

Serious Games, Motivation, and Learning: A Study on Marginalized Youth

Annisa Hasanah, Roger C. Baars

Laboratory of Environmental Education, GSGES, Kyoto University, Kyoto, Japan

Email: annisa.hasanah.sp@gmail.com

How to cite this paper: Hasanah, A., & Baars, R. C. (2023). Serious Games, Motivation, and Learning: A Study on Marginalized Youth. *Creative Education*, 14, 2747-2776.

<https://doi.org/10.4236/ce.2023.1413174>

Received: October 31, 2023

Accepted: December 25, 2023

Published: December 28, 2023

Copyright © 2023 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Marginalized youth are frequently disadvantaged in formal educational systems. In recent years, serious games have shown positive effects on learning for youth. However, the impact of serious games on learning outcomes is somewhat understudied, in particular with regards to marginalized youth. This paper explores motivation and perceived knowledge gain and skill development among marginalized youth playing the Water Champions game (a tabletop game about water and hygiene practices). The empirical study was conducted in Bogor, West Java, Indonesia. The quantitative (surveys) study examines participant motivation, driving factors to participate, and perceptions of knowledge and skills gained. Results show that, although playing the Water Champions Game had positive effects on perceived environmental learning among marginalized youth, perceived knowledge gain and skill development is not highly correlated. This paper argues that serious games could improve learning outcomes for marginalized youth, particularly those that somewhat underperform in the formal education system.

Keywords

Environmental Learning, Marginalized Youth, Motivation, Serious Games

1. Introduction

Despite sustained effort by governments, the private sector, and non-profits organizations active in the educational space; many marginalized communities are still facing everyday challenges in formal education. The formal education sector in many developing countries is characterized by outdated school facilities, a lack of qualified teachers, and a non-engaging pedagogical approach. This limitation can have severe negative consequences for learning outcomes, in particular affecting marginalized groups. Informal education has emerged as a potential edu-

cational pathway to improve the quality of learning among marginalized youth. Informal learning often utilizes various types of educational tools that are compatible with the characteristics of young people who enjoy visual and highly interactive approaches. Among the various tools used in informal learning, serious games are considered as an important tool in motivating and educating young learners. In recent years, serious games have developed into various forms, ranging from analog (e.g., tabletop) to digital (e.g., mobile) games. Games have been shown to benefit users regarding knowledge gain and skill development. Games can no longer be seen simply a mode of entertainment, but are often developed specifically for education purposes (serious games).

Studies on serious games have demonstrated their effectiveness in cultivating student interest on a wide range of subjects (Mangowal et al., 2017; Polys et al., 2017; Wang, 2019). For example, in basic education, serious games have been used to increase necessary skills, such as literacy or calculus. Serious games have also entered the domain of more complex subjects related to, for example, environmental issues. Serious games possess the potential to add a new layer to existing (formal) environmental education initiatives. However, research on ways how serious games could improve environmental learning, in particular for marginalized youth in the Global South, is largely missing. Youth from economically disadvantaged backgrounds are often facing higher educational barriers than their peers in many formal education systems. Informal education approaches, such as serious games, have shown promising outcomes that could help to overcome some of the learning obstacles that marginalized youth are facing. Thus, this paper investigates the potential of serious games in improving educational outcomes for marginalized youth, with a particular focus on environmental learning.

2. Literature Review

2.1. Marginalized Groups in Society

Marginalized groups have been frequently disadvantaged in life because of multiple factors such as race, ethnicity, skin color, gender identity, and socio-economic status (Sevelius et al., 2020; Xiong & Dossetti, 2022). Difficulty in finding employment often causes financial stress. Although many are employed, their opportunities are often limited to blue-collar jobs with an associated minimum wage. As a result, total earnings are often insufficient to cover the costs for many essential elements of life, such as food, water, clothing, and shelter (Glaesser, 2022; Khanday & Akram, 2012). The majority of marginalized people today are living under problematic conditions, many in poverty. Poverty is often associated with poor health (Balboni et al., 2021; Neuwelt & Kearns, 2021). For example, Conradt et al. (2020) report that pregnant women in marginalized communities are likely to experience chronic stress which can affect the child development negatively. This can even be exacerbated by poor diets and sanitation, a common feature in many marginalized communities (Ezeh et al., 2017). In other words,

poverty often generates a snowball effect on many aspects of life. To overcome these problems, education can be considered a key element in achieving better employment opportunities as well as improved living conditions, in particular, related to the health (García & Weiss, 2017). In this context, formal education can play a crucial role in empowering marginalized groups, in particular at a young age.

2.2. Marginalized Students in Formal Education

Formal education is highly structured and can be organized into primary, secondary, and tertiary education. In most countries, primary education is compulsory and free. Khien et al. (2020) illustrate how tuition-free education is positively correlated with school enrollment rates, in particular in developing countries. Formal education has led to significant improvements in marginalized communities by providing ample learning opportunities to all. Ramburuth and Härtel (2010) explores how formal schooling is pivotal, in particular for students from low socioeconomic status (SES), to develop literacy and numeracy skills. Arguably, formal education is an important pre-requisite for students to meaningfully participate in society in later life. However, Liu (2016) found that, despite the significant improvements been made in formal education, students from low SES still experience significant difficulties in education. One factor here, could be the fact that although free education does support marginalized students, educational cost go far beyond tuition fees. Parents must cover significant additional costs, such as school uniforms, books, equipment, transportation, and internet (Khien et al., 2020; OECD/Asian Development Bank, 2015). Given their constrained financial situation, this is a significant financial burden imposed on low-income families.

School facilities also appear to impact students' academic achievements (Azzizah, 2015; Hopland, 2013). Many schools in marginalized communities are lacking up-to date and sufficient facilities. Schneider (2002) compares school facilities across eight developed countries and shows that, compared to wealthy areas in a city, facilities in poor neighborhoods are often insufficient and affect student learning negatively. Similarly, Filardo et al. (2019) found that many public schools suffer from mold contamination, poor ventilation, and inadequate lighting, all of which can harm student health. Furthermore, these inadequate school building often have room only for a few classrooms that are used by a large number of students. This leads to overcrowded classrooms, which was shown to not only affect student performance, but also challenge teachers to deliver effective lessons. Teachers play an important role in student learning, offering additional moral support and motivating students (Dejaeghere & Lee, 2011). Schools in marginalized communities often are under-staffed, which leads to high student-teacher ratios (Pruet et al., 2016; Stevenson et al., 2013). For example, a study on primary school students in Indonesia shows the severe effects of over-crowded classrooms and a low numbers of teachers (Azzizah, 2015). Under these circumstances, teachers often experience stress and suffer from excessive workloads

(Fute et al., 2022). However, rather than improving the situation for students and teachers, providing sufficient tools and materials is often seen as an alternative to deliver lessons to large groups of students in a classroom.

There is a broad range of learning materials available, ranging from rather conventional tools like textbooks, to high-technology devices like computers or tablets. Studies argue that technological resources show the potential of reducing education inequality, based on the argument that technology facilitates easy access to a large amount of educational content (Kim et al., 2012). For example, Thailand's "One Tablet Per Child" policy targeted primary schools in marginalized communities to improve the quality of education (Pruet et al., 2016). Some positive results were observed. Students illustrated higher levels of confidence and knowledge acquisition. Although ICT seems promising, the potential effects are not likely to benefit all students. Marginalized students are more likely to face challenges might limit or even prevent their access to technology, such as regular access to electricity and internet (Kim et al., 2012).

Overall, formal education has made significant improvements to the education of marginalized communities and helps to reduce many educational disadvantages faced by students from low socio-economic backgrounds. However, it must be acknowledged, that the financial capability of families is an important factor in student learning. Therefore, many families in marginalized neighborhoods strive to offer their children additional or even alternative avenues to education. There is a growing demand and potential for informal education to offer an equal and just way of learning for marginalized students.

2.3. Informal Education

Informal education can help address some challenges marginalized students are facing in formal education. Informal learning can be defined as any learning experience performed outside school that is not part of the curriculum provided by formal educational institutions (Eshach, 2007; Schugurensky, 2015). Informal education is characterized by somewhat unstructured, voluntary, and spontaneous participation (Degner et al., 2022; Eshach, 2007). These attributes offer some level of flexibility that could increase access to the learning (Trott, 2020). Flexibility, for example, can manifest itself in terms of the learning environment. Informal education goes beyond the limitations of classrooms and uses different learning environments to optimize both learning processes and outcomes (Kim & Dopico, 2016). For example, outdoor education can help engage students to learn science subjects, like Biology, through outdoor activities, such as nature observation and camping (Salmi et al., 2016). Teachers provide real-life learning settings to foster student learning (Pereira et al., 2019). First-hand experiences have been shown to motivate student action, compared to passive information delivery in class (Pfirman et al., 2021).

An important research focus in informal education has been on its potential to cultivate students' interests in learning (Rossano et al., 2017; Trott, 2020). For instance, museums and science centers have been shown to contribute greatly to

the understanding of science and to encourage students to develop an interest in science (Eshach, 2007). Tools, such as simulation and role-play, often used in informal education, encourage students to be active learners (Arnett-Hartwick & Davis, 2019). However, Wong (2022) reports that marginalized students regularly require more support when stimulating their interest in learning. Marginalized students often perform lower than their peers, possibly linked to their lack of motivation (García & Weiss, 2017; Stevenson et al., 2017). A lack of interest in learning in general can result in unmotivated students more broadly. Motivation and engagement, however, play a critical role in learning success (Liem & Martin, 2012; Saltan & Arslan, 2017). Here, informal education could potentially help to foster higher levels of motivation and engagement (Rooney, 2012).

Engagement and motivation can be developed through various tools used in informal education (Kim & Dopico, 2016). In general, these are less traditional, like books, and more modern and interactive, like digital applications or games. Current generations engage in learning differently than previous students. They are more self-directed learners, have relatively low attention spans, and are more interested in visual forms of learning (Cilliers, 2017; Singh & Dangmei, 2016). Informal education could offer new ways of engagement with this kind of learners. For example, Tan (2013) explores how YouTube could offer positive and enjoyable learning experiences. Apart from audio-visual learning (videos), games have become a prominent example of engaging tools for young students. The benefits of games for informal education programs have increasingly gained attention among educators and learners.

2.4. The Potential of Serious Games in Education

Games can be defined as “a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (Plass et al., 2019: p. 3). Games are a goal-oriented tool that allows users to explore possible outcomes (trial and error) without facing any real-life risks (Sardone & Devlin-Scherer, 2016). Games are often characterized by high levels of interactivity which leads users to spend prolonged hours on gaming (Rooney, 2012). In the UK, the average young person has played games for more than 10,000 hours by the time they reach the age of twenty-one (Ouariachi et al., 2019). Games have gained a wide audience with over 2.3 billion people playing games all over the world (Patterson & Barrat, 2019). Games can be seen as a highly successfully tool to engage young people in entertainment activities. Games take on many different forms, from video or mobile games, to augmented reality (AR), to more traditional analog forms, such as board or card games. Through recent technological advancement, digital games can now be easily accessed by users in both developed and developing nations (Patterson & Barrat, 2019). The wide availability of smartphones, for example, has contributed significantly to the fast growing mobile games sector (Layland et al., 2018). Although digital games are among the most popular types of games, analog games, like board games, also gain attention (Booth, 2021). Reports on the social aspects of gaming, claim that board

games are more effective in developing social interaction and engagement between players, compared to some video games (Fjællingsdal & Klöckner, 2020). Board games can encourage cooperation, competition, and negotiation among players (García-Barríos et al., 2020; Loderer et al., 2019). In an educational context, this could help learners to develop problem-solving and critical-thinking skills.

Games are no longer seen as simple entertainment tools. There is a group of games that have been modified or specifically created for educational domains, so-called serious games. Serious games are defined as “*Games that are not designed solely for entertainment purposes, but also as a tool to educate, train and inform users*” (Madani et al., 2017: p.3). Serious games can be tailored to both analog and digital forms with specific goals and objectives. They have been utilized in a wide range of contexts, such as healthcare, business administration, military operations, policy development, and social impact assessment. The benefit of serious games to simplify complex issues makes them an ideal entry point to communicating new information (Eisenack, 2013; Sardone & Devlin-Scherer, 2016). Serious games can be used as a medium to introduce a topic or challenge to users, framed by a mission or set of rules to follow. Serious games have become an attractive medium because they allow learners to experience direct impacts and outcomes in their decision-making (Dankbaar et al., 2017). Serious games have also been credited as a way to bridge knowledge levels and communication gaps between people from different background (Chappin et al., 2017; Whalen et al., 2018).

Studies on serious games have shown positive results in achieving a variety of learning outcomes, particularly regarding knowledge and skill development among marginalized students (Bosma et al., 2020). Ramburuth and Härtel (2010) pointed out that students from low socio-economic backgrounds often underperform in tasks requiring sound literacy and numerical skills. However, some studies indicate that serious games could have positive effects on such mathematical and literacy skills (Chen & Hsu, 2020; Jagušť et al., 2018). For example, Eisenack (2013) found that serious games help students to better understand complex scientific terminologies. Serious games have also been illustrated to benefit communication skills (Cheng et al., 2019; Lanezki et al., 2020). Denami (2018) states that communicating in serious games can contribute to gaining better communication skills in professional practices.

In recent years, serious games have rapidly gained momentum in informal education to increase student engagement and motivation (Pfirman et al., 2021; Sardone & Devlin-Scherer, 2016; Wilkinson, 2016). Serious games are used as a substitute for upfront lectures to increase students’ interest in a subject (Madani et al., 2017). Engagement can be developed through serious games in various ways. Serious games produce a state of flow that drives a pleasant state of concentration and motivation (Lanezki et al., 2020; Ouariachi et al., 2019). It is also influenced by visual elements which makes learning content more attractive than text-based content (Fjællingsdal & Klöckner, 2020). For this reason, learning

through serious games works favorably compared to the traditional classroom (Chen & Hsu, 2020; Sardone & Devlin-Scherer, 2016). However, it can be subjective because some serious games could have a reverse effect on player's engagement if they find the game is too simple and less challenging (Ouariachi et al., 2017).

2.5. Engaging Marginalized Youth through Serious Games

A group that could benefit from playing serious games in particular, are marginalized youth in the Global South. There have been several studies on the impact of serious games on marginalized communities in developing countries (Beattie et al., 2020; Hussain et al., 2021; Kim et al., 2012). Past studies mostly framed serious games as a tool for fostering social justice and social change. The issue of social justice on marginalized people generally happens among the adult age group who are often discriminated against by society, which results in violence and oppression (Ruberg & Scully-Blaker, 2021). For example, Hussain et al. (2021) show how Muslim women in Pakistan use e-sports to have a voice and presence in their often oppressed and highly masculine environment. Another study reported that serious games provide space for marginalized people to deal with the trauma of sexual violence (Villar & Johnson, 2021).

Serious games offer ways to collect data that is difficult to gather, such as tacit knowledge (García-Barrios et al., 2020). Tacit knowledge, particularly in the form of social capital, can be achieved by the marginalized community in a specific occupation through game simulation (Beattie et al., 2020). Serious game's application was also adopted in participatory research to teach specific subjects to the school-age level, such as children and adolescents (Moloi, 2014). In highly populated countries such as India and Indonesia, serious games have contributed learning improvement for poor children in both urban and rural areas through utilizing digital technologies (Kim et al., 2012; Mangowal et al., 2017). In terms of engagement, games are proven to motivate marginalized students to learn over a short period of time (Bossavit & Parsons, 2018). Despite positive outcomes gained among marginalized youth, few important aspects such as socioeconomic and social factors in motivation are still underexplored. The existing research on serious games lacks interpretive validity in linking driving factors such as familial economic conditions and social influence to their motivations and learning outcomes in serious games. Given the fact that socioeconomic barriers affect their learning motivation, investigating these specific factors on marginalized students becomes critical (Wong, 2022).

This section illustrated the current situation of marginalized youth in relation to formal education and identified crucial factors that create educational barriers. Informal education was introduced as a potential pathway to support marginalized youth. It was shown that informal education can offer diverse learning environments that foster interest and engagement of marginalized youth in a variety of subjects. Multiple tools used in informal education, such as digital appli-

cations and games, were discussed and appear to help engaging young learners. It has been argued, that serious games, in particular, have the potential to counter some negative educational effects of various socio-economic barriers marginalized youth are facing.

3. Methodology

A quantitative approach is used in this study to examine what factors motivate marginalized students to play serious games and what type of knowledge they could gain from this experience. The rationale of quantitative method because of its ability to produce the air of objectivity and directly access student's attitudes and perceptions in the motivation (Urda et al., 2018). Moreover, quantitative method, particularly surveys, have emerged as the predominant method in assessing knowledge and skill acquisition when compared to alternative research approaches (van Laar et al., 2017). In the context of intersectionality theory, the application of quantitative methods is recommended for examining the link between socioeconomic backgrounds and their influence on educational outcomes (McMaster & Cook, 2019).

Serious games have been recognized as beneficial tools in enhancing engagement and knowledge on marginalized youth. For this case study, environmental issue was chosen as the topic because it is still perceived as undervalued in most developing nations (Prabawa-Sear, 2018). Furthermore, an important consideration put in the fact that environmental challenges will impact the most on children and youth, but they are the least engaged in the environmental education (Trott, 2020). Environmental education is necessary to raise knowledge and drive actions for younger groups. Within the field of environmental theme, water and sanitation were chosen to assess knowledge and skills. Water Champions Game (WCG) served as an example of serious games that address environmental issues. WCG is a tabletop game about raising awareness related to water resource management and hygiene practices with an emphasis on developing water-friendly city (Figure 1). Tabletop games are cheaper than digital games and have no technological compatibility issues, so it is easier to incorporate into various learning environments (Pfirman et al., 2021). For that reason, the tool is suitable for our target participants. Thus, this study aimed at two objectives: 1) to identify underlying motivational factors to engage in learning through serious games and 2) to investigate the impact on environmental knowledge and skills after playing serious games.

3.1. Survey

Survey is developed based on a theoretical framework of motivation and environmental knowledge on serious games, adapted from Waugh, Yee, Akter & Ali, and Polys (Akter & Ali, 2014; Polys et al., 2017; Waugh, 2002; Yee, 2006). The framework is developed through merging similar aspects on motivation between learning and gaming, for example, intrinsic and extrinsic factors of motivation



Figure 1. Water champions game.

and add non-intersecting elements such as effort in learning and modes in gaming. Within this framework, motivation is divided into three categories: knowledge driven, social driven, and reward driven. Efforts and emotions are included as a vital factors because it is strongly impact learner's motivation and learning outcomes (Loderer et al., 2019; Wong, 2022).

As for the knowledge, elements of WASH scheme were adopted as the knowledge and skills measurement. WASH is a collective term for Water, Sanitation, and Hygiene which consists of practical personal knowledge such as handwashing, safe drinking water, and perception of practices and environmental awareness (Sah et al., 2017; Sijbesma et al., 2011). Local environmental awareness influences the perception of responsibility within communities so it is useful to insert it in the knowledge aspect (Anthonj et al., 2021; Polys et al., 2017). Based on the literature review, the study formulated two hypotheses: 1) participants are socially driven to join the game and 2) environmental knowledge can be achieved at least on average level.

The survey comprises of three sections organized around the topics of motivation, knowledge and skills. These sections are based on the theoretical framework which converted into set of questions such as multiple choices, Likert-scale, open-ended questions, and matrix. Multiple choices comprise questions on socio-economic background information, efforts, skills, and emotions. The latter two aspects can be responded with a maximum of three answers. The Five-point Likert scales comprises statements on three types of motivation using the spectrum of agreement and disagreement. Likert scale question is used to measure respondent's attitudes to a particular question or statement (Nieh & Wu, 2018; Spooren et al., 2007). For example, social driven motivation is presented through this statement: "I play the game because I want to have fun with others". Matrix questions comprise the depth of participants' knowledge concerning water and sanitation using three level of responses.

The playtesting with WCG was conducted with youth participants in order to provide first-hand experience in serious gaming before collecting information through the surveys. Participation in this playtesting is voluntary. For ethical purposes, the consent form had to be signed by the participant's parent or legal guardian. The study is situated in Bogor city and regency, West Java province,

Indonesia. It was held in two phases: 1) one session in each urban districts: a) Sindangsari village b) Katulampa village and c) Ciawi district in February 2022 and 2) two sessions in one rural district, Cibulao village, in August 2022. Each session was facilitated by student volunteers who had prior game facilitator's training. The playtesting was held in school's indoor hall and community center in a casual setting. The surveys were administered in a printed format right after the playtesting finished. In the first phase, the playtesting and surveys were done by the volunteers while the second phase was collected directly by the author. Participants will receive non-monetary rewards after filling out the survey. The volunteers recapped the results of the survey into Typeform, the online survey platform, for analysis purposes.

Quantitative data for this study came from a sample totaling 98 youth between ages 12 - 18 years old from four marginalized communities in Indonesia. We selected this age group because they are in the development phase of their cognitive abilities for environmental knowledge (Stevenson et al., 2013). This study received more female participants (n = 64) than male (n = 34). Participants consists of students from elementary school, junior high school, and senior high school. Most participants go to regular day school, while some of them in junior high school level go to boarding school. The players' demographic distribution is shown in (Table 1).

Table 1. Player's demographic distribution.

Gender	n
Male	34
Female	64
Grade	
Elementary School	13
Junior High School	77
Senior High School	6
Dropped Out	2
School type	
Day school	67
Boarding school	29
Uncategorized	2
Status	
Public	18
Private	78
Uncategorized	2
Area	
Urban	79
Rural	19

3.2. Data Analysis

The data was analyzed using MS-Excel and JASP. JASP is an open-source program for statistical analysis that was developed by the University of Amsterdam (JASP Team, 2023). The statistical analysis laid out the survey results consisting of three main aspects (knowledge acquisition, skills, and motivation on serious games) along with the correlation between variables within those aspects. These results also addressed participant's socioeconomic factors that may be related to their learning conditions. To determine the correlation between two variables, Spearman's Correlation Test (with the alpha value set to <0.05) was conducted using the survey data. Spearman's Correlation Test was chosen over the Pearson correlation test because it is a more appropriate measurement for non-parametric statistic like Likert scale data (Rebekić et al., 2015). This test examines the relationship between knowledge to skills, emotional factors to motivation, and school performance to motivation.

Geographically, marginalized youth lived in two different areas: rural and urban. Each area shows distinctive characteristic that likely affect their living condition and education. People in rural areas have fewer resources and educational opportunities than those in urban area (Kim et al., 2012). In this study, the rural area is located approximately 2 kilometers from the main road with poor road conditions while the urban area do have better accessibility. Therefore, students in rural villages experience more challenging situations than students in urban districts which could benefit less from education. For that reason, it is important to examine whether the outcomes from learning through serious games show any significant differences between rural and urban areas.

As Spearman's correlation test is not compatible to address this matter, so Independent t-test was employed to examine significant differences between two independent samples (Kim, 2015) which is rural and urban area in this particular context. The t-score quantifies the difference in means, while p -value indicates the statistical significance of the difference. Given the unequal sample size between rural and urban area, independent t-test become suitable test because it compares mean scores. The t-test was performed to compare the differences in knowledge and skills between youth in urban and rural areas.

4. Results and Discussions

Socioeconomic status can be conceptualized, among others, as a result of investments in various forms of capital (Heflin & Pattillo, 2006). Housing, for example, can be an indicator for economic capital. This study found that participants live in one of three types of housing: private houses (owned by their family), rented houses (rented property), and loaned houses (property provided by a company). The latter is a form of housing provided by the tea corporation in the village of Cibulao. About 20% of participants lived in a loaned house. Although families who live in loaned houses do not have to pay any monthly rent to the corporation, their monthly salary as tea farmers is as low as IDR 900,000 (USD

58.5) which is way below the regional minimum wage (USD 293). 62% of participants lived in a rented house which means they had to spend a large part of their income on rent (Figure 2). Students who live in loaned or rented houses are more prone to financial burdens compared to those living in private houses because parents with low-paid jobs will heavily spend money on food and housing. This could limit the ability to pay educational costs.

Family size is another significant factor related to students' socioeconomic status (Bogan, 2015). In developing countries, poor households commonly have more children than wealthier households because children are considered an economic asset (Patrinos & Psacharopoulos, 1997). 91 out of 98 respondents have at least one sibling, with the majority of participants having one to three siblings (Figure 3). 14 respondents stated they have more than four siblings. Families with a higher number of children will demand more resources (time, money, and energy). Bigger family size with little money will be more burdened with educational costs. For this reason, marginalized children become under-performed in their educational achievements (Wijanarko & Wisana, 2019). Because of the financial pressure, children from low-income families often leave school early so that they can go to work and support the family financially.

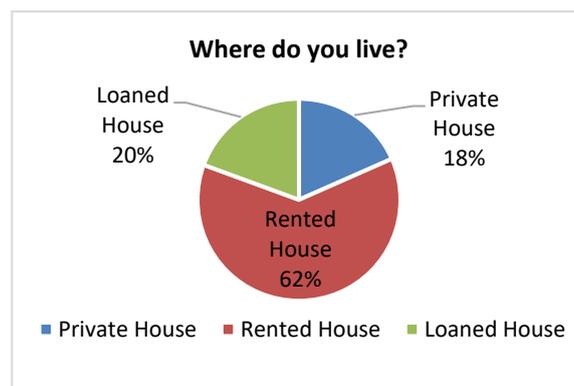


Figure 2. Housing status.

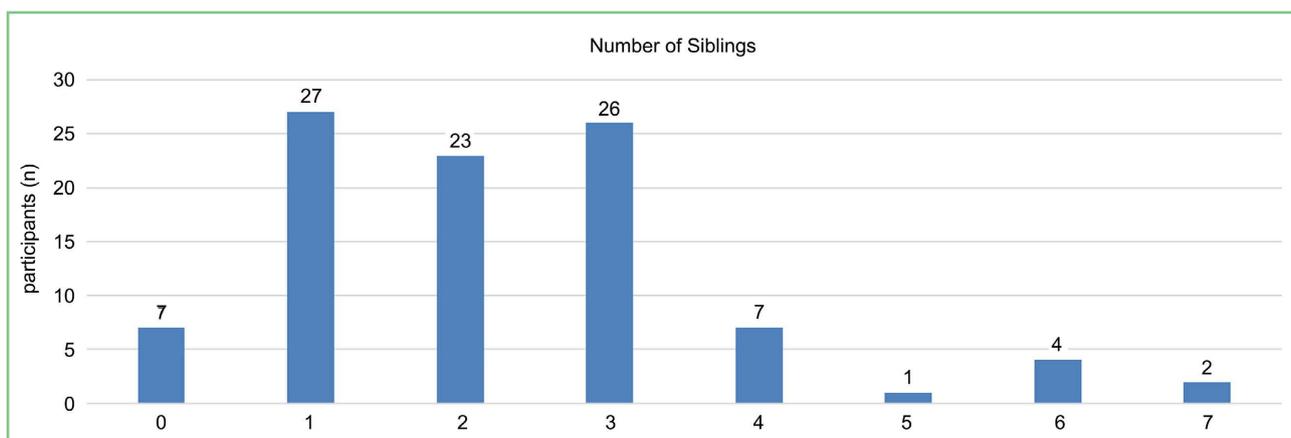


Figure 3. Number of siblings.

4.1. Schooling Conditions, Performance, and Learning Efforts in Games

96 out of 98 participants are still in school. Two participants dropped out after completing junior high school and started working at a local business. Most respondents are enrolling in private schools ($n = 78$), with only a few being in public schools ($n = 18$). In Indonesia, local private schools are often based on religious foundations and public schools do not adhere to this concept. It becomes the main reason parents send their children to school not only to study general subjects but also to be able to deepen their religious knowledge at school.

Private schools for marginalized students can be easily found in urban areas, while rural areas only have a few public schools but rarely private schools available. However, it is important to stress that private schools in Indonesia do not necessarily have better facilities or offer more support to marginalized students than public schools. In general, both schools receive financial support from the government through *Bantuan Operasional Sekolah* (BOS) funding (School Operational Assistance) in order to improve the quality of education. However, the implementation in both schools is still found to be problematic in terms of fund management. The accountability of BOS funding is still being questioned because the school does not announce transparency of the fund allocation and the usage is not in line with the needs of teachers (Seger, 2022; Zainudin, 2021). Therefore, receiving financial support doesn't reflect in the improvement of school welfare. Facilities and infrastructures in marginalized schools have not changed much due to this factor.

Despite the often-insufficient facilities and support structures in their schools, the majority of students are motivated to make a considerable effort to study at school (Figure 4). 83% of participants spend their time and energy studying at school. It shows that the structure of formal learning does not hinder their willingness to study. There could be a hint that their interest in studying will be escalated if they study through a more engaging method than formal learning. Like other youth, marginalized youth also have the desire to learn despite of economic limitations.

After playing the Water Champions game, participants were asked to reflect on the effort they had to put in to learn environmental issues using the Water Champions game. Waugh's conceptual model of motivation utilizes the concept of effort as a contributing factor (Waugh, 2002). Effort can consist of two elements: 1) the amount of tasks to complete and 2) the mental effort required (Fisher & Ford, 1998). The first is measured by the time spent on a task while the second is measured by the intellectual capacity that has to be invested into a task. Time and monetary effort were measured to determine capacity. Each participant played one session of the Water Champions game for around 60 - 90 minutes. Figure 5 shows that 59% of participants were content to invest a considerable amount of time to play the game, while some (34%) even wish to play longer (invest more time). Spending more time on a task can be interpreted as an enjoyable activity. It maintains their interest and keep them focused on the learning process.

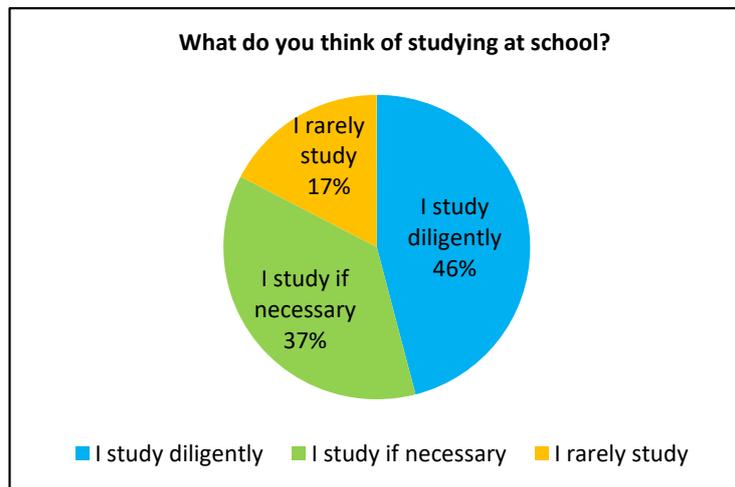


Figure 4. Perception of school performance.

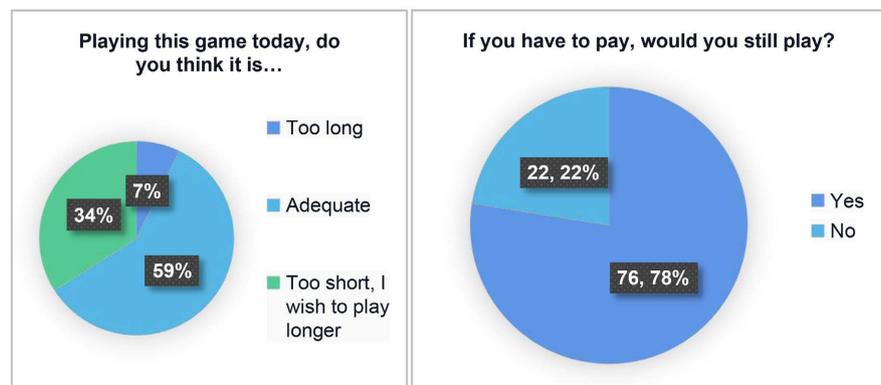


Figure 5. Efforts to play the game.

76.8% of participants are willing to pay a reasonable amount of money to play serious games, like the Water Champions game (Figure 5). The amount of money mentioned in the survey is equal to the cost of a snack (US 40 cents). This means that the value of learning is worth enough for money despite of their limited budgets. Clearly, the affordability makes serious games accessible to them. This illustrates that serious game is considered just as engaging and worth paying as entertainment game.

4.2. Environmental Knowledge

This section explores how participants perceive environmental knowledge gain in serious games. Environmental knowledge can be divided into personal practices and environmental awareness (Akter & Ali, 2014; Polys et al., 2017). Results show that marginalized youth perceive to have gained significant knowledge on personal sanitation practices, such as handwashing, clean drinking, and COVID-19 safety action through the game, and a fair amount of knowledge on environmental awareness, such as water facilities, river condition, and water demand (Figure 6). COVID-19 Safety Action is perceived to have been gained the most,

followed by handwashing practice. Knowledge of personal water practice was perceived higher than knowledge on local environmental issues (see hygiene practices and river cleaning/**Figure 6**). Conveying complex knowledge related to the relationships between the physical environment and people is often a challenge and limited in effect, when playing serious games. Serious games can be seen to be more effective in educating people on explicit knowledge, such as environment-related personal knowledge and specific instructions, rather than indirect or implicit knowledge, such local environment issues. In other words, serious games seem to be more suitable for direct knowledge acquisition with a specific focus.

4.3. Perceived Skills

In addition to acquiring environmental knowledge, participants were queried regarding their attainment of soft skills through their engagement with serious games. The survey provided six skills, categorized into two groups: generic and social skills (Hikmah & Siregar, 2017). Generic skills consist of problem-solving and creative thinking skills, while social skills consist of communication and collaboration skills. Results show that all participants perceived to have improved their soft skills from playing serious games (**Figure 7**). Both, collaboration and problem-solving skills are perceived to have been improved the most. Collaboration skills are fostered by the game, based on players requirement to

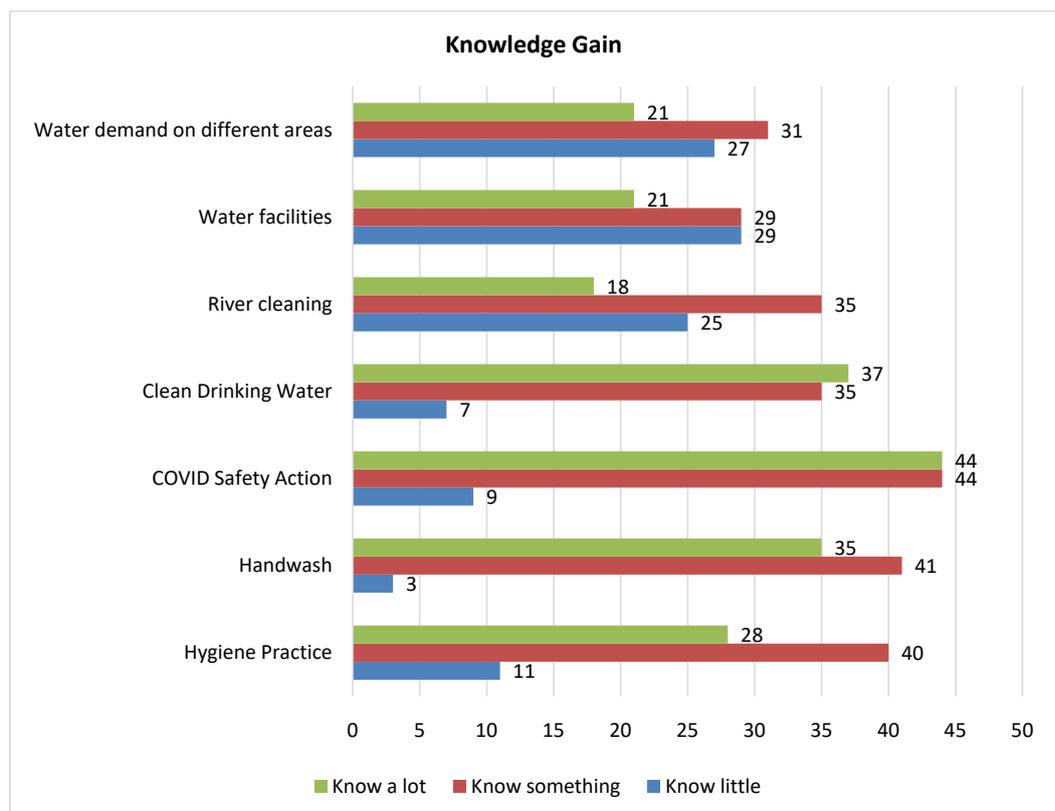


Figure 6. Knowledge gain.

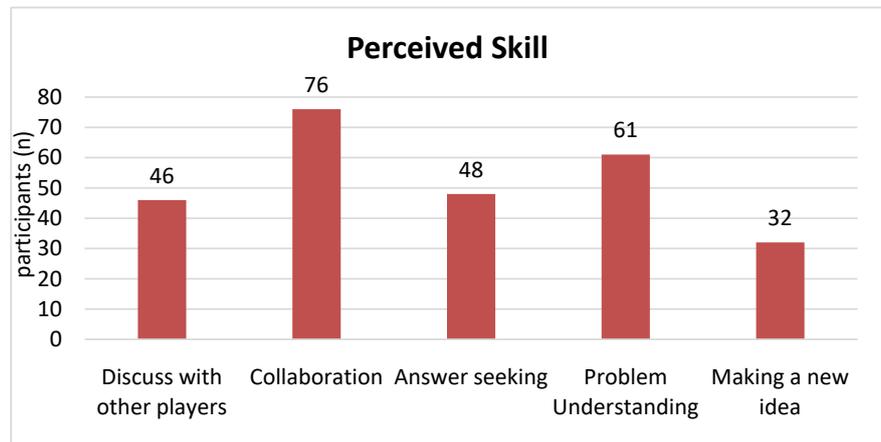


Figure 7. Perceived skills.

compromise, discuss and make group decisions each turn. Perceived skill acquisition, however, is a subjective assessment of an individual's ability. Therefore, this form of self-reflection might not reflect the "real" changes in skill development among participants.

Given that knowledge and skills were perceived to have been gained from playing serious games, this section investigates potential correlations between the two items (knowledge and skills). A Spearman's correlation test was conducted to ascertain the degree of correlation between specific skills and environmental knowledge. The variable of skills which were tested are Communication (DWOP), Collaboration (CLB), Problem solving (ANS), Problem Understanding (PROB), and Creativity (NWID). Results show no significant correlation between an increase in perceived knowledge and improved skills, within the context of environmental learning (all p -values are higher than 0.05; see **Table 2**). This suggests that there is no discernible relationship between knowledge and skills. For example, participants that perceive to have gained knowledge on water and sanitation do not perceive an increase in their ability to perform specific skills (e.g., collaboration, problem solving, and communication). This means that there might be a mismatch between their subjective belief and actual acquisition of knowledge and skills.

4.4. Learning Outcomes: Urban vs Rural Youth

This paper also compared potential differences in learning outcomes between urban and rural participants. Results show that perceived knowledge gain seem to be largely on the same level for rural as well as urban participants. Both groups perceive to have gained substantial levels of knowledge from playing serious games (**Table 3**), with handwashing being the skill with the highest value. The lowest value was found in knowledge gain related to water demand (rural youth) and water facilities (urban youth). This could imply that the experiences and outcomes obtained at a low level between rural and urban youth reflect a slightly different focus on their local environment. Rural youth often exhibit a

deeper and more intimate connection and understanding of their environment, compared to urban youth.

Table 2. Spearman's correlation result: Knowledge and skills.

Knowledge	Skills	Spearman's rho	<i>p</i>
Hygiene	DWOP	0.07	0.49
Hygiene	CLB	0.1	0.33
Hygiene	ANS	-0.135	0.19
Hygiene	PROB	0.129	0.2
Hygiene	NWID	0.032	0.76
Handwashing	DWOP	0.063	0.54
Handwashing	CLB	0.019	0.86
Handwashing	ANS	0.125	0.22
Handwashing	PROB	0.003	0.97
Handwashing	NWID	-0.048	0.64
Clean Drinking Water	DWOP	0.102	0.32
Clean Drinking Water	CLB	0.097	0.34
Clean Drinking Water	ANS	0.002	0.98
Clean Drinking Water	PROB	0.053	0.6
Clean Drinking Water	NWID	-0.116	0.26
River Cleaning	DWOP	0.037	0.72
River Cleaning	CLB	0.068	0.51
River Cleaning	ANS	-0.125	0.22
River Cleaning	PROB	0.058	0.57
River Cleaning	NWID	0.048	0.64
Water Facilities	DWOP	0.032	0.75
Water Facilities	CLB	-0.118	0.25
Water Facilities	ANS	-0.066	0.52
Water Facilities	PROB	0.09	0.38
Water Facilities	NWID	0.035	0.73
Water Demand	DWOP	0.049	0.63
Water Demand	CLB	0.058	0.57
Water Demand	ANS	-0.032	0.75
Water Demand	PROB	0.061	0.55
Water Demand	NWID	0.034	0.74
COVID Safety Action	DWOP	0.025	0.81
COVID Safety Action	CLB	-0.002	0.99
COVID Safety Action	ANS	-0.018	0.86
COVID Safety Action	PROB	0.138	0.18
COVID Safety Action	NWID	0.041	0.69

Table 3. Group descriptive: Knowledge gain.

Knowledge	Group	n	Mean	SD	SE
Hygiene	Rural	19	2.211	0.787	0.181
	Urban	79	2.215	0.673	0.076
Handwashing	Rural	19	2.632	0.684	0.157
	Urban	79	2.405	0.567	0.064
Clean Drinking Water	Rural	19	2.474	0.612	0.14
	Urban	79	2.38	0.647	0.073
River Cleaning	Rural	19	2.105	0.737	0.169
	Urban	78	1.91	0.742	0.084
Water Facilities	Rural	18	2.056	0.725	0.171
	Urban	79	1.899	0.794	0.089
Water Demand	Rural	19	1.789	0.713	0.164
	Urban	79	1.924	0.781	0.088
COVID Safety Action	Rural	18	2.333	0.686	0.162
	Urban	79	2.367	0.644	0.072

A subsequent independent t-test on perceived knowledge gain also shows no significant difference between rural and urban participants (Table 4). All p-values are higher than 0.05 and, thus, statistically insignificant. Results suggest that both urban and rural participants perceive to have gained knowledge at a similar level. Serious games as an educational tool, therefore, seem to be a reasonably effective tool for knowledge accumulation. Different contexts (rural/urban) have had no measurable influence.

Another t-test was conducted on five skills across both participant groups. Collaboration (CLB) returned the highest scores for perceived skill development for both urban and rural youth (Table 5). Creativity (NWID) earned the lowest value for both rural and urban youth. The perceived improvement of other skills was low and returned values on a similar level between both groups.

Both t-tests conducted in this study reveal no statistically significant difference in perceived knowledge gain or skill development between rural and urban youth (all p-values are higher than 0.05; see Table 6). The disparity between urban and rural area in terms of school facilities and access was expected to have some effect on learning achievements, where rural youth frequently show lower educational achievements compared to urban youth. However, serious games do not elicit such an effect. This could suggest that serious games may potentially contribute to improving learning performance, particularly among rural youth.

4.5. Motivation in Serious Games: Knowledge, Social, or Reward Driven?

This paper categorizes motivation into three driving factors: Knowledge-driven (“I want to know more about water and sanitation”), Reward driven (“I want to

Table 4. Independent T-Test: Knowledge of rural and urban youth.

Knowledge	t	df	p	Mean Difference	SE Difference
Hygiene	-0.026	96	0.979	-0.005	0.178
Handwashing	1.502	96	0.136	0.227	0.151
Clean Drinking Water	0.574	96	0.567	0.094	0.164
River Cleaning	1.029	95	0.306	0.195	0.19
Water Facilities	0.768	95	0.445	0.157	0.204
Water Demand	-0.685	96	0.495	-0.135	0.196
COVID Safety	-0.198	95	0.843	-0.034	0.17

Note. Student's t-test.

Table 5. Group descriptive: Perceived skills.

Knowledge	Group	n	Mean	SD	SE
DWOP	Rural	19	0.474	0.513	0.118
	Urban	79	0.468	0.502	0.057
CLB	Rural	19	0.684	0.478	0.11
	Urban	79	0.797	0.404	0.046
ANS	Rural	19	0.474	0.513	0.118
	Urban	79	0.494	0.503	0.057
PROB	Rural	19	0.526	0.513	0.118
	Urban	79	0.646	0.481	0.054
NWID	Rural	19	0.263	0.452	0.104
	Urban	79	0.342	0.477	0.054

Table 6. Independent T-Test: Skills between rural and urban youth.

Skills	t	df	p	Mean Difference	SE Difference
DWOP	0.041	96	0.967	0.005	0.129
CLB	-1.058	96	0.293	-0.113	0.107
ANS	-0.155	96	0.877	-0.02	0.129
PROB	-0.957	96	0.341	-0.119	0.125
NWID	-0.651	96	0.517	-0.079	0.121

Note. Student's t-test.

get a certificate from the organizer”), and Social driven (“I want to have fun with others”) (Waugh, 2002; Yee, 2006). Based on five-level Likert scales, participants were presented with statements and asked about their level of agreement regarding these three types of motivation. Result shows that participants are mostly driven by knowledge curiosity and social benefits (Figure 8). Knowledge curiosity earned a higher value than social interaction as the driver of youth partici-

pating in the game. Around 45% of the respondents remain neutral in their perception of rewards being a motivating factor, while only 17% of the respondents remain neutral in their perception of social interaction as an important motivator to play the game.

We illustrate three variables of motivation using descriptive Statistics to compare mean scores of the degree of agreement in joining serious games (Table 7). The mean scores for knowledge-driven and social-driven motivations are relatively equal on the agreement while reward driven motivation falls below the level of agreement. Findings suggest that the desire of participants for social interaction, such as interacting with their peers and collaborating with them in group activities, plays a significant role in motivating them to learn through playing serious games. Knowledge gain is a crucial motivator to play games as an educational tool. External rewards, such as prizes and rewards, are not crucial drivers of motivation. This indicates that participants do not seem to respond to material incentives in the context of educational activities, despite their somewhat disadvantaged socio-economic backgrounds.

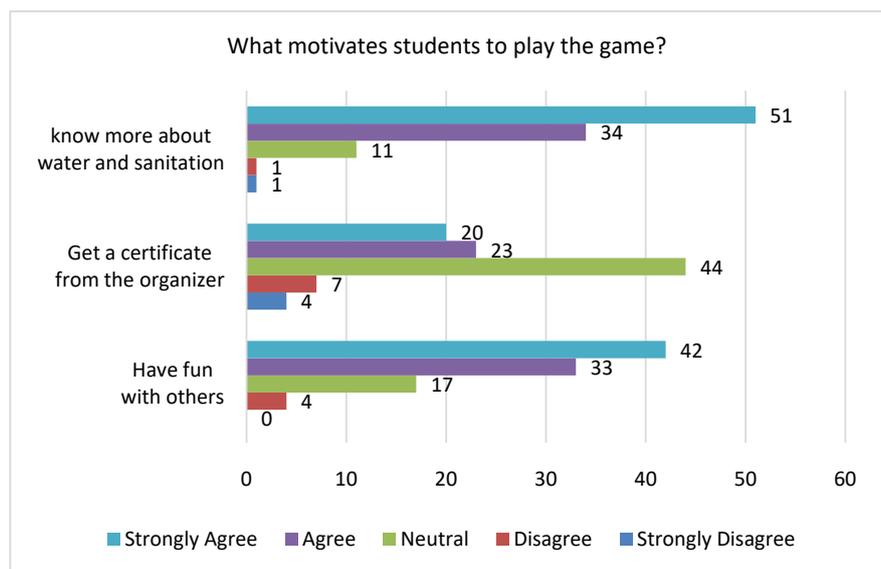


Figure 8. Motivation.

Table 7. Descriptive statistics of motivation.

Motivation	Knowledge driven	Social driven	Reward driven
Valid	98	96	98
Missing	0	2	0
Mean	4.041	4.177	3.490
Std. Deviation	0.731	0.871	1.028
Minimum	3.000	2.000	1.000
Maximum	5.000	5.000	5.000

4.6. Emotional Factors

Game-based learning can generate a variety of emotions. In the survey, participants were asked to select up to three emotions that represented their feelings when partaking in the game session. Loderer et al. (2019) argue that, based on valence, emotions can be categorized into two dimensions: positive (pleasant) and negative (unpleasant). Emotional valence describes the extent to which an emotion is perceived as positive or negative (Citron et al., 2014). Participants selected more pleasant than unpleasant emotions. Emotions with the highest values are “excited” (20%), “curious” (19%), and “happy” (18%). None of the participants associated their gaming experience with unpleasant emotions such as fear, sadness, and anxiety (Figure 9). However, a small number of participants indicated feeling “shy” or “nervous” during the play test. This might be due to their unfamiliarity with the game and play environments.

Emotion can strongly impact learners’ motivation (Loderer et al., 2019). A Spearman’s correlation test was conducted to identify if emotional factors are associated with motivation. All twelve emotions (Table 8) were examined in relation to the three categories of motivation (see above). Results revealed that three emotions were significantly correlated with two types of motivation (knowledge-driven and social-driven). No significant correlation was observed with regards to reward-driven motivation. “Happy” displayed a positive correlation to knowledge-driven and social-driven motivations, while “Indifferent” and “Confused” displayed negative correlations with these two motivational categories. Results indicate that “Indifferent” youth are not highly driven to acquire knowledge through serious games. Similar results were found among the “Confused” youth participants. However, “Indifferent” respondents also score low on socially driven motivation, but slightly higher compared to “Confused” respondents on the same motivation category. This suggests that participants with higher levels of happiness are more likely to also experience higher levels of internal and external motivation. Contrarily, participants experiencing feelings of indifference and confusion may be associated with lower levels of motivation to play the game.

The findings suggests that positive emotions contribute to a more engaging and rewarding experience in serious games. It is driven by the desire to gain knowledge and engage socially. Thus, emotional states can play a significant role in shaping the motivation of players in serious games. To explore whether the motivation to play serious games could have a relationship with overall school performance, the subsequent analysis examined correlations between motivation levels and school performance. Results derived from a Spearman’s correlation test reveal that knowledge-driven motivation among participants shows a statistically significant positive correlation with school performance (p -value of 0.004). In contrast, social-driven and reward-driven motivations did not demonstrate significant correlations with school performance, as indicated by a p -value of 0.779 and 0.288 respectively (Table 9).

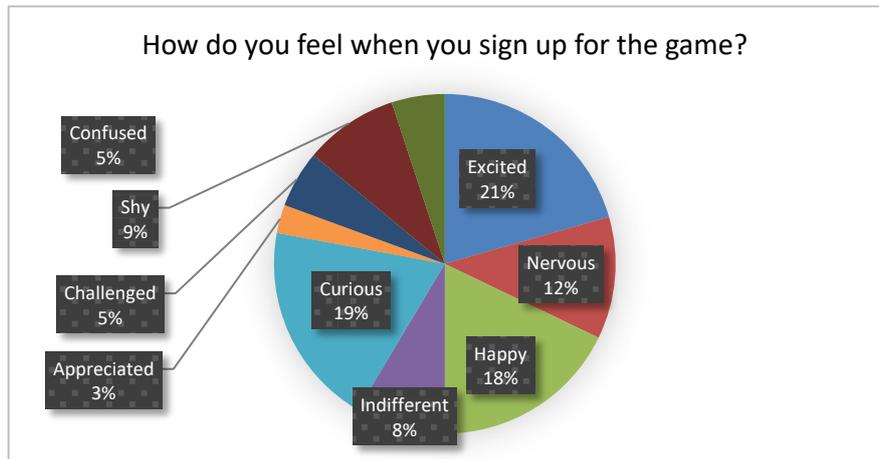


Figure 9. Emotions. (“Afraid”, “Anxious”, “Sad” had values of zero percent).

Table 8. Spearman’s Correlation Test: Emotions and Motivation.

Emotions	Motivation	Spearman’s rho	<i>p</i>
Happy	Social driven	0.306**	0.002
Happy	Reward driven	0.094	0.359
Happy	Knowledge driven	0.321**	0.001
Indifferent	Social driven	-0.323**	0.001
Indifferent	Reward driven	-0.169	0.096
Indifferent	Knowledge driven	-0.356***	<0.001
Confused	Social driven	-0.261*	0.01
Confused	Reward driven	-0.196	0.053
Confused	Knowledge driven	-0.373***	<0.001

p* < 0.05, *p* < 0.01, ****p* < 0.001.

Table 9. Spearman’s correlation test: School performance and motivation.

		Spearman’s rho	<i>p</i>
STUDY -	I play the game because I am interested in the issues of water	0.287**	0.004
STUDY -	I play the game because I want to have fun with others	0.029	0.779
STUDY -	I play the game because I want to know more about water and sanitation	0.264**	0.009
STUDY -	I play the game because I want to get a certificate from the organizer	0.108	0.288

p* < 0.05, *p* < 0.01, ****p* < 0.001.

These findings indicate that high level of school performance is positively associated with knowledge driven motivation to play serious games. This was expected as knowledge driven learners are likely to perform well in the formal education system. However, socially driven motivation did not show a positive

correlation with school performance. However, these participants were nevertheless shown to exhibit a perceived increase in knowledge gain and skill development. This could indicate that participants who are not performing well in school could obtain knowledge and skills in different ways, for example by playing serious games. In other words, serious games could offer advantages in learning outcomes for marginalized students that may not be achieved in formal education. However, this is, at this point, only speculation and needs further investigation by subsequent studies.

5. Conclusion

The application of serious games in education represents an intriguing opportunity to address the multifaceted impact of motivation on learning outcomes. This study yielded several crucial insights. First, perceived knowledge gains are highly correlated with playing serious games, accompanied by perceived skill development with a strong emphasis on collaborative learning, facilitating the acquisition of generic skills and social competencies among marginalized youth. Second, the benefit of serious games for educational purposes seems to affect youth in both urban and rural areas in similar ways. While learning disparities in traditional classroom settings have been noticed, serious games do not replicate such effects. Third, serious games were shown to potentially provide significant benefits to marginalized youth in addressing their often-noted underperformance in a formal educational setting.

This study provided similar findings to previous studies (Kim & Dopico, 2016; Rooney, 2012) and illustrated that higher levels of motivation and engagement can be achieved by informal learning. Serious games in particular seem to have a positive educational impact on marginalized youth. Other studies (Chappin et al., 2017; Eisenack, 2013; Whalen et al., 2018) came to similar conclusions, showing that marginalized youth could benefit from serious games in terms of knowledge gain. However, this paper explored the new aspect of how emotional factors are related to youth's motivation and engagement in playing serious games. This study illustrates a variety of emotions that affect motivation to learn from serious games, both positively and negatively. Thus, this paper offers new insights into the role of informal education, such as serious games, for marginalized youth in overcoming some barriers in formal education.

However, it is essential to acknowledge that, while serious games have been shown to enhance perceived knowledge acquisition, this does not apply to all knowledge domains, such as local environmental awareness. Complex environmental systems might impose challenges in terms of deepening student understanding that cannot be addressed by serious games. Furthermore, this study is limited by its assessment of participants' subjective assessment (perception) of their knowledge gain and skill development. This might not result in actual improvements and requires further investigation. Conducting objective assessments of actual learning outcomes based on serious games should be considered in the future.

Acknowledgements

This research was supported by the Australia Grant Scheme Round 1/2021. We would like to express our gratitude to Prof. Ernan Rustiadi and Mr. Andi Yoga Saputra for their support during fieldwork in Cibulao village. We extend our sincere appreciation to Mr. Stathi Paxinos, Dr. Jane Holden, Ms. Devita Marwana, Ms. Nur Adlina, Ms. Namira Andiani and Ms. Halimah Azzahra for their assistance in the implementation of Water Champions project. Lastly, our appreciation goes to all facilitators of Water Champions board game who support us during playtesting and data collection.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- Akter, T., & Ali, A. M. (2014). Factors Influencing Knowledge and Practice of Hygiene in Water, Sanitation and Hygiene (WASH) Programme Areas of Bangladesh Rural Advancement Committee. *Rural and Remote Health, 14*, 2628. <https://doi.org/10.22605/RRH2628>
- Anthonj, C., Githinji, S., Höser, C., Stein, A., Blanford, J., & Grossi, V. (2021). Kenyan School Book Knowledge for Water, Sanitation, Hygiene and Health Education Interventions: Disconnect, Integration or Opportunities? *International Journal of Hygiene and Environmental Health, 235*, Article 113756. <https://doi.org/10.1016/j.ijheh.2021.113756>
- Arnett-Hartwick, S. E., & Davis, T. S. (2019). Poverty Simulation Participation: Transformative Learning Outcomes among Family and Consumer Sciences Students. *Journal of Research in Technical Careers, 3*, 24-35. <https://doi.org/10.9741/2578-2118.1057>
- Azzizah, Y. (2015). Socio-Economic Factors on Indonesia Education Disparity. *International Education Studies, 8*, 218-230. <https://doi.org/10.5539/ies.v8n12p218>
- Balboni, C. A., Bandiera, O., Burgess, R., Ghatak, M., & Heil, A. (2021). *Why Do People Stay Poor?* National Bureau of Economic Research, No. 29340. <http://www.nber.org/papers/w29340> <https://doi.org/10.3386/w29340>
- Beattie, H., Brown, D., & Kindon, S. (2020). Solidarity through Difference: Speculative Participatory Serious Urban Gaming (SPS-UG). *International Journal of Architectural Computing, 18*, 141-154. <https://doi.org/10.1177/1478077120924337>
- Bogan, V. L. (2015). Household Asset Allocation, Offspring Education, and the Sandwich Generation. *American Economic Review, 105*, 611-615. <https://doi.org/10.1257/aer.p20151115>
- Booth, P. (2021). *Board Game as Media*. Bloomsbury Academic. <https://doi.org/10.5040/9781501357206>
- Bosma, R. H., Ha, T. T. P., Hiep, T. Q., Phuong, N. T. H., Ligtenberg, A., Rodela, R., & Bregt, A. K. (2020). Changing Opinion, Knowledge, Skill and Behaviour of Vietnamese Shrimp Farmers by Using Serious Board Games. *Journal of Agricultural Education and Extension, 26*, 203-221. <https://doi.org/10.1080/1389224X.2019.1671205>
- Bossavit, B., & Parsons, S. (2018). Outcomes for Design and Learning When Teenagers with Autism Codesign a Serious Game: A Pilot Study. *Journal of Computer Assisted*

- Learning*, 34, 293-305. <https://doi.org/10.1111/jcal.12242>
- Chappin, E. J. L., Bijvoet, X., & Oei, A. (2017). Teaching Sustainability to a Broad Audience through an Entertainment Game—The Effect of Catan: Oil Springs. *Journal of Cleaner Production*, 156, 556-568. <https://doi.org/10.1016/j.jclepro.2017.04.069>
- Chen, H. J. H., & Hsu, H. L. (2020). The Impact of a Serious Game on Vocabulary and Content Learning. *Computer Assisted Language Learning*, 33, 811-832. <https://doi.org/10.1080/09588221.2019.1593197>
- Cheng, P. H., Yeh, T. K., Tsai, J. C., Lin, C. R., & Chang, C. Y. (2019). Development of an Issue-Situation-Based Board Game: A Systemic Learning Environment for Water Resource Adaptation Education. *Sustainability (Switzerland)*, 11, Article 1341. <https://doi.org/10.3390/su11051341>
- Cilliers, E. J. (2017). The Challenge of Teaching Generation Z. *PEOPLE: International Journal of Social Sciences*, 3, 188-198. <https://doi.org/10.20319/pijss.2017.31.188198>
- Citron, F. M. M., Gray, M. A., Critchley, H. D., Weekes, B. S., & Ferstl, E. C. (2014). Emotional Valence and Arousal Affect Reading in an Interactive Way: Neuroimaging Evidence for an Approach-Withdrawal Framework. *Neuropsychologia*, 56, 79-89. <https://doi.org/10.1016/j.neuropsychologia.2014.01.002>
- Conradt, E., Carter, S. E., & Crowell, S. E. (2020). Biological Embedding of Chronic Stress across Two Generations within Marginalized Communities. *Child Development Perspectives*, 14, 208-214. <https://doi.org/10.1111/cdep.12382>
- Dankbaar, M. E. W., Roozeboom, M. B., Oprins, E. A. P. B., Rutten, F., Van Merriënboer, J. J. G., Van Saase, J. L. C. M., & Schuit, S. C. E. (2017). Preparing Residents Effectively in Emergency Skills Training with a Serious Game. *Simulation in Healthcare*, 12, 9-16. <https://doi.org/10.1097/SIH.0000000000000194>
- Degner, M., Moser, S., & Lewalter, D. (2022). Digital Media in Institutional Informal Learning Places: A Systematic Literature Review. *Computers and Education Open*, 3, Article 100068. <https://doi.org/10.1016/j.caeo.2021.100068>
- Dejaeghere, J., & Lee, S. K. (2011). What Matters for Marginalized Girls and Boys in Bangladesh: A Capabilities Approach for Understanding Educational Well-Being and Empowerment. *Research in Comparative and International Education*, 6, 27-42. <https://doi.org/10.2304/rcie.2011.6.1.27>
- Denami, M. (2018). Serious Game-Based Learning: The Place of Users' Verbalization in the Acquisition of Specific Skills. *International Journal of Training and Development*, 22, 144-161. <https://doi.org/10.1111/ijtd.12123>
- Eisenack, K. (2013). A Climate Change Board Game for Interdisciplinary Communication and Education. *Simulation and Gaming*, 44, 328-348. <https://doi.org/10.1177/1046878112452639>
- Eshach, H. (2007). Bridging In-School and Out-of-School Learning: Formal, Non-Formal, and Informal Education. *Journal of Science Education and Technology*, 16, 171-190. <https://doi.org/10.1007/s10956-006-9027-1>
- Ezeh, A., Oyebo, O., Satterthwaite, D., Chen, Y. F., Ndugwa, R., Sartori, J., Mberu, B., Melendez-Torres, G. J., Haregu, T., Watson, S. I., Caiaffa, W., Capon, A., & Lilford, R. J. (2017). The History, Geography, and Sociology of Slums and the Health Problems of People Who Live in Slums. *The Lancet*, 389, 547-558. [https://doi.org/10.1016/S0140-6736\(16\)31650-6](https://doi.org/10.1016/S0140-6736(16)31650-6)
- Filardo, B. M., Vincent, J. M., & Sullivan, K. (2019). How Crumbling School Facilities Perpetuate Inequality. *Phi Delta Kappan*, 100, 27-31. <https://doi.org/10.1177/0031721719846885>
- Fisher, S. L., & Ford, J. K. (1998). Differential Effects of Learner Effort and Goal Orienta-

- tion on Two Learning Outcomes. *Personnel Psychology*, *51*, 397-420. <https://doi.org/10.1111/j.1744-6570.1998.tb00731.x>
- Fjællingsdal, K. S., & Klöckner, C. A. (2020). Green across the Board: Board Games as Tools for Dialogue and Simplified Environmental Communication. *Simulation and Gaming*, *51*, 632-652. <https://doi.org/10.1177/1046878120925133>
- Fute, A., Sun, B., & Oubibi, M. (2022). Assessing Teaching Compassion, Work Engagement and Compassion Fatigue among Teachers During the Pandemic. *Psychology Research and Behavior Management*, *15*, 2561-2571. <https://doi.org/10.2147/PRBM.S383292>
- García, E., & Weiss, E. (2017). *Reducing and Averting Achievement Gaps: Key Findings from the Report "Education Inequalities at the School Starting Gate" and Comprehensive Strategies to Mitigate Early Skills Gaps*. Economic Policy Institute.
- García-Barrios, L., Rivera-Núñez, T., Cruz-Morales, J., Urdapilleta-Carrasco, J., Castro-Salcido, E., Peña-Azcona, I., Martínez-López, O., López-Cruz, A., Morales, M., & Espinoza, J. (2020). The Flow of Peasant Lives: A Board Game to Simulate Livelihood Strategies and Trajectories Resulting from Complex Rural Household Decisions. *Ecology and Society*, *25*, 48. <https://doi.org/10.5751/ES-11723-250448>
- Glaesser, J. (2022). Relative Educational Poverty: Conceptual and Empirical Issues. *Quality & Quantity*, *56*, 2803-2820. <https://doi.org/10.1007/s11135-021-01226-3>
- Heflin, C. M., & Pattillo, M. (2006). Poverty in the Family: Race, Siblings, and Socioeconomic Heterogeneity. *Social Science Research*, *35*, 804-822. <https://doi.org/10.1016/j.ssresearch.2004.09.002>
- Hikmah, N., & Siregar, S. H. (2017). Development of Soft Skills Education in Non-Formal Education to Indonesian Society. In *Proceedings of the 3rd NFE Conference on Lifelong Learning (NFE 2016)* (pp. 142-145). Atlantis Press. <https://doi.org/10.2991/nfe-16.2017.35>
- Hopland, A. O. (2013). School Facilities and Student Achievement in Industrial Countries: Evidence from the TIMSS. *International Education Studies*, *6*, 162-171. <https://doi.org/10.5539/ies.v6n3p162>
- Hussain, U., Yu, B., Cunningham, G. B., & Bennett, G. (2021). "I Can Be Who I Am When I Play Tekken 7": E-Sports Women Participants from the Islamic Republic of Pakistan. *Games and Culture*, *16*, 978-1000. <https://doi.org/10.1177/15554120211005360>
- Jagušt, T., Botički, I., & So, H. J. (2018). Examining Competitive, Collaborative and Adaptive Gamification in Young Learners' Math Learning. *Computers and Education*, *125*, 444-457. <https://doi.org/10.1016/j.compedu.2018.06.022>
- JASP Team (2023). *JASP (Version 0.17.3)*. Computer Software. <https://jasp-stats.org/faq/>
- Khanday, A. Z., & Akram, M. (2012). Health Status of Marginalized Groups in India. *International Journal of Applied Sociology*, *2*, 60-70. <https://doi.org/10.5923/j.ijas.20120206.02>
- Khiem, P. H., Linh, D. H., Tai, D. A., & Dung, N. D. (2020). Does Tuition Fee Policy Reform Encourage Poor Children's School Enrolment? Evidence from Vietnam. *Economic Analysis and Policy*, *66*, 109-124. <https://doi.org/10.1016/j.eap.2020.03.001>
- Kim, M., & Dopico, E. (2016). Science Education through Informal Education. *Cultural Studies of Science Education*, *11*, 439-445. <https://doi.org/10.1007/s11422-014-9639-3>
- Kim, P., Buckner, E., Kim, H., Makany, T., Taleja, N., & Parikh, V. (2012). A Comparative Analysis of a Game-Based Mobile Learning Model in Low-Socioeconomic Communities of India. *International Journal of Educational Development*, *32*, 329-340.

- <https://doi.org/10.1016/j.ijedudev.2011.05.008>
- Kim, T. K. (2015). T Test as a Parametric Statistic. *Korean Journal of Anesthesiology*, 68, 540-546. <https://doi.org/10.4097/kjae.2015.68.6.540>
- Lanezki, M., Siemer, C., & Wehkamp, S. (2020). "Changing the Game—Neighbourhood": An Energy Transition Board Game, Developed in a Co-Design Process: A Case Study. *Sustainability*, 12, Article 10509. <https://doi.org/10.3390/su122410509>
- Layland, E. K., Stone, G. A., Mueller, J. T., & Hodge, C. J. (2018). Injustice in Mobile Leisure: A Conceptual Exploration of Pokémon Go. *Leisure Sciences*, 40, 288-306. <https://doi.org/10.1080/01490400.2018.1426064>
- Liem, G. A. D., & Martin, A. J. (2012). The Motivation and Engagement Scale: Theoretical Framework, Psychometric Properties, and Applied Yields. *Australian Psychologist*, 47, 3-13. <https://doi.org/10.1111/j.1742-9544.2011.00049.x>
- Liu, L. (2016). Why Do Chinese College Students Learn ESP: An Analysis of Language Learning Motivations within SDT Framework. *English Language Teaching*, 9, 92-105. <https://doi.org/10.5539/elt.v9n4p92>
- Loderer, K., Pekrun, R., & Plass, J. L. (2019). Emotional Foundation of Game-Based Learning. In J. L. Plass, R. E. Mayer, & B. D. Homer (Eds.), *Handbook of Game-Based Learning* (pp. 111-152). The MIT Press.
- Madani, K., Pierce, T. W., & Mirchi, A. (2017). Serious Games on Environmental Management. *Sustainable Cities and Society*, 29, 1-11. <https://doi.org/10.1016/j.scs.2016.11.007>
- Mangowal, R. G., Yuhana, U. L., Yuniarno, E. M., & Purnomo, M. H. (2017). MathBharata: A Serious Game for Motivating Disabled Students to Study Mathematics. In *SeGAH'17: 2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH)* (pp. 1-6). IEEE. <https://doi.org/10.1109/SeGAH.2017.7939277>
- McMaster, N. C., & Cook, R. (2019). The Contribution of Intersectionality to Quantitative Research into Educational Inequalities. *Review of Education*, 7, 271-292. <https://doi.org/10.1002/rev3.3116>
- Moloi, T. J. (2014). The Use of Morabara Game to Concretise the Teaching of the Mathematical Content. *Mediterranean Journal of Social Sciences*, 5, 585-591. <https://doi.org/10.5901/mjss.2014.v5n27p585>
- Neuwelt, P. M., & Kearns, R. A. (2021). Playing the Game: Interactively Exploring Journeys into Primary Care. *Wellbeing, Space and Society*, 2, Article 100045. <https://doi.org/10.1016/j.wss.2021.100045>
- Nieh, H.-P., & Wu, W.-C. (2018). Effects of a Collaborative Board Game on Bullying Intervention: A Group-Randomized Controlled Trial. *Journal of School Health*, 88, 725-733. <https://doi.org/10.1111/josh.12675>
- OECD/Asian Development Bank (2015). *Education in Indonesia: Rising to the Challenge*. OECD Publishing.
- Ouariachi, T., Olvera-Lobo, M. D., & Gutiérrez-Pérez, J. (2017). Gaming Climate Change: Assessing Online Climate Change Games Targeting Youth Produced in Spanish. *Procedia-Social and Behavioral Sciences*, 237, 1053-1060. <https://doi.org/10.1016/j.sbspro.2017.02.154>
- Ouariachi, T., Olvera-Lobo, M. D., Gutiérrez-Pérez, J., & Maibach, E. (2019). A Framework for Climate Change Engagement through Video Games. *Environmental Education Research*, 25, 701-716. <https://doi.org/10.1080/13504622.2018.1545156>
- Patrinos, H. A., & Psacharopoulos, G. (1997). Family Size, Schooling and Child Labor in Peru. *Journal of Population Economics*, 10, 387-405.

- <https://link.springer.com/content/pdf/10.1007%2Fs001480050050.pdf>
<https://doi.org/10.1007/s001480050050>
- Patterson, T., & Barrat, S. (2019). *Playing for the Planet—How Video Games Can Deliver for People and the Environment*. UN Environment/GRID-Arendal.
- Pereira, S., Fillol, J., & Moura, P. (2019). Young People Learning from Digital Media Outside of School: The Informal Meets the Formal. *Comunicar. Media Education Research Journal*, 27, 41-50. <https://doi.org/10.3916/C58-2019-04>
- Pfirman, S., O’Garra, T., Bachrach Simon, E., Brunacini, J., Reckien, D., Lee, J. J., & Lukaszewicz, E. (2021). “Stickier” Learning through Gameplay: An Effective Approach to Climate Change Education. *Journal of Geoscience Education*, 69, 192-206. <https://doi.org/10.1080/10899995.2020.1858266>
- Plass, J. L., Homer, B. D., Mayer, R. E., & Kinzer, C. K. (2019). Theoretical Foundations of Game-Based and Playful Learning. In B. Plass, L. Jan, R. Mayer, & Homer (Eds.), *Handbook of Game-Based Learning* (pp. 3-24). The MIT Press.
- Polys, N., Hotter, J., Lanier, M., Purcell, L., Wolf, J., Hession, W. C., Sforza, P., & Ivory, J. D. (2017). Finding Frogs: Using Game-Based Learning to Increase Environmental Awareness. In *Proceedings of the 22nd International Conference on 3D Web Technology* (pp. 1-8). Association for Computing Machinery. <https://doi.org/10.1145/3055624.3075955>
- Prabawa-Sear, K. (2018). Winning Beats Learning: Environmental Education in Indonesian Senior High Schools. *Indonesia and the Malay World*, 46, 283-302. <https://doi.org/10.1080/13639811.2018.1496631>
- Pruet, P., Ang, C. S., & Farzin, D. (2016). Understanding Tablet Computer Usage among Primary School Students in Underdeveloped Areas: Students’ Technology Experience, Learning Styles and Attitudes. *Computers in Human Behavior*, 55, 1131-1144. <https://doi.org/10.1016/j.chb.2014.09.063>
- Ramburuth, P., & Härtel, C. E. J. (2010). Understanding and Meeting the Needs of Students from Low Socioeconomic Status Backgrounds. *Multicultural Education and Technology Journal*, 4, 153-162. <https://doi.org/10.1108/17504971011075156>
- Rebekić, A., Lončarić, Z., Petrović, S., & Marić, S. (2015). Pearson’s or Spearman’s Correlation Coefficient—Which One to Use? *Poljoprivreda/Agriculture*, 21, 47-54. <https://doi.org/10.18047/poljo.21.2.8>
- Rooney, P. (2012). A Theoretical Framework for Serious Game Design: Exploring Pedagogy, Play and Fidelity and Their Implications for the Design Process. *International Journal of Game-Based Learning*, 2, 41-60. <https://doi.org/10.4018/ijgbl.2012100103>
- Rossano, V., Roselli, T., & Calvano, G. (2017). A Serious Game to Promote Environmental Attitude. *Smart Innovation, Systems and Technologies*, 75, 48-55. https://doi.org/10.1007/978-3-319-59451-4_5
- Ruberg, B., & Scully-Blaker, R. (2021). Making Players Care: The Ambivalent Cultural Politics of Care and Video Games. *International Journal of Cultural Studies*, 24, 655-672. <https://doi.org/10.1177/1367877920950323>
- Sah, R. K., Sah, P. K., Sah, J. K., Chiluwal, S., & Shah, S. K. (2017). Assessment of the Knowledge, Attitude and Practice Regarding Water, Sanitation and Hygiene among Mothers of Under-Five Children in Rural Households of Saptari District, Nepal. *American Journal of Public Health Research*, 5, 163-169.
- Salmi, H., Kaasinen, A., & Suomela, L. (2016). Teacher Professional Development in Outdoor and Open Learning Environments: A Research Based Model. *Creative Education*, 7, 1392-1403. <https://doi.org/10.4236/ce.2016.710144>
- Saltan, F., & Arslan, Ö. (2017). The Use of Augmented Reality in Formal Education: A

- Scoping Review. *Eurasia Journal of Mathematics, Science and Technology Education*, 13, 503-520. <https://doi.org/10.12973/eurasia.2017.00628a>
- Sardone, N. B., & Devlin-Scherer, R. (2016). Let the (Board) Games Begin: Creative Ways to Enhance Teaching and Learning. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 89, 215-222. <https://doi.org/10.1080/00098655.2016.1214473>
- Schneider, M. (2002). *Do School Facilities Affect Academic Outcomes?* National Clearinghouse for Educational Facilities.
- Schugurensky, D. (2015). On Informal Learning, Informal Teaching, and Informal Education: Addressing Conceptual, Methodological, Institutional, and Pedagogical Issues. In O. Mejiuni, P. Cranton, & O. Táiwò (Eds.), *Measuring and Analyzing Informal Learning in the Digital Age* (pp. 18-36). IGI Global. <https://doi.org/10.4018/978-1-4666-8265-8.ch002>
- Seger, M. S. D. (2022). Bureaucratic Accountability in the Management of the Operational Fund School (BOS) (Case Study on Elementary Education Kupang). *MAMEN: Jurnal Manajemen*, 1, 504-513. <https://doi.org/10.55123/mamen.v1i4.1039>
- Sevelius, J. M., Gutierrez-Mock, L., Zamudio-Haas, S., McCree, B., Ngo, A., Jackson, A., Clynes, C., Venegas, L., Salinas, A., Herrera, C., Stein, E., Operario, D., & Gamarel, K. (2020). Research with Marginalized Communities: Challenges to Continuity during the COVID-19 Pandemic. *AIDS and Behavior*, 24, 2009-2012. <https://doi.org/10.1007/s10461-020-02920-3>
- Sijbesma, C., Sikoki, B., Suriastini, W., & Ponsonby, M. (2011). Methodological Lessons and Findings from an Impact Evaluation of a WASH Project in Indonesia. In *The Future of Water, Sanitation and Hygiene in Low-Income Countries: Innovation, Adaptation and Engagement in a Changing World—Proceedings of the 35th WEDC International Conference* (pp. 1-8).
- Singh, A. P., & Dangmei, J. (2016). Understanding the Generation Z: The Future Workforce. *South-Asian Journal of Multidisciplinary Studies*, 3, 1-5.
- Spooren, P., Mortelmans, D., & Denekens, J. (2007). Student Evaluation of Teaching Quality in Higher Education: Development of an Instrument Based on 10 Likert-Scales. *Assessment and Evaluation in Higher Education*, 32, 667-679. <https://doi.org/10.1080/02602930601117191>
- Stevenson, K., Peterson, M. N., Bondell, H. D., Mertig, A. G., & Moore, S. E. (2013). Environmental, Institutional, and Demographic Predictors of Environmental Literacy among Middle School Children. *PLOS ONE*, 8, e59519. <https://doi.org/10.1371/journal.pone.0059519>
- Stevenson, R. B., Nicholls, J., & Whitehouse, H. (2017). What Is Climate Change Education? *Curriculum Perspectives*, 37, 67-71. <https://doi.org/10.1007/s41297-017-0015-9>
- Tan, E. (2013). Informal Learning on YouTube: Exploring Digital Literacy in Independent Online Learning. *Learning, Media and Technology*, 38, 463-477. <https://doi.org/10.1080/17439884.2013.783594>
- Trott, C. D. (2020). Children's Constructive Climate Change Engagement: Empowering Awareness, Agency, and Action. *Environmental Education Research*, 26, 532-554. <https://doi.org/10.1080/13504622.2019.1675594>
- Urdan, T., Bruchmann, K., Urdan, T., & Bruchmann, K. (2018). Examining the Academic Motivation of a Diverse Student Population: A Consideration of Methodology. *Educational Psychologist*, 53, 114-130. <https://doi.org/10.1080/00461520.2018.1440234>
- van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2017). The Relation between 21st-Century Skills and Digital Skills: A Systematic Literature Review. *Computers in Human Behavior*, 72, 577-588. <https://doi.org/10.1016/j.chb.2017.03.010>

- Villar, M. E., & Johnson, P. W. (2021). Tailoring Content for Authenticity and Adoption: Community-Based Participatory Research and the Co-Creation of Story-Based Health Communication for Underserved Communities. *Frontiers in Communication*, 6, Article 663389. <https://doi.org/10.3389/fcomm.2021.663389>
- Wang, Q. (2019). *Game-Based Language Learning in ESL Classrooms: Effective Interventions and Influences on Students' Vocabulary Acquisition, Communicative Competence and Writing*. PhD Thesis, Kyoto University.
- Waugh, R. F. (2002). Creating a Scale to Measure Motivation to Achieve Academically. *The British Journal of Educational Psychology*, 72, 65-86. <https://doi.org/10.1348/000709902158775>
- Whalen, K. A., Berlin, C., Ekberg, J., Barletta, I., & Hammersberg, P. (2018). 'All They Do Is Win': Lessons Learned from Use of a Serious Game for Circular Economy Education. *Resources, Conservation and Recycling*, 135, 335-345. <https://doi.org/10.1016/j.resconrec.2017.06.021>
- Wijanarko, D. W., & Wisana, I. D. G. K. (2019). Does the Number of Siblings Affect Adult Income? An Indonesian Case Study. *International Journal of Business and Society*, 20, 29-41.
- Wilkinson, P. (2016). A Brief History of Serious Games. In R. Dörner, S. Göbel, M. Kickmeier-Rust, M. Masuch, & K. Zweig (Eds.), *Entertainment Computing and Serious Games. Lecture Notes in Computer Science* (Vol. 9970, pp. 17-41). Springer. https://doi.org/10.1007/978-3-319-46152-6_2
- Wong, R. (2022). What Do They Actually Need? An Investigation of English Learning Motivation of the Underprivileged Students. *English Language Teaching*, 15, 1-13. <https://doi.org/10.5539/elt.v15n11p1>
- Xiong, M., & Dossetti, A. J. (2022). Fostering Culturally Affirming College and Career Readiness. In S. Brant-Rajahn, E. Gibson, & M. Cook Sandifer (Eds.), *Developing, Delivering, and Sustaining School Counseling Practices through a Culturally Affirming Lens* (pp. 147-172). IGI Global. <https://doi.org/10.4018/978-1-7998-9514-5.ch008>
- Yee, N. (2006). Motivations for Play in Online Games. *Cyberpsychology and Behavior*, 9, 772-775. <https://doi.org/10.1089/cpb.2006.9.772>
- Zainudin, M. (2021). Misrepresentation of Funds May Occur Due to Lack of School Transparency towards the Public. *Jurnal Jendela Hukum*, 6, 32-38. <https://doi.org/10.24929/fh.v6i2.1558>