are consolidating their learning through games" and "Students were always excited to have you come in and play games," highlight the enjoyment and motivation experienced by students while using the platform.

Khan Academy Kids, in particular, is designed to make learning fun, interactive, and self-paced. The Khan Academy Kids application focuses on mastery learning, which allow students to learn at their own pace without feeling forced to keep up with the rest of the class (Putri, 2021). Students receive fast feedback, which can make it easier for them to correct their mistakes and reduce their fear of failing (Wisniewski et al., 2020). Additionally, the Khan Academy Kids platform is designed to be exciting and enjoyable. Learning can be enhanced to be more interesting and less intimidating by using colorful graphics, animated characters, and game-like elements, which may reduce anxiety (Wu et al., 2020).

The statistical data from the SCAS survey shows that 40% of the students struggled with separation anxiety and 30% with learning anxiety. Observational data such as "A student remained near the teacher and avoided conversation" and "A student showed limited communication by only moving their head while avoiding social interaction" align with the SCAS survey findings. This suggests that while digital learning platforms like Khan Academy Kids can reduce certain forms of anxiety, they might not be as successful in addressing all aspects of this complex condition. According to Beidel et al. (1995), anxiety is a complicated condition with numerous aspects and triggers. In some cases, the self-paced, interactive, and engaging nature of these platforms can indeed alleviate certain aspects of anxiety, such as learning anxiety, often linked to the fear of failure or the pressure to keep pace with peers (Warr & Downing, 2000; Wu et al., 2023).

In this light, the Khan Academy Kids platform might not be as successful in reducing all types of anxiety, such as separation anxiety, which is frequently related to circumstances outside of the actual learning environment. According to 40% of students, there may be other elements,

such as the child's home environment or personal circumstances, that technological tools for learning do not adequately address. It's also possible that the duration of time spent using these digital learning tools may have a significant impact. As well the eight gaming sessions may not have long enough to make a significant difference in the students' separation anxiety levels.

Overall, these findings indicate that while digital tools like Khan Academy Kids can help students experience less anxiety about learning and promote a positive learning environment, they should be viewed as a component of a comprehensive strategy rather than a stand-alone solution.

6.3 The pedagogical impact of the Khan Academy Kid platform on elementary students' problem-solving skills

The third research question explored the pedagogical impact of the Khan Academy Kids platform on elementary students' problem-solving skills. The pedagogical impact of the Khan Academy Kids platform on elementary students' problem-solving skills is supported by the findings of this study, which align with the existing literature.

First-session observations of initial resistance to and avoidance of problem-solving strategies are consistent with earlier research pointing to the challenges that students experience when exposed to unfamiliar educational environments or methods (Hmelo-Silver et al., 2004). As such, observed themes of lack of communication, lack of participation, and inability to identify problems might be viewed as common initial reactions to unfamiliar pedagogical tools.

However, over time, it was observed that students in this study became more familiar and comfortable with the Khan Academy Kids platform and Chromebooks as a new device in the classroom, which is consistent with Hmelo-Silver et al.'s (2004) research on students' confusion

and discomfort when exposed to new educational environments or approaches. This challenge, however, often results in deeper, more engaged learning as it aligns with the constructivist approach wherein learners actively construct knowledge and meaning. Along the same line, research by Karsenti and Fievez (2013) discovered that although students initially resisted using tablets in the classroom, acceptability and usage significantly increased with time. The study concluded that students' continuous exposure and practice with the new technology increased their comfort level and proficiency.

Students became increasingly engaged in problem-solving tasks over the eight gameplay sessions, consistent with observations from Kebritchi et al.'s (2010) study on technology-based learning environments. By the end of the gaming session, students' participation and problem-solving skills had improved, as evidenced by words like "attention," "compare," "question," "conversation," "encourage," "imagination," "help," "fun," and "think." These findings support the pedagogical benefits of digital platforms, like Khan Academy Kids, for fostering greater engagement and participation and, as a result, better problem-solving skills. They also show an evolution of student behaviour toward more active engagement with the platform and its problem-solving tasks. The aforementioned observations are supported by the teacher interview in which she expressed changes in students' development in terms of their ability to work together, their greater desire to assist one another, their improved communication, and their increased engagement and motivation to navigate the Khan Academy Kid platform and solve problems with the games. These findings are in line with research that showcase how creating collaborative learning environments can students' problem-solving abilities (Alharbi et al., 2022; Roschelle et al., 2010; Xu et al., 2023).

Teacher quotes such as "Students worked together to figure out how to use the Chromebook and play games," "I was able to see the dynamic between the teammates who were participating and working together," and "the group work that was happening and the social skills that they were working on like they did some really great turn-taking" are key findings during her reflection on the classroom dynamics throughout this digital learning experience. This observation of students working together to solve problems is consistent with constructivist learning theory, which emphasizes the significance of social interactions in knowledge construction (Chuang, 2021). The teacher noted, "I find that students helped each other and had nice communication". She pointed out that the main problem-solving exercises for the students weren't limited to the games, as using the Chromebook involved navigating the Khan Academy to find a new or previously played game.

The teacher mentioned that "playing games and using Chromebooks was interesting for students," that the "Khan Academy Kids application was very engaging" and "students were motivated to try to solve game problems. They were motivated to try to figure out how they get this to work". Moreover, the teacher also noted a direct connection between gameplaying and improvement in problem-solving skills, stating, "After playing Khan Academy, I noticed a breed of growth in their ability to analyze the situation".

Together, the study's findings and earlier studies (Alharbi et al., 2022; Borup et al., 2014; Kebritchi et al., 2010; Roschelle et al., 2010; Xu et al., 2023) indicate that the Khan Academy Kids platform may improve elementary kids' problem-solving abilities through improved pedagogy.

6.4 The Most Valuable Knowledge When Children are Part of a Crisis, such as The Covid-19 Pandemic

The four research questions explored what constitutes the most valuable knowledge when children are part of a crisis, such as the Covid-19 pandemic. Many children have had to adjust to a new learning environment as a result of the Covid-19 pandemic, which has changed their behaviour and communication habits. The Covid-19 pandemic has caused a significant change in the way kids approach learning. According to Wang et al. (2020), an alteration can result in several difficulties, such as changes in academic behaviour, communication style, and general learning process.

Based on study findings generated from classroom observations, teacher interviews, and SCAS survey, it is evident that knowledge of, and interaction with new technologies, digital learning platforms, and developing problem-solving skills through interactive gaming are essential abilities for kids to acquire when they are involved in a crisis like the Covid-19 pandemic. According to Dias and Victor (2022) and Jääskelä et al. (2017), having an effective knowledge of technology is essential in the twenty-first century for social interaction, information access, and academic objectives. The need for these skills increased during the Covid-19 pandemic when physical distancing policies forced an uncommon reliance on technology for education (Whalen, 2020). Additionally, it has been emphasized that problem-solving abilities, particularly those fostered via interactive gaming, are crucial for today's learners (Franco & DeLuca, 2019). These abilities help children deal with change and challenges, which are helpful in situations of crisis. In fact, the activities offered by digital learning applications like Khan Academy Kids help develop both these vital skills and academic

learning. A child's adaptability and resilience in the face of an unforeseen situation can be greatly enhanced by their capacity to use novel technology tools and acquire problem-solving abilities (Gorard et al., 2017). It enhances their capacity to learn and engage meaningfully even when faced with new and potentially stressful situations (Zhao & Watterston, 2021).

Initial classroom observations indicated hesitation, avoidance, and a lack of communication among students when first introduced to the new learning environment. This is consistent with studies on the psychological effects of the pandemic on kids since many students struggled in unfamiliar circumstances and were afraid of the future (Lee, 2020). However, by the last session, the same children were using the platform more enthusiastically and exhibiting problem-solving skills. This progress suggests that learning to navigate and use digital learning platforms can provide valuable expertise in crisis situations, promoting resilience and adaptability (Almaiah et al., 2020). These results are supported by findings from the teacher's interview, which highlighted that Khan Academy Kids promoted social skills and teamwork in addition to academic development. During a crisis, the importance of these skills cannot be overstated. Effective peer collaboration and communication can improve problem-solving and decrease feelings of isolation (Banerjee & Rai, 2020).

Findings from classroom observations and teacher interviews implies that using digital learning platforms might help students deal with the emotional effects of a crisis. According to studies that suggest digital learning may generate a positive learning environment and increase motivation (Kebritchi et al., 2010), the use of Khan Academy Kids may help students feel less anxious. However, it should be highlighted that even if these digital platforms can address certain aspects of anxiety, such as learning anxiety, they might not be enough to address other

aspects of this complicated problem. For instance, the data showed that some students still struggled with separation anxiety despite the use of the platform.

In conclusion, the most valuable knowledge when children are part of a crisis like the Covid-19 pandemic may be learning how to adapt and thrive in new learning environments, developing problem-solving skills, and fostering resilience and emotional well-being (Verger et al., 2021).

6.5 Effective Digital Learning Strategies for Elementary Students: A Practical Approach

The fifth research question explored practical and effective digital learning strategies for elementary students. Based on the study's results, game-based digital learning platforms, especially Khan Academy Kids, offer elementary students an effective and interesting way to learn, which is essential in challenging situations like the Covid-19 pandemic. This is aligned with the extensive body of research that confirms the efficacy and advantages of game-based learning (Ahmad et al., 2021; Amzalag, 2021; Hanus & Fox, 2015; Liu et al., 2022; Nurhayati, 2020).

During the first observation session of game playing, the students displayed actions including avoiding play and aggression. These actions were indicated by the recurrent themes of "lack of communication," "cannot identify problems," "refusal to play," “distraction”, and "avoidance behaviours." This could be interpreted as a lack of problem-solving abilities and students' initial discomfort with the new digital learning environment. The last observation session revealed a shift in student behaviours and attitudes. There was an increase in the use of words such as "like", "attention", "compare", "question", "conversation", "encourage", "imagination", "avoid", "help", "fun", and "think". This suggested a greater level of engagement

and enthusiasm for learning. New themes also appeared, such as "collaboration," "comparison," "critical thinking," and "analyzing information," which signified better understanding, the use of problem-solving skills, and a more collaborative and comfortable learning environment. This behavioural change was reinforced by observations such as "Students displayed ease using Chromebooks and demonstrated ease navigating through various games on Khan Academy," and "Students expressed their plans for playing the Number Match games to the teacher and other students in their group." These observations illustrate students' gradual adaptation to the digital learning environment, demonstrating planning, problem-solving, and creativity. The teacher noticed a positive change in student behaviour over time, saying, "I find that students help each other and had nice communication."

In this study, the benefits of game-based learning for elementary kids were clearly illustrated. The first change was an increase in engagement. The interactive and captivating activities provided by the Khan Academy Kids platform naturally engage children's interest and maintain their focus. The teacher affirmed the appeal of the Khan Academy Kids platform, stating, "The Khan Academy application was very engaging. They are motivated to try to figure out how they get this most kind of work. Students were always excited to have you come in and play games. They really enjoyed Khan Academy Kids."

Research by Hanus and Fox (2015) and Liu et al. (2022) noted that game-based learning significantly increases students' motivation. Furthermore, Byusa et al. (2022) stated that educational games help students comprehend concepts and raise their interest in learning while having fun and making sense of the material they have studied. Evidence supporting the Constructivist Learning Theory was also observed, as exemplified when “a student discussed the

different games available on the Khan Academy platform, their awareness of the game levels and difficulty, and their ability to discern the variations between games." These observations began from Session 5 and illustrate that students were not just engaging with the games but critically analyzing them, engaging in constructive learning, and building on prior knowledge from the previous four sessions.

Additionally, the platform provided real-time feedback, allowing students to understand their mistakes, modify their approaches, and learn from their mistakes and failures, an aspect corroborated by Shute's (2007) research. Results of this study are also aligned with those of Gee's (2013) investigation, which emphasized the educational potential of video games and digital games, particularly their ability to offer real-time feedback and help players learn from their mistakes. Gee and Esteban-Guitart (2019) also accepted the idea that feedback systems are essential to design components that enable learners to evaluate and improve their performance.

The growth of problem-solving skills and abilities was a key finding. Students were challenged with puzzles, math games, memory games or other tasks that required critical thinking, planning, and problem-solving. In line with the findings of Ngai et al. (2015) and Puga (2022), the platform promoted cooperation and teamwork among students, helping them develop critical interpersonal and communication skills.

The Khan Academy Kid platform also adapted to the learner's level, offering a personalized learning path that catered to a wide range of abilities and learning speeds, paralleling the conclusions made by Park and Choi (2014) regarding the advantages of personalized learning, especially when it is facilitated through digital platforms. This study highlights the need for using digital game-based learning platforms in the classroom, especially

in challenging situations like pandemics where standard teaching approaches might not be practical.

To sum up, game-based digital learning platforms, particularly Khan Academy Kids, was shown to be useful for elementary children, in terms of improving engagement, teamwork, and problem-solving skills, and making learning a pleasant and engaging experience. The findings of earlier studies are further supported by the beneficial change in behaviours and attitudes seen in this study. The long-term effects of such platforms on students' academic achievement and emotional health could be investigated in further research.

The discussion in Chapter 5 highlights the fact that the Khan Academy Kids app has a positive impact on the anxiety levels and problem-solving skills of elementary students. The qualitative findings from teacher interviews and classroom observations indicate that the app creates an enjoyable and motivating learning environment, thus reducing anxiety and fostering enthusiasm among students. The results provide useful insights for educators and researchers in the field of digital learning by highlighting the potential of game-based digital learning platforms like Khan Academy Kids to reduce students' anxiety and improve their problem-solving skills.

Chapter 7 of this study will provide a conclusion that summarizes the findings discussed in Chapter 4 and 5. It will explore the implications and recommendations, limitations of the study and propose directions for future research.

Chapter 7: Conclusion

This study examined the impact of the Khan Academy Kids digital platform on elementary students' anxiety and problem-solving skills in the aftermath of the Covid-19 pandemic. Globally, the pandemic forced considerable reforms in education systems, including a significant shift from traditional in-person instruction to online courses (Sun et al., 2020; UNICEF, 2020). The sudden shift caused students to experience higher levels of stress and anxiety, which disrupted their regular learning routines and could have an effect on their academic performance (Başağaoğlu Demirekin & Buyukcavus, 2022; Li et al., 2020).

The goal of the study was to determine how effectively a game-based digital learning platform such as Khan Academy Kids could address these emerging challenges. Thus, the study examined the teacher's perspective of how technology and digital games were used in the classroom and their thoughts about implementing digital games. Data sources included student behaviours observed during game playing, teacher interviews, and a student survey. Study findings offer insight into the practical use of these digital technologies in a learning environment in the midst of an unprecedented crisis.

Student involvement, teamwork, and problem-solving improved over time, especially when faced with interactive challenges provided in a game-based environment. The teacher noticed a considerable improvement in their students' capacity to collaborate and analyze situations, and they clearly attributed this development to the Khan Academy Kids' interactive features. The gamified learning environment effectively stimulated students' interest, attention, and problem-solving skills through goal setting, challenges, and rewards, bolstering their desire to learn and understand.

One of the main features of the Khan Academy Kid platform is the availability of real-time feedback, which enables students to recognize their errors, modify their approaches, and gain knowledge from their errors. It emphasizes the value of immediate feedback in learning contexts and parallels earlier research findings. Along with encouraging collaboration and teamwork, the platform helped students develop critical interpersonal and communication skills.

The Khan Academy Kids platform's capacity to adjust to various learning styles and capacities, offering a customized learning path suited to various skills, is an essential feature. This characteristic is in line with the idea of personalized learning, which has been shown to be beneficial, especially when it is promoted through digital platforms.

7.1 Implications and Recommendations

This study suggests several implications and recommendations for implementing technology and digital games in elementary classrooms. The findings emphasize the value of empowering students through innovative and engaging learning environments, especially in the face of unprecedented environments like the Covid-19 pandemic.

In the post-pandemic era, education should be evaluated and modified in line with the changing demands of students. Digital educational materials, like the Khan Academy Kid platform, have been demonstrated to increase student engagement, improve problem-solving abilities, and reduce anxiety associated with learning. Thus, including these platforms in education could help students be more prepared for unanticipated events in the future. Teachers also require training to properly incorporate technology into their teaching methods as it becomes an essential component of education. Furthermore, digital pedagogy-focused

professional development initiatives could improve instructors' capacity to support technology-driven learning.

School boards are recommended to invest in digital devices such as tablets, ensuring that all students have access to these essential learning tools. Expanding access to digital learning platforms should be a priority, promoting inclusivity and equality in education. Finally, considering the success of digital game-based learning found in this study, it is advised that schools make educational games more accessible. In addition to making learning more pleasant, these games help children develop essential abilities like resilience, teamwork, and problem-solving. As a result, educators and decision-makers should recognize the value of including digital games in educational approaches and leverage these technologies to develop motivating, dynamic, and effective learning environments.

7.2 Limitations of the Study

There are a number of limitations that need to be taken into account while interpreting the results. The sample size was small, involving 10 students and one teacher. Because of that, the findings may not be generalized to a larger group of elementary school students and educators.

The study may not accurately reflect the complete range of experiences and results related to implementing digital learning platforms in elementary education as a result of the sample size limitation. The specific characteristics of the participants, such as their prior technological exposure and individual learning preferences, may have an impact on their responses and the advantages of the Khan Academy Kids platform that are observed. Thus, the results of this study may not necessarily be applicable to all elementary teachers and children in various contexts.

Additionally, the intervention only lasted one month and included eight gaming sessions. This limited period might not have been adequate to fully uncover the extensive effects of the Khan Academy Kids app on students' anxiety and problem-solving skills. Due to this temporal restriction, long-term consequences and the sustainability of observed effects have not been extensively investigated.

As well, using a survey questionnaire to gather data may have unintentionally increased respondents' anxiety. Students may not have fully expressed their experiences; instead, they may have given responses that they thought were expected. This could potentially compromise the validity of the research findings. Lastly, this study relied on subjective self-reported anxiety measurements. Even though validated scales were used, these measurements might still be influenced by a number of variables, such as the students' mood or comprehension of the questions at the moment of responding, which could, once again, alter the reliability of the results.

7.3 Future Research

Future research can continue to investigate the effects of digital games on elementary students, especially in the context of emergency circumstances like the Covid-19 pandemic, based on the findings of this study. The first piece of recommendation would be to increase the sample size in future research. The current study's small sample size limits its ability to represent the wide range of experiences and outcomes that might occur in a larger and diverse population. Therefore, future research ought to include a broader and more varied sample, reflecting a range of age groups, cultures, educational backgrounds, and levels of technology experience.

Additionally, the present study was completed in a short amount of time—one month (8 sessions)—which may not have allowed for a thorough understanding of the long-term effects of digital learning environments incorporating games, such as Khan Academy Kids. Further studies could examine these outcomes over an extended period of time to monitor changes and growth in the students' problem-solving abilities and anxiety levels.

Additionally, the current study mainly focused on elementary students, paving the way for researchers to expand this exploration to secondary and high school students. This would help understand the developmental changes in students' responses to digital game-based learning and the differential effects across various age groups.

Future research should examine various digital game-based learning platforms in addition to continuing to study the existing platform, Khan Academy Kids. This would enable a comparison of the effectiveness of several platforms and the discovery of any particular advantages or difficulties associated with each.

Last but not least, this study emphasized two main outcomes: anxiety and problem-solving abilities. The variety of outcomes under investigation might be expanded by future research. For instance, research may examine how playing digital games affects other crucial skills like creativity, critical thinking, or digital literacy. Understanding how digital games influence a broader range of skills will give a more holistic view of their role in education.

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Appendix 1

Interview Protocol

at the beginning of the study, the participating teacher was asked the following eight questions in Part A about their views of digital games.

Interview Questions- Part A

1. What are your views about digital games?
2. In your opinion, how can digital games engage in the learning process?
3. How do you use digital games in your classroom?
4. What are your expectations of doing Khan Academy in your classroom?

Part B included questions that the participating teacher asked at the study's end after students had played Khan Academy games for four weeks. I asked the teacher 15 open-ended questions about learning anxiety and problem-solving skills among elementary students.

Interview Questions- Part B

1. How can Khan Academy/digital games experience affect children's thinking abilities? (Gunawardhana & Palaniappan, 2015).
2. Are your students open to trying something new in their learning? (Learning anxiety)
3. Do your students fear doing something that they think will be too difficult? (Learning anxiety)
4. Can your students separate from old habits that have worked for them? (Learning anxiety)

5. Can your students learn something new that can put them in new groups? (Learning anxiety)
6. What aspects of the Khan Academy platform interface assisted the learning?
7. Regarding using digital games (Khan Academy), are any aspects of the experience that stand out for you as different from traditional ways of teaching? If so, please elaborate on these with any examples that illustrate your point of view (Perras, 2019).
8. How eager were your students to play games on the Khan Academy platform?
9. How well did children solve challenges while playing Khan Academy? (Problem-solving skills)
10. Do you view the digital game-based format/ Khan Academy as a way of learning different from other classroom activities? If so, in what ways do you find this kind of feedback to be different and helpful for you and your students? (Perras, 2019).
11. Are your students able to analyze new situations? (Problem-solving skills)
12. Could your students find a way to solve their problems quickly and effectively? (Problem-solving skills)
13. Does Khan Academy use in your classroom cause a significant difference in students' motivation?
14. Does Khan Academy use in your classroom cause a significant difference in students' attitudes toward study? (Learning anxiety)
15. Does Khan Academy use in your classroom cause a significant difference in students' teamwork in the classroom? (Problem-solving skills)

Appendix 2

Observation Check List- Anxiety

Students	Engagement or Disinterest	Try new things or Routine	Afraid of losing or Fearless	Nervous or Calm
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Observation Check List- Problem-Solving Skills

Students	Apply skills learned or Neglecting	Try different ways or Inflexibility	Group management and team bond or Disruptive	Judging and evaluating skills or Ignoring
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Appendix 3

The Spence Children's Anxiety Scale (SCAS)

Code: _____ Date: _____

Grade: _____ Boy [ ] Girl [ ]

DIRECT

IONS:

There are lists of statements on the following pages.

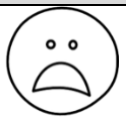
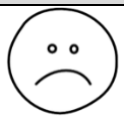
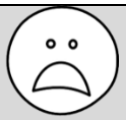
Please check mark ✓ your answer by marking **how you feel** about each statement.

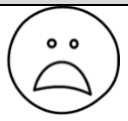
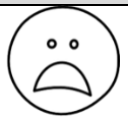
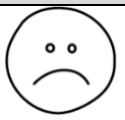
For example:

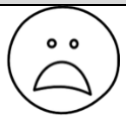
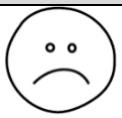
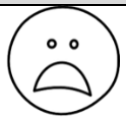
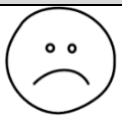
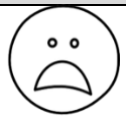
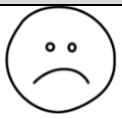
	No	**Not very much**	**I am not sure/ maybe?**	**A little bit**	**Yes**
1. I worry about things.					

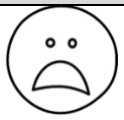
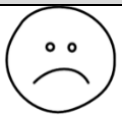
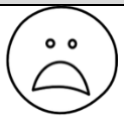
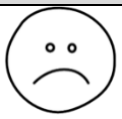
There are no "*right*" or "*wrong*" answers!

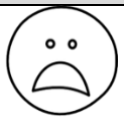
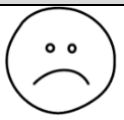
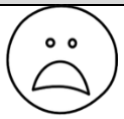
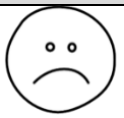
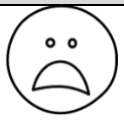
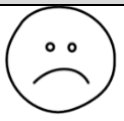
PLEASE FILL IN ONLY ONE ANSWER PER QUESTION.

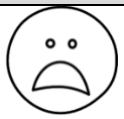
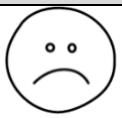
	No	**Not very much**	**I am not sure/ maybe?**	**A little bit**	**Yes**
1. I worry about things.					
2. I am afraid of talking in school.					

3. When I have a problem, I get a funny feeling in my stomach.					
4. I feel afraid.					
5. I would feel afraid of being on my own at home.					
6. I feel scared when I have to take a test.					
7. I feel afraid if I have to use public toilets or					
8. I worry about being away from my friends.					
9. I feel afraid that I will make a fool of myself in					
10. I worry that I will do badly in my schoolwork.					
11. I am not popular amongst my classmates.					
12. I worry that something awful will happen to	**No**	**Not very much**	**I am not sure/**	**A little bit**	**Yes**

13. I suddenly feel as if I can't breathe when there is					
14. I have to keep checking that I have done					
15. I feel scared if I have to sleep on my own.					
16. I have trouble going to school in the mornings					
17. I am not good at playing digital games.					
18 .I'm afraid to come back to study during the					
19. I can't seem to get bad or silly thoughts out of my head.					
20. When I have a problem, my heart beats					
21. I suddenly start to tremble or shake when					
22. I worry that something bad will					

23. I suddenly start to shake when I have a					
24. When I have a problem, I feel shaky.	**No**	**Not very much**	**I am not sure/**	**A little bit**	**Yes**
25. I am afraid of losing a digital game.					
26. I am a bad person.					
27. I have to think of special thoughts to stop bad things from					
28. I feel nervous when I can't solve the challenge					
29. I worry about what other people think of me.					
30. I am afraid of being in crowded places (like shopping centers, and					
31. I feel sad.					
32. All of a sudden, I feel really scared for no					

33. I am afraid to join new groups instead of the					
34. I suddenly become dizzy or faint when there					
35. I feel afraid if I have to talk in front of my					
36. My heart suddenly starts to beat too quickly	**No**	**Not very much**	**I am not sure/**	**A little bit**	**Yes**
37. I worry that I will suddenly get a scared					
38. I do not like myself.					
39. I am afraid of being in small, closed places, like					
40. I have to do some things over and over again (like washing my					
41. I get bothered by bad or silly thoughts or					
42. I have to do some things in just the right					

43. I can not do my schoolwork.					
44. I would feel scared if I had to stay away from					

Appendix 4

Principal Information Letter and Consent

Dear Principal,

As you may know, due to the Covid-19 pandemic, education systems must change and use technology and innovative tools to be more flexible and meet all children's needs. The ongoing COVID-19 pandemic has transitioned into a new stage. All these changes make it stressful for students. Moreover, COVID-19 is still a problem in the world today, and its effects are causing significant problems for children. These changes are curricular alterations that illustrate what students should learn and emphasize the important role of technology in education.

This study aims to explore the impact of the Khan Academy Kids as a famous platform among children that contain instructional videos, games, and puzzles on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic. The study aims to find a fun and engaging digital tool for decreasing children's anxiety and improving vital skills such as problem-solving skills. I am interested in recruiting one teacher of elementary students and ten elementary students aged 5-8 in your school to participate in the study.

Data collection for the research study will include the following:

1. Interviews with one teacher of elementary students about using digital game-based platforms in the classroom at the beginning of the study.
2. The teacher also will be asked 15 open-ended questions about observed changes in students after playing with Khan Academy for 4 weeks.

The interviews will be recorded with "Voice Memo," a voice recording app on the phone, with the teacher's consent. If the teacher doesn't want their voice to be recorded, I will take notes during the interview according to their responses. If the teacher also doesn't want notes taken according to their responses during the interview, I will provide the questions so that teachers can write their responses directly.

Interviews with the teacher will take place during school time when students are doing their school duties, and the interview won't take their instructional time.

3. I will observe 10 elementary students when they are playing Khan Academy during class time for 4 weeks, approximately 3 times each week for one hour or less. I will look at 10 participants from one or two classes. If not, enough participants consent in one class, I will use two classes in the same school. I will interview two teachers if I have to use two different classes.

Khan Academy can be used as a part of regular classroom activities because Khan Academy is a digital platform that promotes reading skills, science, and mathematics study. The teacher will select games in Khan Academy that are relevant to the class's topic and aligned with the Ontario curriculum. For students' privacy and safety, the teacher will create an account, add class rosters within them, and invite students to join with a class code in the letter of information for the teacher.

I will use NVivo12 software to analyze teachers' interviews and observations made of students. NVivo is a desktop application used for qualitative research analysis. NVivo is software locally installed on the computer; the data will not leave the computer and no data will be identifiable. Canadian customer data is stored in Canada.

NVivo doesn't create new significant risks to the computing environment.

The third party in NVivo software is QSR International, and you have access to 3rd party privacy policy information via https://www.qsrinternational.com/privacy-policy

4. Ten elementary students will participate in The Spence Children's Anxiety Scale (SCAS) survey at the end of the study. The scale will explore how students feel after 4weeks of playing with the Khan Academy learning platform in the classroom.

Participation in this study is voluntary. If you choose not for the school to participate in the study or leave the study at any time, it will not affect your academic status, or relationship with the board, university, or researcher. You do not waive any legal rights by consenting to this study. The teacher, parents of students or students may also decide not to be in this study. If they choose not to participate or leave the study at any time, it will not affect their status. They do not waive any legal rights by consenting to this study. Even if they consent to participate, they have the right not to answer.

Teachers and parents can withdraw from the study by emailing the school's principal, the researcher, or the PI. Students also have the right to withdraw at any time. They can ask their parents, teacher, principal of the school or the researcher to withdraw from the study.

All information gathered will remain private and confidential. The full names will be collected on the consent forms for parents and teacher. All the identifiable information is secured and only the PI and the researcher will have access. This information won't be used in publications.

I won't use any personal information, such as names of the school, teacher and students or other identifying information within the publication. I will only use some of the teacher's responses to the interview questions as direct or indirect quotes in the publication. Quotes will be used in the publication with the teacher's consent.

For students' safety and privacy, teachers set up their own accounts on the Khan academy application and create a student roster through their account by adding students. The app generates an anonymous username and password for each student.

The name of students will be tracked on the master list, and only the researcher and PI will have access to it. For the survey, classroom observation or withdrawal, each student will receive a unique code in accordance with their gender (B is a boy, and G is a girl). Students will receive random numbers after their B/G codes, such as B001.

Codes will be assigned to all students, and your school. All observations, surveys and interview transcripts will be kept in locked files, only accessible by me and my supervisor. All data pertaining to this research study will be destroyed after seven years following Western University's Data Security Guidelines.

Delegated institutional representatives of Western University and its Non-Medical Research Ethics Board may require access to study-related records to monitor the conduct of the research in accordance with regulatory requirements.

It is important to note that a record of your participation must remain with the study, and as such, the researchers may not be able to destroy your signed letter of information and consent, or your name on the master list. However, any data may be withdrawn upon your request.

Parents and the teacher will receive an information letter and consent forms prior to the start of the project. Only students whose parents/guardians consent to their participation will be involved in the study. I will not begin data collection until I have been granted permission from the students and their parents.

Should you agree to the involvement of your school in this study, I acknowledge that students

have the right to withdraw from participating in the study at any time, without reason.

I do hope that you will consider this project to be a worthwhile endeavor and that you will agree for your school to participate. Thank you in advance for your consideration regarding this matter. Should you have further questions regarding any aspect of this study, please do not hesitate to contact.

Sincerely,

Roksana Mirzaei Ranjbar

Consent Form – Principal

Study Title: Exploring the Impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic.

Principal Investigator

Dr. Isha DeCoito, Faculty of Education, University of Western Ontario.

Additional Research Staff

Roksana Mirzaei Ranjbar, Faculty of Education, University of Western Ontario.

I have read and understood the terms and conditions of the Study as outlined in the information letter. Yes □ No □

I agree that Roksana Mirzaei Ranjbar may conduct the "Impact of Khan Academy on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic" study in our school contingent upon students' interest in becoming involved in the study. Yes □ No□

I agree to download and use the Khan Academy application. Yes □ No□

Signature of School Administrator……

Date …….

Name of School ……

Signature of Researcher ……

Date ……

Appendix 5

Letter of Information - Teacher

Study Title: Exploring the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic.

Document Title: Letter of Information and Consent.

Principal Investigator

Dr. Isha DeCoito, Faculty of Education, University of Western Ontario.

Additional Research Staff + Contact

Roksana Mirzaei Ranjbar, Faculty of Education, University of Western Ontario.

Invitation to participate

You are invited to participate in this research study focusing on the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic. The main purpose of this letter is to provide you with the information you need to make an informed decision regarding your participation in this research study.

Please read the information below and clarify anything you do not understand before considering whether to participate.

Background/ Purpose

This study aims to explore the impact of the Khan Academy as a famous platform among children that contains instructional videos, games, and puzzles on elementary students' learning

anxiety and problem-solving skills during the Covid-19 pandemic. The study aims to find a fun and engaging digital tool for decreasing children's anxiety and improving vital skills such as problem-solving skills.

Procedures

Participation in this research study is voluntary. If you decide to participate, you will be invited to participate in face-to-face or telephone interviews. The first interview will be at the beginning of the study, and it will explore your views of digital games in teaching/learning. The interview includes eight open-ended questions and will take approximately 20 minutes. You will also be required to participate in another interview at the end of the study about students' change after playing on the Khan Academy platform in the classroom. It contains 15 questions and will last approximately 30 minutes. Interviews will take place during school time when students are doing their school duties, and the interview won't take their instructional time.

With your consent, the interviews will be audiotaped with "Voice Memo," a voice recording app on the phone. I will take notes during the interview if you don't wish to be recorded.

If you do not want notes taken according to your answers during the interview, I will provide the questions so that you can write your responses directly.

Your students, aged 5-8, will play with Khan Academy, a digital game-based learning platform, for four weeks, three times each week, for one hour or less.

You will select some games in Khan Academy that are relevant to the class's topic and aligned with the Ontario curriculum. Therefore, Khan Academy can be used as a part of your regular classroom activities. Khan Academy is a digital platform that promotes reading skills and science and mathematics study.

I will be in your classroom when students are playing and observe 10 students and take notes about their engagement with the platform.

For students' safety and privacy, you need to set up your own accounts on the Khan Academy Kid application and create a student roster through your account by adding students. The app generates an anonymous username and password for each student.

Your students will also participate in The Spence Children's Anxiety Scale (SCAS) survey at the end of the study. This survey has 44 questions and takes approximately 30 minutes to complete. The survey will take place during school time.

I will use NVivo12 software to analyze interviews and observations made of students. NVivo is a desktop application used for qualitative research analysis. NVivo is software locally installed on the computer; the data will not leave the computer and no data will be identifiable. Canadian customer data is stored in Canada.

NVivo doesn't create new significant risks to the computing environment. The third party in NVivo software is QSR International, and you can have access to the 3rd party's privacy policy information via https://www.qsrinternational.com/privacy-policy

Inclusion criteria

To be eligible to participate in this study, participants need to be teachers of elementary students and have knowledge about technology and digital games.

Risks

Technical difficulties, non-preference for computer-based learning, the potential to trigger learning anxiety, and prolonged screen time are considered potential risks of this study.

To mitigate the technical difficulties of playing with Khan Academy, I will provide assistance with downloading and installing Khan Academy before playing.

Students will play with Khan Academy for one hour or less. I will try to limit the time of playing digital games to minimize screen time.

Before start playing digital games and collecting data, I will select some games from Khan Academy with the help of the teacher which is relevant to the class's topics and interest for children to increase their learning preferences.

Benefits

You may not directly benefit from participating in this study. Still, the information gathered provides benefits that will increase the awareness of the impact of digital games, especially Khan Academy, on elementary students' learning anxiety and problem-solving skills. This study could help teachers to make better decisions about using technology and digital games in the classroom. Khan Academy is a free online platform for kids' learning that incorporates gaming aspects in students' progress. Therefore, it provides an enjoyable learning environment for children. Khan Academy also could help students get beyond prior lesson delivery issues and offers an alternative for tracking their academic progress. It also improves students' critical and creative thinking skills.

Confidentiality

Participation in the study is voluntary. The collected data will be used only for research purposes and stored and archived securely. Any information that could identify you and your students will not be used in any publication or presentation of the study results. Your full name will be

collected on the consent form, but all the identifiable information is secured and only the PI and the researcher will have access.

If the study results are published, your name will not be used in any publication. I will use some of your responses to the interview questions in the publication as direct or indirect quotes. Quotes will be used with your consent.

It is important to note that a record of your participation must remain with the study, and as such, the researchers may not be able to destroy your signed letter of information and consent or your name on the master list. However, any data may be withdrawn upon your request.

To protect your students' personal information, consent forms will generate a list of participating students, and each will be assigned a unique code (B/G001...) for the purpose of the survey, classroom observation and withdrawal.

Delegated institutional representatives of Western University and its Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research in accordance with regulatory requirements Representatives of Western University's Non-Medical Research Ethics Board may require access to your study-related records to monitor the conduct of the research. As per Western University policy, all collected data will be destroyed after seven years.

Compensation

You will not be compensated for your participation in this research.

Rights as a participant

Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from

the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on your employment status or academic standing. You do not waive any legal right by consenting to this study.

You can withdraw the study by emailing the school's principal, the researcher, or the PI. Your students also have the right to withdraw at any time. They can ask you, their parents, the principal of the school or the researcher to withdraw from the study.

Questions about the Study

If you have any questions about the study, don't hesitate to get in touch with the principal investigator, Dr. Isha Decoito or the co-investigator, Roksana Mirzaei Ranjbar.

If you have any questions about your rights as a research participant or the conduct of this study, you may contact the Office of Human Research Ethics (519) 661-3036, 1-844- 720-9816, email: ethics@uwo.ca. This office oversees the ethical conduct of research studies and is not part of the study team. Everything that you discuss will be kept confidential.

Publication

The study results will be made public via peer-reviewed publications or presentations. If the results of the study are published, your name will not be used in any publication or presentation.

This letter is yours to keep for future reference.

Consent Form – Teacher

Study Title: Exploring the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic.

Principal Investigator

Dr. Isha DeCoito, Faculty of Education, University of Western Ontario.

Additional Research Staff

Roksana Mirzaei Ranjbar, Faculty of Education, University of Western Ontario.

I have read the letter of information and all questions have been answered to my satisfaction.

I agree to participate in the study. Yes * No *

I agree for my interviews to be audiotaped. Yes * No *

I agree to use direct and indirect quotes from my interviews in publications. Yes * No *

Name (please print): …….

Signature: …….

Date: …….

Person Obtaining Information Consent (please print): ……

Signature: …….

Date: …….....

Appendix 6

Letter of Information - Parents

Study Title: Exploring the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic.

Document Title: Letter of Information and Consent.

Principal Investigator

Dr. Isha DeCoito, Faculty of Education, University of Western Ontario.

Additional Research Staff + Contact

Roksana Mirzaei Ranjbar, Faculty of Education, University of Western Ontario.

Invitation to participate

Your child is invited to participate in this research study focusing on the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic. The main purpose of this letter is to provide you with the information you need to make an informed decision regarding your child's participation in this research study. Please read the information below and clarify anything you do not understand before considering whether to participate.

Background/ Purpose

This study aims to explore the impact of the Khan Academy as a famous platform among children that contains instructional videos, games, and puzzles on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic. The study aims to find a fun

and engaging digital tool for decreasing children's anxiety and improving vital skills such as problem-solving skills.

Procedures

Participation in this research study is voluntary. If you decide for your child to participate in this study, your child will play with Khan Academy digital games on a tablet in the classroom during class time. The study will take 4 weeks, and students will play Khan Academy 3 times a week for one hour or less. I will look at 10 participants from one or two classes. If not enough participants consent in one class, I will use two classes in the same school.

Khan Academy can be used as a part of regular classroom activities because Khan Academy is a digital platform that promotes reading skills and science and mathematics study. The teacher of your child will select some games from Khan Academy that are relevant to the class's topic and aligned with the Ontario curriculum. Therefore, Khan Academy can be a part of the regular academy activities.

I will observe children playing with Khan Academy, taking notes about their learning anxiety, behavior, and performance during class. Your child also will participate in The Spence Children's Anxiety Scale (SCAS) survey at the end of the study. The survey has 44 questions, and it takes approximately 30 minutes. But even if they start the survey, your child has the right to not answer individual questions or to withdraw from the study at any time.

I will use NVivo12 software to analyze observations made of your child. NVivo is a desktop application used for qualitative research analysis. NVivo is software locally installed on the computer; the data will not leave the computer and no data will be identifiable. Canadian customer data is stored in Canada.

NVivo doesn't create new significant risks to the computing environment.

The third party in NVivo software is QSR International, and you can have access to the 3rd party's privacy policy information via https://www.qsrinternational.com/privacy-policy

Inclusion criteria

To be eligible to participate in this study, participants must be elementary students between the ages of 5-8.

Risks

Technical difficulties, non-preference for computer-based learning, the potential to trigger learning anxiety, and prolonged screen time are considered potential risks of this study.

To mitigate the technical difficulties of playing with Khan Academy, I will provide assistance with downloading and installing Khan Academy before playing.

Students will play with Khan Academy for one hour or less. I will try to limit the time of playing digital games to minimize screen time.

Before start playing digital games and collecting data, I will select some games from Khan Academy with the help of the teacher which is relevant to the class's topics and interest for children to increase their learning preferences.

Benefits

Khan Academy is a free online platform for kids' learning that incorporates gaming aspects in students' progress. Therefore, it provides an enjoyable learning environment for your children. Khan Academy could help students get beyond prior lesson delivery issues and offers an alternative for tracking their academic progress. It also improves students' critical and creative thinking skills.

Confidentiality

Participation in the study is voluntary. The collected data will be used only for research purposes and stored and archived securely. Your child will be assigned a unique code; thus, any information that could identify your child will not be used in any publication or presentation of the study results. For the confidentiality of your child's personal information, consent forms will generate a list of participating students, and each will be assigned a unique code (B/G001...) for the purpose of the survey, classroom observation and withdrawal. Each student will receive a unique code in accordance with their gender (B is a boy, and G is a girl). Students will receive random numbers after their B/G codes, such as B001.

Your full name will be collected on the consent form, but all the identifiable information is secured and only the PI and the researcher will have access. If the study results are published, your name and your child's name will not be used in any publication. It is important to note that a record of your participation must remain with the study, and as such, the researchers may not be able to destroy your signed letter of information and consent or your name on the master list. However, any data may be withdrawn upon your request.

Delegated institutional representatives of Western University and its Non-Medical Research Ethics Board may require access to study-related records to monitor the conduct of the research in accordance with regulatory requirements.

As per Western University policy, all collected data will be destroyed after seven years.

Compensation

You will not be compensated for your participation in this research.

Rights as a participant

Your participation in this study is voluntary. You may decide for your child not to be in this study. If you choose for your child not to participate or leave the study at any time, it will not affect your child's academic standing. You do not waive any legal rights by consenting to this study. Even if you consent for your child to participate, you have the right to withdraw your child from the study at any time.

Your child also has the right to participate in or leave the study at any time. They have the right not to answer individual questions or withdraw from the study at any time. They do not waive any legal rights by consenting to this study, which will not affect their academic standing or educational position.

You can withdraw the study by emailing the school's principal, the researcher, or the PI. Your child also has the right to withdraw at any time. They can ask their parents, teacher, principal of the school or the researcher to withdraw from the study.

Questions about the Study

If you have any questions about the study, please don't hesitate to get in touch with the principal investigator, Dr. Isha DeCoito or the co-investigator, Roksana Mirzaei Ranjbar (Email: XXX - Phone: XXX).

If you have any questions about your child's rights as a research participant or the conduct of this study, you may contact the Office of Human Research Ethics (519) 661-3036, 1-844-720-9816, email: ethics@uwo.ca. This office oversees the ethical conduct of research studies and is not part of the study team. Everything that you discuss will be kept confidential.

Publication

The study results will be made public via peer-reviewed publications or presentations. If

the results of the study are published, your child's name will not be used in any publication or presentation.

Consent Form – Parents

Study Title: Exploring the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic.

Principal Investigator

Dr. Isha DeCoito, Faculty of Education, University of Western Ontario.

Additional Research Staff

Roksana Mirzaei Ranjbar, Faculty of Education, University of Western Ontario.

I have read the letter of information and all questions have been answered to my satisfaction.

I agree with my child's participation in the study. Yes □ No □

Name of parents (please print): …….

Signature: …….

Date: …….

Person Obtaining Information Consent (please print): …….

Signature: …….

Date: …….

Appendix 7

Assent Letter for Students

Study Title: Exploring the impact of the Khan Academy digital platform on elementary students' learning anxiety and problem-solving skills during the Covid-19 pandemic.

Document Title: Assent letter for students.

Principal Investigator

Dr. Isha DeCoito, Faculty of Education, University of Western Ontario.

Additional Research Staff + Contact

Roksana Mirzaei Ranjbar, Faculty of Education, University of Western Ontario.

1. Why are you here?

You are here because your class is participating in my study, and part of the study is playing digital games in class.

2. Why are they doing this study?

We want to find a fun digital game for you to play in the classroom.

3. What will happen to you?

If you want to be in the study, you will play Khan Academy digital games for 4 weeks, three times each week. I will stay in your class when you are playing and observe you. You will also participate in a survey at the end of the study. This survey has 44 questions and takes approximately 30 minutes to complete.

4. Will there be any tests?

There will be no tests or marks for this study.

5. Will the study help you?

This study may help your teacher to make better decisions about using digital games in the classroom, and he/she may specify more time for playing digital games.

6. Do you have to be in the study?

You do not have to be in the study. It is up to you. No one will be upset if you do not want to do this. If you do not want to be in the study, tell your parents or teacher. Even if you say yes now, you can change your mind later.

7. What if you have any questions?

You can ask questions at any time, now or later. You can also talk to your teacher or me.

You will be given a copy of this paper to keep.

This letter is yours to keep for future reference.

Appendix 8

Assent Form

I want to participate in this study and play digital games. □ Yes □ No

I want to participate in a survey. □ Yes □ No

Print Name of Student: ……..

Date: ……

Name of Person Obtaining Assent: ……..

Signature of Person Obtaining Assent: …….

Curriculum Vitae

Name: Roksana Mirzaei Ranjbar

Full- time: Yes

ACADEMIC BACKGROUND

Master of Psychology and Education of Children with Special Needs **2017-2019**

University of Isfahan (Iran)

Bachelor of Psychology and Education of Children with Special Needs **2013-2017**

University of Isfahan (Iran)

RELATED WORK EXPERIENCE

School Age Educator 2022-2023
Part- Time

YMCA southwestern London, ON

Special Needs Teacher 2013-2019
Part- Time

Sarmad Charity (Iran)

Like Skills Teacher 2018-2019
Part-Time

Shahid Ayat School (Iran)

Intelligence Tester 2018-2019
Part-Time

Ministery of education of Iran (Iran)

Personal Tutor 2019-2020
Part-Time

Iran

PUBLICATIONS

The Effectiveness of Intervention Based on Play Therapy on the Social Skills and Problems Behaviors in Children with Intellectual and Developmental Disabilities (Meta-Analysis)

Author(s):

Roxana Mirzaie Ranjbarr, Ghasem Norouzi, Ahmad Abedi, Mohammad Ashori

Meta-analysis of the Effectiveness of Psychological Interventions on the Level of Stereotypical Behaviors in Autistic Children

Author(s):

Shahrzad Adili, Roxana Mirzaie Ranjbarr, Ahmad Abedi

Barriers and limitations of employment for people with intellectual and developmental disabilities

Author(s):

Ghasem Norouzi, Roxana Mirzaie Ranjbarr, Mohammad Ashori

The Effectiveness of Filial Therapy on the Quality of Parent-Child Interactions and Health-Related Quality of Life in Children with Behavioral/Emotional Problems

Author(s):

Shahrzad Adili, Roxana Mirzaie Ranjbarr, Ahmad Abedi