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Leveling up Learning: Enhancing Self-Directed Learning in Computer Applications Technology with Classcraft

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Abstract: This study explores how gamification can be incorporated when facilitating theoretical content in Computer Applications Technology (CAT) to promote self-directed learning of Generation Z learners. The CAT curriculum consists of practical and theoretical content, and Generation Z learners tend to perceive theoretical content as less engaging and less stimulating. The dynamic nature of CAT, however, requires CAT learners to be self-directed learners who take ownership of their learning and are motivated and engaged in learning both the practical and theoretical components. A basic interpretive study, within an interpretivist paradigm, was applied as the research design. Purposive sampling was utilized, and 106 CAT learners at a South African high school participated in the research. A traditional teacher-centered approach was first followed to facilitate theoretical content. Thereafter, gamification with Classcraft was applied as an intervention. Data collection was performed by implementing post-open-ended questionnaires and focus group interviews. Results indicate that Generation Z learners crave instant gratification and lack skills such as self-motivation and critical thinking. A teacher-centered approach was found unsuitable for facilitating theoretical content to Generation Z learners. Gamification has the potential to entice Generation Z learners from different socioeconomical and cultural backgrounds to experience theoretical content in a more engaging and enjoyable manner and foster self-directed learning.



Academic Editor: João Piedade

Received: 31 December 2024

Revised: 27 January 2025

Accepted: 29 January 2025

Published: 4 February 2025

Citation: Stoltz, J. H., Bunt, B., & van Zyl, S. (2025). Leveling up Learning: Enhancing Self-Directed Learning in Computer Applications Technology with Classcraft. *Education Sciences*, 15(2), 180. <https://doi.org/10.3390/educsci15020180>

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Keywords: gamification; generation Z; self-directed learning; computer applications technology

1. Introduction

Education is faced with an evolutionary test to prepare learners for a VUCA-world characterized by volatility, uncertainty, complexity, and ambiguity (Panthalookaran, 2022). Accordingly, school subjects such as Computer Applications Technology (CAT) that lie within the domain of Computer Science are constantly affected by rapid technological progress and digital infiltration. Self-directed learning (SDL) is considered a crucial competence as it empowers learners to be lifelong learners, taking ownership of their learning and adapting to a changing world (Van den Broeck et al., 2024; Morris, 2024). When engaging in the process of SDL, learners will individually or in collaboration with others identify their learning needs, set learning goals, find resources, implement strategies to obtain their learning goals, and reflect on the attainment of their goals (Knowles, 1975).

Generation Z is generally viewed as learners who were born between 1995 and 2010. This generation has distinct qualities that reshape what takes place in a classroom. Adept at navigating the online world thanks to having grown up with smartphones

and social media, they prefer hands-on learning that is tailored around their interests (Szymkowiak et al., 2021). Generation Z learners are distinguished by a desire to use digital tools; to seek immediate validation, they crave instant gratification and question the relevance of information (Rue, 2018). It should thus not come as a surprise when traditional teacher-centered methods serve their needs inadequately or with subpar motivation (Rue, 2018). Attaining learners' interest in the learning process is therefore a challenging task that is elevated when the focus is on theoretical content and where traditional teaching methods are applied (Szymkowiak et al., 2021).

Computer Applications Technology (CAT) is an elective subject in the South African school curriculum, which can be selected by high school learners in the Further Education and Training phase, in grades 10 to 12. Computer Applications Technology has cemented itself as a key subject to integrate practical and theoretical content knowledge for developing digital skills. The focus is on applying knowledge and skills of computer hardware and software applications to solve real-world problems (Department of Basic Education, 2011). However, the theoretical content, which covers approximately fifty percent of the curriculum, is often challenging for learners, and consequently, they lose motivation when traditional teacher-centered practices are applied (Bernstein, 2018; Mee Mee et al., 2020). For Generation Z learners, this problem is especially pertinent as they are known for being digitally literate and expecting interactive technology-driven classrooms (Szymkowiak et al., 2021).

Gamification as a teaching and learning strategy incorporates game design elements in non-gaming contexts. Points, badges, and leaderboards are used to enhance learning and motivation (del Olmo-Muñoz et al., 2023), which could enhance SDL (Palaniappan & Noor, 2022). Recent findings on gamification are quite contradictory; some research advocates for the positive effect of the approach to provoke complex learning and passion, while others claim it is capable of evoking only shallow learning (del Olmo-Muñoz et al., 2023; Mee Mee et al., 2020; Palaniappan & Noor, 2022). This research intends to contribute to this discussion by discussing the empirical findings when applying gamification to facilitate theoretical content in CAT.

A lacuna exists in the literature on applying learner-centered teaching as a learning strategy to facilitate theoretical content in CAT education. Moreover, other pressing issues informed this research of a rapidly changing, technology-driven world; curriculum content in an educational system that reacts slowly to the needs of a VUCA-world; and Generation Z learners with their distinct preferences. It is within this context that this research seeks to explore how gamification can be applied when facilitating theoretical content in CAT to enhance SDL and address the lack of engagement and motivation of Generation Z.

This research aims to determine how gamification can be applied to facilitate the theoretical content of CAT to enhance SDL among Generation Z learners. This study examines specific gamification strategies, such as Classcraft and other tools, that can make theoretical content more engaging and improve learners' SDL skills, including time management, problem-solving, and intrinsic motivation. The findings highlight the potential of gamification to address challenges in traditional teaching approaches and provide actionable insights for educators and educational technology designers, paving the way for a more interactive and effective learning experience for Generation Z learners.

1.1. Self-Directed Learning

Debates discussing the necessity of SDL to prepare learners for a changing world have continued in the literature since the 1970s. SDL has become increasingly significant and a fundamental competence as the challenges of a VUCA-world are unfolding (Morris, 2024; Panthalookaran, 2022). As defined by Knowles (1975), SDL is a process where the learner takes the initiative to identify learning needs, formulate learning goals, identify relevant

resources, choose and implement learning strategies, and evaluate whether learning goals were met. Although a learning need is initiated by the individual, SDL is not an individual journey, but learning is enhanced by reaching out to others and engaging with others (Knowles, 1975).

Apart from the SDL process abilities mentioned by Knowles (1975), SDL is recognized by learner characteristics or attributes. Self-directed learners display initiative, are independent, persistent, self-confident, self-disciplined, and creative, and have emotional security. They are goal-oriented, possess a high degree of curiosity, find joy in learning, are intrinsically motivated, are innovative, and have a strong desire to learn or change (Guglielmino et al., 2009; Morris, 2024). They have a tolerance towards ambiguity and a tendency to view problems as challenges, seek to learn and collaborate with others, and plan for completing tasks (Guglielmino et al., 2009).

Self-directed learning can be viewed on a continuum, and all learners possess a certain level of SDL, which can be infinitely enhanced (Williamson, 2007). Learners will subsequently have different levels of SDL, which will acquire different levels of support from educators. Teaching and learning strategies must therefore be applied to meet learners' SDL needs, and scaffolding should be implemented to optimally promote SDL.

In the next section, the characteristics and preferences of Generation Z will be discussed to determine how Generation Z learners could be approached to address their SDL needs.

1.2. Generation Z

In Table 1, the characteristics of Generation Z learners are summarized according to the literature consulted for this research. These characteristics and preferences have been compiled with a view on learning and engagement for this research and are not an exhaustive list of characteristics and preferences. It is also acknowledged that these results are generalized for Generation Z and that individual differences will exist.

Table 1. Characteristics and preferences of Generation Z learners.

Characteristic/Preference	Source
Crave technology	(Çoklar & Tatli, 2021; Saxena & Mishra, 2021; Szymkowiak et al., 2021)
Lack of critical thinking skills and evaluating information	(Baskoro et al., 2023; Rue, 2018)
Limited attention span	(Çoklar & Tatli, 2021)
Instant gratification, rewards, and feedback	(Baskoro et al., 2023; Çoklar & Tatli, 2021; Szymkowiak et al., 2021)
High expectations for engagement and service	(Rue, 2018)
Pragmatic, hands-on, and active	(Baskoro et al., 2023; Szymkowiak et al., 2021)
Collaboration and social skills	(Chicca & Shellenbarger, 2018; Rue, 2018)
Independent learning	(Seemiller & Grace, 2017)
Multimedia learning	(Çoklar & Tatli, 2021; Saxena & Mishra, 2021)
Multitasking	(Çoklar & Tatli, 2021)

Generation Z learners learn differently from other generations because of their defining characteristic—digital nativity—and their craving for technology (Çoklar & Tatli, 2021; Szymkowiak et al., 2021). They were born into a world of technology, could use technology from a young age, and can obtain information fast from various online sources. However, they do not tend to evaluate the credibility of information and seem to lack critical thinking skills (Baskoro et al., 2023; Rue, 2018). It should be noted that the abilities of

Generation Z to use technology as well as to use technology effectively differ significantly and also across contexts. Teachers therefore have an important role in guiding Generation Z learners on using technology effectively and developing their higher-order thinking skills (Baskoro et al., 2023; Szymkowiak et al., 2021).

As a result of their extensive use of smartphones and technology and the instant feedback generated by technology, Generation Z tends to be impatient, crave instant gratification, and require instant feedback and results. They tend to multitask and have a limited attention span (Çoklar & Tatli, 2021), and a decreased interest is noticed in reading books (Rue, 2018). Their frequent access to multimedia resources leads to a preference for visual material and to communicate visually. Accordingly, they also prefer multimedia, especially videos and graphics for teaching and learning resources (Çoklar & Tatli, 2021; Rue, 2018).

Generation Z prefers learning individually. They like setting their own pace, focusing on information according to their preference, and constructing their own meanings before sharing it with others (Seemiller & Grace, 2017). They question the relevance of information and constantly 'operate with filters' that question if the information is relevant to their contexts (Rue, 2018). Their social and relationship skills seem to be underdeveloped (Chicca & Shellenbarger, 2018), although they enjoy collaborating and socializing in the digital space (Rue, 2018).

Generation Z as online consumers have high expectations for service and engagements and accordingly prefer classroom environments where they are serviced, challenged, and engaged (Rue, 2018). Studies have indicated a preference for active learning in a collaborative environment where they apply concepts (Rue, 2018). With all these preferences and characteristics taken into account, it can be predicted that Generation Z will not easily sit through a lecture (Rue, 2018). Teaching and learning strategies with a focus on technology and engagement, such as gamification, could therefore be applied to motivate Generation Z (Saxena & Mishra, 2021).

When comparing the characteristics of Generation Z learners and self-directed learners, some contrasting characteristics are noticed. Self-directed learners display a love of learning and an eagerness to pursue knowledge, to plan and manage their learning, to show persistence, and to work collaboratively. Generation Z, on the other hand, wants to work independently, craves instant gratification, questions the necessity of information, and prefers learning according to their individualistic preferences as indicated in Table 1.

The characteristics of Generation Z, particularly within the South African educational context, necessitate a critical examination that considers the unique socio-economic and cultural realities of the country. Generation Z is often characterized by a strong affinity for technology, a desire for instant gratification, and challenges in critical thinking skills. However, these traits must be understood against the backdrop of South Africa's significant digital divide, which affects access to technology and digital literacy among learners. For instance, while many Generation Z students globally are digital natives, the reality in South Africa is that access to technology varies greatly across different schools and communities, which can hinder the implementation of technology-driven educational strategies such as gamification (Walker & Mkwanzani, 2015; Huus et al., 2016; Kobayashi et al., 2018).

The disparities in access to technology are compounded by socio-economic challenges that many South African learners face. The educational landscape is fragmented, where the quality of education is inconsistent, particularly for marginalized communities (Huus et al., 2016; Kobayashi et al., 2018). This inconsistency not only affects learners' academic performance but also their motivation and engagement with learner-centered, technology-driven strategies. The challenges of accessing higher education for marginalized groups thus highlight the need for tailored educational interventions that consider

these socio-economic realities (Walker & Mkwanzani, 2015; Luckett & Mzobe, 2016). Future research should delve deeper into how these contextual factors influence the effectiveness of gamification and other educational strategies in South African classrooms, thereby providing educators and policymakers with actionable insights (Huus et al., 2016; Kobayashi et al., 2018; Luckett & Mzobe, 2016).

Moreover, the cultural diversity and multilingualism inherent in South Africa further complicate the educational landscape. Generation Z learners often navigate complex social environments that require them to adapt to various cultural contexts, which can impact their learning experiences (Naidoo, 2015; Chukwuere et al., 2015). The integration of culturally relevant pedagogical approaches, such as Ubuntu philosophy, could enhance the educational experience for these learners by fostering a sense of community and belonging (Boboyi, 2024; Omodan & Diko, 2021). As such, it is crucial for studies to explore how these cultural and contextual factors shape the learning experiences of Generation Z in South Africa, particularly in relation to technology-enhanced learning environments (Boboyi, 2024; Omodan & Diko, 2021).

1.3. Gamification

Gamification in education has emerged as a significant trend globally, characterized by the integration of game-like elements into educational contexts to enhance student engagement and motivation (Nakiyemba, 2024). This literature review synthesizes findings from various studies that explore the implementation and impact of gamification in educational settings, with a particular focus on its application in South Africa.

The concept of gamification involves incorporating elements such as points, badges, leaderboards, and challenges into educational frameworks to foster a more engaging learning environment. Research indicates that gamification can positively influence students' motivation and engagement, which are critical factors for successful learning outcomes (Nakiyemba, 2024). For instance, Saxena and Mishra (2021) highlight that gamification elements can enrich the learning journey by enhancing students' intellectual activities and overall engagement in the classroom. Similarly, Dichev and Dicheva (2017) emphasize the need for rigorous empirical studies to establish a comprehensive understanding of gamification's benefits across various educational contexts. This aligns with findings from Santos-Villalba et al. (2020), who assert that gamification positively influences student motivation and engagement, particularly when teachers are well-trained in its implementation.

In the context of South Africa, the adoption of gamification has been relatively nascent but is gaining traction as educators seek innovative methods to engage students. The unique socio-economic challenges faced by South African students necessitate creative educational strategies that can enhance learning experiences. Research conducted in South Africa has indicated that gamification can serve as a powerful tool to address these challenges by making learning more interactive and enjoyable. For example, Fuchs (2024) notes that gamified approaches can improve student participation and performance, particularly in subjects that traditionally struggle to engage learners. Furthermore, the integration of technology in education has facilitated the acceptance of gamified learning environments among students, leading to improved academic outcomes (Naseri et al., 2023).

Despite the promising potential of gamification, challenges remain in its implementation. Critics argue that gamification may merely be a repackaging of existing educational strategies rather than a transformative approach (Wiggins, 2016). Additionally, the effectiveness of gamification can vary significantly based on the design elements employed and the context in which they are applied. Khaldi et al. (2023) conducted a systematic review that underscores the importance of understanding which gamification elements are most effective in enhancing learning outcomes. This highlights the need for educators

to adopt a thoughtful and evidence-based approach when integrating gamification into their curricula.

Moreover, the literature suggests that the success of gamification in education is influenced by various factors, including students' self-efficacy and the perceived relevance of gamified activities to their learning goals (Tamrin et al., 2022). As such, it is essential for educators to consider these factors when designing gamified learning experiences. The role of gender in gamification acceptance has also been explored, indicating that different demographic groups may respond differently to gamified elements, which could inform more tailored educational strategies (Tamrin et al., 2022).

Gamification presents a valuable opportunity for enhancing educational experiences both globally and in South Africa. While the evidence supporting its effectiveness is growing, further empirical research is needed to refine gamification strategies and ensure their successful implementation in diverse educational contexts. As educators continue to explore innovative approaches to teaching and learning, gamification stands out as a promising avenue for fostering student engagement and motivation.

Effective gamification in educational contexts necessitates both a robust technological infrastructure and proficient educators capable of integrating gamified elements into their teaching practices. In regions like South Africa, where access to educational resources is uneven, schools often encounter significant challenges in acquiring and maintaining essential technology, including devices, reliable internet access, and software subscriptions. These infrastructural limitations can severely impede the successful implementation of gamification and exacerbate existing educational inequalities. Research indicates that disparities in technology access can hinder teachers' ability to utilize innovative pedagogical tools effectively, leading to a reliance on traditional teaching methods that may not engage students as effectively as gamified approaches (Ghory & Ghafory, 2021).

Moreover, the role of teacher training is critical in leveraging gamification as a pedagogical tool. Educators must cultivate both technical skills and a comprehensive understanding of how to design and facilitate gamified learning experiences that align with curriculum objectives. Without adequate training, teachers may struggle to implement gamification effectively, resulting in superficial applications that fail to enhance learning outcomes. Studies highlight that many teachers express a need for more training in gamification, indicating that the complexity of implementing such approaches often exceeds their current capabilities (Rodríguez & Argüello, 2023; Puerta, 2024). Additionally, challenges such as limited time for professional development, restricted access to training programs, and resistance to new methodologies further complicate the integration of gamification into teaching practices (Sáez-López et al., 2022).

The importance of ongoing professional development cannot be overstated. Teachers require continuous support and training to adapt to the evolving educational landscape, particularly in the context of gamification. Research suggests that educators who receive targeted training in gamification report higher confidence and competence in using these strategies effectively (Spathopoulou, 2024). Furthermore, fostering collaborative environments where teachers can share experiences and strategies related to gamification can enhance the overall effectiveness of these educational innovations (Araújo & Carvalho, 2022). In summary, addressing the dual challenges of technological infrastructure and teacher training is essential for the successful implementation of gamification in education, particularly in resource-constrained settings like South Africa.

2. Materials and Methods

This study applied a basic interpretive qualitative research design (Merriam & Tisdell, 2015) under an interpretivist paradigm to determine the lived experiences of Generation

Z towards the teaching of CAT theoretical content and the extent to which incorporating gamification enhanced their SDL.

The population was grade 8 to grade 12 learners from a secondary school located in South Africa. At the time of the research, approximately 1300 learners from grades 8–12 were enrolled in the school, which consisted of male learners only. The learners derived from different ethnic and cultural groups and socio-economic classes. The sampling process involved the use of purposive and convenient sampling methods to include learners in grades 10 and 11 who had CAT as an elective subject. These learners were between the ages of 15 and 17 years. All learners who adhered to the criteria were invited to participate in the research, and non-random sampling was applied. A total of 106 out of 201 learners consented to participate in this study.

The use of a convenience sample ($n = 201$) was necessitated by the practical constraints of the study context, as the primary researcher was also a teacher at the school where this study was conducted. This provided access to participants with relevant experience in CAT, which was essential for evaluating the intervention. While convenience sampling can introduce potential biases, efforts were made to mitigate these by inviting all eligible learners in Grade 10 and Grade 11 to participate, ensuring diversity within the sample.

Data were collected by administering an open-ended questionnaire pre- and post-intervention and by conducting focus group interviews after the intervention. The open-ended questionnaire was administered as an online Google form and included eleven questions that aimed to elicit the participants' experiences with CAT theoretical content. The pre-intervention open-ended questionnaire was completed by 104 willing participants. Only 56 participants completed the post-intervention open-ended questionnaire. The open-ended questionnaire was completed anonymously, and no identifiable data were collected to mitigate power relationships because one of the researchers was also a teacher.

To obtain further elaborated data, semi-structured focus group interviews were conducted after responses to the pre- and post-open-ended questionnaires were analyzed. The interview sessions averaged 20 min, which was limited to five participants per group. Only 48 participants were willing to participate in the semi-structured focus group interviews. Interviews were conducted based on a set of developed questions, while some probing questions were permitted to allow the researchers to delve deeper into the participant's answers.

Regarding the non-response rate, only 56 participants completed the post-intervention questionnaire, which represents a limitation in terms of generalizability. However, this was addressed by incorporating focus group interviews with an additional 48 participants to ensure depth and richness in the data. A detailed comparison of pre- and post-intervention responses was conducted to analyze potential biases and assess the consistency of findings across different data sources, thus providing a comprehensive understanding of the intervention's impact.

The data analysis of the open-ended questionnaires followed an *in vivo* coding process (Saldaña, 2013) where participants' own words were used as codes to describe their experiences of CAT theoretical content. Transcriptions of the focus group interviews were coded by using descriptive codes (Saldaña, 2013). Codes were combined into categories, in accordance with the constructions created from the participants' responses. This involved content analysis to discover key concepts and themes concerning SDL and gamification. The categories were then recombined into overarching themes (Saldaña, 2013).

Approval to conduct this study was sought from the North-West University Education Management and Economic Sciences, Law, Theology, Engineering, and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC), and an approval number was granted. Permission was granted by the provincial Department of Basic Education, the school principal, and the school governing body. The learners' parents or guardians provided their

consent, and the learners also provided their consent, as all participants were under 18 years of age. There was no coercion for participation and the subjects' rights to anonymity were upheld and they could withdraw from the research at any time without any prejudice. In all the reports and publications that emanated from the research study, the identities of the participants and the school were concealed.

The dual role of the researcher as a teacher at the participating school is acknowledged as a potential source of bias, particularly regarding the honesty of participants' responses. To mitigate this, several measures were implemented. Participation was entirely voluntary, and informed assent and consent were obtained to ensure that learners understood their rights, including the option to withdraw at any time without repercussions. Anonymity was strictly maintained in all responses, and data collection methods, such as online questionnaires and focus group interviews, were designed to minimize direct interaction between the researcher and participants during the data submission process. Additionally, the use of open-ended questions and the triangulation of data from questionnaires and interviews helped to reduce potential bias by providing multiple perspectives and increasing the reliability of the findings. These measures ensured that participants felt secure sharing their honest views without fear of judgment or influence.

2.1. Intervention

During the second school term, a teacher-centered approach was first applied to facilitate theoretical content. However, during the third term, gamification was applied as an intervention when facilitating theoretical content. The intervention referred to as the Classcraft gamification intervention required the introduction of gaming elements such as points, badges, and leaderboards into the CAT theoretical content. Classcraft was chosen as the main intervention software to introduce gamification to the learners because it was freely available, easy to use, included various game elements, and could be customized by entering one's own rules and elements. Classcraft was applied for every class that focused on theoretical content. Three other software applications were also used occasionally, namely Kahoot, Socrative, and Flashcards by cram.com. The results from these three applications were used to award XP points to the learners on Classcraft.

Learners could level up, work in teams, and earn powers that have real-world consequences. Classcraft uses inspiration from role-playing video games to transform any classroom into a role-playing platform that fosters stronger learner collaboration and encourages better behavior (Sanchez et al., 2017). It was assumed that constant stimulation and the use of incentives would keep the learners more focused and interested during the learning process. Each gamification intervention focuses on specific lesson aims according to the learning objectives in the curriculum. Lessons were introduced by engaging learners with a random Classcraft event. During the lesson, Classcraft was used to encourage engagement and enhance motivation and collaboration by, for example, randomly assigning learners to explain or summarize concepts. Group discussion sessions were incorporated, and constant feedback was provided by utilizing Classcraft. Assessments were carried out throughout the intervention by using Classcraft or Kahoot for questions on the lesson content. Informal assessments were performed as exit activities on Socrative and to complete activities to prepare for next classes.

2.2. Data and Materials

Any materials, data, and protocols used in the context of this publication will be provided upon request. Limitations exist regarding the accessibility of some kinds of information, which were employed in the current research under license and, thus, can be

considered as non-public. However, data can be released by the authors on request and after obtaining the necessary permission from the concerned authorities.

3. Findings

The findings are presented in a structured manner to provide a comprehensive overview of the data collected before and after the gamification intervention. Initially, the pre-intervention findings are discussed to establish a baseline understanding of learners' perceptions and challenges regarding CAT theoretical content and SDL. This is followed by an analysis of the post-intervention findings, highlighting changes in learners' experiences and behaviors after gamification was introduced. Finally, insights from focus group interviews are presented, providing qualitative depth to the findings and exploring learners' perspectives on the effectiveness of gamification.

Table 2 summarizes the categories, themes, and codes that emerged from the data that will be elaborated on in this section.

Table 2. Emerging characteristics and preferences of Generation Z learners.

Category	Theme	Code
Enjoyability and value	Positive experience	Fun, enjoyable, exciting, helpful, and informative
	Perceived importance	Important and valuable
	Level of Interest	Interesting
Challenging aspects	Homework load	Too much, too little, and fair amount
	Negative experience	Boring, repetitive, hard, exhausting, and unproductive
	Study workload	Too much and fair amount
	Time constraints	Too little time and competing priorities
Neutral aspect	Teaching approach	Practical vs. theory-based focus
	Not challenging	Easy, manageable, and challenging but fair
Resources	Mixed perception	Plain, average, and sometimes boring
	Digital resources	Internet, YouTube, textbook, and software tools
	Physical resources	Textbooks and slideshows
Task completion	External Help	Friends, teachers, and family
	Immediate completion	As soon as possible
	Proximity to deadline	Days before or just before the deadline
	Flexible approaches	When time allows
Motivation	No attempt	Leave blank or no submission
	Extrinsic motivation	Good marks, avoiding punishment, and impressing others
	Intrinsic motivation	Self-motivation and, enjoying subjects
	Avoiding consequences	Meeting deadlines and avoiding falling behind
Involvement	Lack of motivation	Uninteresting work and procrastination
	Academic achievement	Better marks and boosting term scores
Involvement	Active involvement	Engaged in class and participating actively
	Variable involvement	Sometimes engaged or depending on interest
	Lack of involvement	Passive listening, distracted, and bored

3.1. Findings of Pre-Intervention Open-Ended Questionnaire

This section explores the findings from the pre-intervention open-ended questionnaire, focusing on learners' perceptions of CAT theoretical content and their SDL characteristics.

The responses revealed diverse attitudes, with some learners finding the content engaging and resourceful, while others struggled with motivation and interaction. Key themes that emerged include learners' enjoyment, mixed or negative perceptions of the content, challenges related to workload and time management, and varying levels of SDL skills such as problem-solving, intrinsic motivation, and engagement (see Table 2). These insights provide a baseline understanding of the participants' experiences and challenges prior to the gamification intervention.

3.1.1. Perceived Enjoyability and Perceived Value of Computer Applications Technology Theoretical Content

Regarding the theoretical content of CAT, it was found that before the intervention, the learners' experiences differed. While a few participants characterized the content as interesting and reported positive experiences, the majority expressed mixed or negative attitudes.

Some participants reported positive experiences and appreciated the structure and resourcefulness of the content. Participant QM001 stated, "Nice, best educational", while participant QM021 remarked, "Exciting, educational, and fun". Another participant, QM027, noted, "Fun, interesting, important". Similarly, QM037 added, "I have a lot of interest towards the subject, that's why I chose it". Participant QM062 summarized, "Fun, easy, important, helpful".

Several participants had mixed perceptions. They acknowledged the relevance of the content but struggled with its interactive aspects. For example, participant QM044 mentioned, "Interesting, cool, boring: CAT theory is not bad to learn compared to other subjects because it is easy to learn and remember, but sometimes the lessons can get boring". Participant QM029 stated, "Some of it is difficult to understand, and some of the work is easy to understand". Additionally, QM104 observed, "Long, tiring, interesting".

A significant portion of participants had negative perceptions and found the content hard and unexciting. Participant QM054 expressed, "Boring, waste of time, long". Similarly, QM053 remarked, "Exhausting, long, boring". Another student, QM099, commented, "It provides a better understanding of how the world works but does not necessarily develop problem-solving skills". Participant QM062 also highlighted a lack of modernization: "Not quite—it's not up to modern standards".

3.1.2. Challenges Related to Computer Applications Technology Theoretical Content

Participants reported that they experienced challenges in the form of homework load, study workload, and time constraints.

Excessive homework causes stress and disengagement. Participant QM056 stated, "I still find myself with too much work, which still requires to be done". Participant QM045 mentioned, "It feels like I spend more time on CAT homework than all my other subjects combined".

Learners reported extensive study requirements as problematic. QM054 commented, "The amount of work needed to cover and study is too much". QM028 echoed, "There is too much work that needs to get done".

Time management was a recurring challenge. Participant QM015 explained, "I hardly have time to do my theory assignments". Participant QM038 shared, "I often find myself rushing through the theory work just to submit on time, which means I don't really learn anything".

3.1.3. Self-Directed Learning Characteristics

SDL characteristics that emerged from the data revealed varying degrees of proficiency among learners. The SDL characteristics were identified as time management, problem-solving, intrinsic motivation, and engagement.

Time management presented challenges for many learners, as they often struggled to manage their study schedules effectively. Participant QM011 noted, “The workload is difficult to fit into the busy life of a student since there are other private activities that often interfere with the schoolwork”. Similarly, participant QM023 stated, “I have little time to complete my tasks”, reflecting ongoing struggles with time constraints. However, some learners showed progress, with participant QM001 mentioning they completed tasks “As soon as possible”. Participant QM029 preferred working ahead, saying, “Several days before the submission date”, while others managed tasks gradually, as indicated by participant QM066, who said, “Slowly each day”.

Reliance on teacher guidance remained a significant feature, with many learners demonstrating limited independence in problem-solving. Participant QM027 remarked, “If the teacher doesn’t explain it step by step, I get lost quickly”. This sentiment was echoed by participant QM044, who said, “I can sometimes figure things out, but most of the time, I need help to even start”. A few participants expressed interest in developing problem-solving skills, as participant QM016 noted, “CAT involves a lot of problem-solving, which I like”.

Intrinsic motivation was low among learners, with many relying on external factors such as grades or avoiding negative consequences. Participant QM005 summarized their approach: “To avoid detention”. Others linked their efforts to assessments, such as participant QM058, who stated, “I only study when I know there’s a test or assignment due”. Despite this, a few participants expressed interest in improving their performance, such as participant QM042, who said, “I want to do well, but it’s more about getting the marks than actually enjoying the work”.

Engagement levels remained low, with learners often feeling discomfort during interactive aspects of lessons. Participant QM052 stated, “No, I don’t like having attention on me when I answer a question”. Participant QM033 echoed this sentiment, saying, “I feel nervous and try to avoid participating in class discussions”. These passive experiences were compounded by lessons that lacked interactivity, as participant QM047 observed, “It’s hard to focus when the lesson is just the teacher talking, and we don’t get to do anything interactive”.

3.2. Findings of Post-Intervention Open-Ended Questionnaire

This section examines the findings from the post-intervention open-ended questionnaire, highlighting the shifts in learners’ perceptions and experiences after the introduction of gamification. Key themes that emerged include a significant increase in positive engagement and enjoyment of CAT theoretical content, a reduction in negative perceptions, and improvements in SDL characteristics such as time management, problem-solving abilities, intrinsic motivation, and active engagement. While some challenges persisted, particularly regarding workload, study load, homework, and content difficulty, the data revealed notable progress in learner attitudes and self-directed learning behaviors compared to the pre-intervention findings.

Most participants had positive experiences and said that a gamified approach was fun and engaging. Participant QM043 described it as “Fun, interesting, joyful”. Participant QM035 added, “It was like playing a game, but I was learning at the same time, which made it exciting”. Participant QM021 noted, “Exciting, educational, and fun”. Participant QM048 shared, “I looked forward to the lessons because it felt different from the usual

boring theory work". Similarly, participant QM054 expressed, "Interesting, different, and entertaining". Participant QM051 remarked, "The points and rewards made it competitive in a good way; it pushed me to try harder".

Some participants reported both positive outcomes and lingering challenges with the content. Participant QM054 stated that the work is, "Interesting, different, and entertaining". Participant QM029 added, "Some of it is difficult to understand, and some of the work is easy to understand". Another participant, QM059, observed, "I enjoyed the activities, but I still struggled with understanding some of the concepts".

The intervention significantly reduced negative views among the participants, though a few still felt the experience was repetitive. Participant QM052 remarked, "It feels like I am doing the same thing over and over again". Participant QM060 echoed this, saying, "The gamified lessons were fun at first, but after a while, it felt like the same routine". Another learner, QM063, commented, "I liked the change, but it didn't completely solve the problem of the content feeling too hard".

Post-intervention feedback highlighted changes in how learners perceived and managed challenges. The elements of game design used minimized the perceived workload on the students on the homework assignments given. Participant QM042 said, "The work is quick and easy to complete". Participant 2QN087 added, "We get flooded with a large amount of homework and study work for theory when only half of it is asked. As a result, I lose interest in studying for it and paying attention". However, Participant 2QN047 shared a contrasting perspective: "If you keep up with the work given each day, it really does not become a lot of work to do. We are given time in class to complete the work and ask questions. By doing these little amounts of work each day, it really helped me be prepared for the test series".

Self-Directed Learning Characteristics

The intervention positively influenced various SDL characteristics among participants, as demonstrated through the following examples derived from the research:

Learners displayed improved time management strategies post-intervention. Many participants indicated completing tasks promptly, as reflected in statements such as, "As soon as possible" (QM001). Others demonstrated effective planning by completing tasks a few days before deadlines, with one learner noting, "About 2–4 days before the submission date" (QM066), and another sharing, "Slowly each day" (QM029). Some participants preferred even earlier preparation, with one stating, "Before it is given by at least a week" (QM020). However, challenges persisted for some, such as those who only worked on tasks "Whenever the time suits me" (QM038) or postponed them until the last minute, saying, "When I have to" (QM073).

Problem-solving abilities also showed marked improvement. Participants highlighted the role of scenario-based questions in enhancing these skills. For instance, one learner mentioned, "Yes, mostly through scenarios that they give us to work with, then we have to figure out what's wrong from the information given and figure out how to solve it" (QM062). Others appreciated how this approach encouraged creative thinking, saying, "It provides a better understanding of how the world works but does not necessarily develop problem-solving skills" (QM099).

Intrinsic motivation among learners increased notably after the intervention. While initially relying on extrinsic motivators such as grades, participants began to show a greater internal drive to engage with the material. One learner described this change as, "of course" (QM012), while another noted, "Yes, definitely" (QM045). This demonstrates a shift towards a more self-directed approach in their studies.

Learner engagement significantly improved with the incorporation of interactive elements. Many learners reported feeling more involved, with one stating, “We have a game we play that acquires attention and max focus” (QM033). Another participant noted how this approach reduced their passivity in lessons, saying, “Interactive activities made me want to participate more” (QM047).

3.3. Findings of Post-Intervention Focus Group Interviews

This section presents findings from the post-intervention focus group interviews, which offered deeper insights into learners’ experiences with gamification and its impact on SDL (see Table 3). The themes that emerged from the discussions include the shift in teaching methods to a more interactive and engaging approach, the practical application and relevance of gamified activities to real-life scenarios, and increased learner interaction and engagement. These themes highlight the transformative potential of gamification in enhancing student motivation, collaboration, and the overall learning experience.

Students particularly appreciated the shift from traditional teaching to a more interactive, quiz-style approach. One participant shared, “Before the class we were just sitting and opening our book and trying to study; there was nothing doing; we were doing nothing practical” (IN6). Another participant highlighted the enjoyment of the new style, saying, “It was easier to understand and felt more exciting because it wasn’t just reading notes” (IN3). A student reflected, “I liked how the teacher explained with examples that made the work feel less boring and more like solving a puzzle” (IN8).

The use of gamified activities helped students connect theoretical content with real-life applications. Participant IN5 noted, “Co-operation in viewing the manner of learning the content of the work in a new perspective”. Another student commented, “The game made me realize how some of the theory applies to things I see every day, like why systems behave a certain way” (IN4). A learner added, “It’s not just about marks anymore; I felt like I was learning skills I could use in real life” (IN7).

The gamified approach encouraged greater interaction and engagement among students. One participant stated, “Everyone in the group wanted to win, so we worked harder and helped each other” (IN9). Another remarked, “I felt more involved because I wasn’t just listening but doing something that made me think” (IN2). Some learners enjoyed the competitive aspect, as a student expressed, “It was fun competing and seeing who could get the answers right the fastest” (IN1).

3.4. Summary of Findings

From the comparison of the pre- and post-intervention data alongside the focus group discussion results, it seemed that adopting a gamification approach enhanced SDL among Generation Z learners in the context of CAT theoretical content. As indicated in Table 3, motivation, time management, problem-solving, and relevance of content all improved, contributing to a more engaging and enjoyable learning process.

Table 3. Pre- and post-intervention self-directed learning characteristics.

SDL Characteristic	Pre-Intervention	Post-Intervention
Time management	Poor	Improved
Problem-solving	Inconsistent	Enhanced
Motivation	Low (Extrinsic)	High (Intrinsic)
Engagement	Passive	Active

Table 4 shows frequency counts of data (Saldaña, 2013) that relate to the learners' perceptions of CAT theoretical content. A shift from negative to positive experiences is noticed, with 65% of the counts indicating positive experiences after the gamification intervention.

Table 4. Learner perceptions of Computer Applications Technology theoretical content.

Perception Category	Pre-Intervention	Post-Intervention
Positive experiences	20%	65%
Mixed perceptions	50%	25%
Negative perceptions	30%	10%

4. Discussion

The main aim of this current research study was to establish how the concept of gamification may be applied in the teaching and learning of the theoretical component of the subject CAT to improve SDL among Generation Z students. The implications of the research presented in this paper provide useful information regarding the overall efficiency of the use of gamification in the context of education, as well as the promotion of modern learners' engagement and the enhancement of their SDL.

4.1. Self-Directed Learning, Engagement, and Motivation

The responses to the open-ended questionnaires that were given before and after the intervention, as well as the focus group discussions conducted with the learners who participated in the research post-intervention, indicated that engagement and motivation are two key factors in knowledge acquisition and SDL (Guglielmino et al., 2009; Morris, 2024). This aligns with findings from various studies that highlight the importance of these factors in educational settings to enhance SDL, particularly in the context of gamification, which has been shown to enhance learners' engagement and motivation significantly (Nakiyemba, 2024; Santos-Villalba et al., 2020; Saxena & Mishra, 2021). As a result, before the intervention, it was common for learners to perceive conventional learning as tedious and unmotivating, a sentiment echoed in the literature where traditional educational methods are often criticized for failing to engage students effectively (Nakiyemba, 2024). The integration of the gamification intervention, specifically Classcraft, was shown to improve the learners' level of engagement and core self-evaluations. The roleplay elements of Classcraft resulted in learners increasingly taking responsibility for their learning because they respected the character they enacted and did not want to let down their team. This aligns with research from Sanchez et al. (2017), confirming the potential of gamification platforms to foster good habits and thus also SDL characteristics.

Research indicates that gamification can lead to improved educational outcomes by fostering a more engaging learning environment (Nakiyemba, 2024). For instance, regarding the use of Classcraft, one participant remarked that it was a fun way of learning, reflecting the broader trend noted in educational research where gamified approaches are recognized for their ability to transform learning experiences into more enjoyable and interactive processes (Nakiyemba, 2024). One participant stated, "I preferred the Classcraft approach of learning to the classic and dull just-go-to-the-book style", which underscores the shift in learner preferences towards more dynamic and engaging educational methodologies. The suitability of gamification for the preferences of Generation Z learners with regard to their high expectations for engagement and pragmatic, hands-on activities is also subsequently underscored (Baskoro et al., 2023; Rue, 2018; Szymkowiak et al., 2021). Interestingly, although participants had various sociocultural backgrounds and different levels of digital literacy, no comments from participants were noticed that indicated a hindrance in the implementation of gamification as cautioned by literature (Walker & Mkwanzani,

2015; Huus et al., 2016; Kobayashi et al., 2018). This could be possibly explained by the fact that all participants had CAT as a subject and had some form of digital literacy.

The analysis revealed that SDL skills and characteristics, such as time management, problem-solving, and curiosity (Morris, 2024), were enhanced due to the introduction of gamification. At the beginning of this study, participants displayed difficulties in these areas, as responses indicated a lack of personal initiative and challenges related to time management. There was a significant increase in perceived levels of intrinsic motivation and efficiency during time management-related tasks after the intervention. One participant noted, “I think it’s about your interest, what you are interested in; everyone is interested in different parts of computer science, and what you find interesting may not be interesting to someone else” (IN3). The gap was thus reduced between the preference of Generation Z to be individualistic about their preferences and selective in their learning and the intrinsic motivation of self-directed learners who are eager to learn more (see Table 3).

4.2. The Role of Technology and Interactivity

Learners of Generation Z prefer interactive and tech-enhanced learning environments because they are aware of the application of technology in learning. Respondents expressed the value of the interactional approach of the intervention consonant with the learners’ preferences. This fact is in harmony with the results listed by prior studies showing that Generation Z learners perform well when technology is included in the learning process and feedback is prompt (Baskoro et al., 2023; Çoklar & Tatli, 2021; Szymkowiak et al., 2021).

4.3. Teacher-Centered vs. Learner-Centered Approaches

This research supported the argument that with teaching Generation Z, teacher-centered approaches are less successful than learner-centered approaches (Rue, 2018). The different elements from the gamification intervention contributed to changing the paradigm towards an active-learning approach where learners are engaged and receive instant feedback (Çoklar & Tatli, 2021; Rue, 2018; Szymkowiak et al., 2021). This had a positive impact not only on the interaction with other peers but also on the understanding and enjoyment of the content.

4.4. Note for the Future Direction of the Research and Practice

The results indicate some avenues for further research and practice. Future research could investigate the long-term results of gamification on SDL skills and the performance of the learners across different academic fields and academic levels. Further, the research could examine the feasibility of implementing these types of interventions in schools at large and could look at the differences in these interventions’ efficacy for schools with differing levels of resources and in varying student populations.

4.5. Limitations of This Study

The present research took place in one school and targeted a particular population of male learners; thus, objective results might not be feasible. The sources of information are based on open-ended questionnaires and interviews, and subjective bias might also be present. The population focused on CAT learners, who are also more accustomed to using technology, although learners from various socio-economic groups with various levels of digital literacy were part of the sample. The digital literacy of participants, socio-economic backgrounds, and cultural groups were not recorded during data collection. It is recommended for subsequent research and similar studies to include a quantitative assessment of engagement and learning, digital literacy, and demographic data to enhance the effectiveness of the proposed approach.

5. Conclusions

In conclusion, the enhancement of teaching CAT theoretical content with the help of gamification positively impacted the level of learners' engagement, motivation, and SDL abilities in the context of Generation Z learners. Comparing the methods to the tendencies preferred by these contemporary learners, it became clear that it is possible to establish more effective approaches in learning for Generation Z learners. Gamification that incorporates the guidelines presented below assisted in aligning the preferences of Generation Z learners with the characteristics of self-directed learners. The desire for instant gratification and technology could be addressed, as well as taking responsibility for one's own learning, time management and planning, curiosity, intrinsic motivation, and collaboration.

Based on our research, we recommend the following guidelines for effectively implementing gamification to enhance SDL. A lesson plan (see Table 5) is also provided to give an example of how these guidelines could be practically implemented:

- Start with clear objectives: Educators should identify specific learning outcomes related to both subject content and SDL characteristics, such as enhancing intrinsic motivation, fostering problem-solving skills, or developing time management abilities. Gamified activities should be designed to encourage learners to take initiative, set goals, and reflect on their progress.
- Select appropriate tools: Choose gamification tools that are not only user-friendly but also support SDL. Platforms like Classcraft, Kahoot, and Habitica allow learners to track their progress, set personalized goals, and receive feedback, fostering independence and ownership of their learning journey.
- Design meaningful activities: Gamified elements should directly promote SDL skills. For instance:
 - Time management: Include daily or weekly quests with deadlines to help learners plan and prioritize tasks.
 - Problem-solving: Use scenario-based challenges that require learners to analyze information, propose solutions, and collaborate if needed.
 - Reflection: Add checkpoints or reflective tasks where learners evaluate their strategies and outcomes, reinforcing self-assessment skills.
- Provide teacher training: Educators need to understand how to embed SDL principles into gamified learning. Training should emphasize scaffolding strategies, such as gradually increasing the complexity of tasks or encouraging learners to set their own goals and monitor their progress.
- Foster collaboration: Gamification should include team-based challenges that develop collaborative SDL attributes, such as peer feedback, shared goal-setting, and group problem-solving. Assigning specific roles, like timekeeper or strategy leader, can encourage responsibility and teamwork.
- Incorporate feedback mechanisms: Frequent feedback is crucial for SDL. Gamified tools can provide instant feedback on performance (e.g., quiz results or badges for milestones), while reflective group discussions or journaling exercises encourage learners to internalize what they have learned and plan improvements.
- Adapt to context: Tailor gamified interventions to learners' needs and environments while promoting SDL. For resource-limited contexts, simple strategies like point systems, leaderboard charts, or group rewards can still encourage learners to take initiative and collaborate.
- Evaluate and adjust: Regularly assess the gamified activities' impact on both content knowledge and SDL development. Use instruments like SDL readiness scales,

learner reflections, and performance data to identify growth areas and adapt the intervention accordingly.

This research thus adds to the knowledge concerning gamification in the learning context while giving useful recommendations to the concerned stakeholders in the education sector seeking to introduce changes to the learning environment. Table 5 suggests a practical implementation of the above guidelines in the form of a generic lesson plan.

Table 5. Lesson plan for gamification to enhance self-directed learning.

Lesson Phase or Aspect	Description
Materials and resources	• Gamification platform (e.g., ClassCraft and Kahoot) • Presentation materials (e.g., textbook, slides, and online resources) • Lesson material (e.g., textbook activities and online activities)
Preparation	• Ensure learners have a basic understanding of the topic from the subject. • Prepare the presentation material and gamified activity. Ensure the learning aid aligns with the learning objective. • Set up the gamification platform to incorporate interactive elements like quizzes, random events, random student pickers, or rewards.
Learning objectives	• Identify and explain key concepts within the subject lesson. • Evaluate and discuss real-world applications of these concepts. • Demonstrate understanding through gamified assessment and/or group activities or informal feedback of choice.
Prior knowledge	• Learners should be introduced to the specific gamification platform prior to the lesson for optimal results. • Encourage preparation for the lesson by building on previous lessons or assigning preparation prior to this lesson.
Lesson introduction	• Learners need to be engaged with prior knowledge using the gamification platform, e.g., using a random spin wheel to trigger an event or select a learner to provide feedback after posting an intriguing question or scenario.
Teacher's role	• Encourage learners to prepare for class and provide guidance on class preparation. • Engage learners with a random event from the chosen gamification platform. • Introduces the topic by providing an intriguing question to the learners. • Facilitates informal conversations and group discussions. • Facilitates game-based engagement and feedback: randomly selecting learners to explain or summarize concepts; awarding XP, badges, or other incentives according to the selected gamification platform and available elements. • Ensure that constant feedback is provided during the gamification activity.
Learner's role	• Prepares for class. • Participates in the random event. • Reflects and engages in discussions and class activities.
Assessment	• Select and apply a suitable gamification platform for informal assessment through quizzes and interactive activities. • Use activities for feedback, e.g., exit activities or exit questionnaires.

From this study, it can be concluded that applied and well-planned gamification can solve some issues connected to traditional approaches in the class, mainly concerning digital Generation Z learners. The results support literature on the positive impact of gamification in the learning environment concerning an increase in engagement and motivation among students (del Olmo-Muñoz et al., 2023; Saxena & Mishra, 2021). The results further reveal that gamification appeals to Generation Z learners from different socioeconomic and cultural backgrounds and various digital literacy levels. Although concerns are raised that a lack of access to technology for many learners in South Africa could hinder the implementation of gamification (Walker & Mkwana, 2015; Huus et al., 2016; Kobayashi et al., 2018), no such evidence emerged during the data analysis. We acknowledge that the population all had some form of digital literacy and that more research should be conducted in other populations who do not have CAT as a subject.

Furthermore, the research revealed that learner-centered approaches are more effective than teacher-centered approaches when facilitating theoretical content. Learners are more engaged during gamification and are subsequently less passive and more actively contributing to the learning process. Despite this, such a shift is necessary for the acquisition of SDL skills, which are vital in the process of continuing education in a dynamic world (Morris, 2024; Van den Broeck et al., 2024).

We acknowledge that the gamification intervention was applied for only one school term, which limits the ability to assess its long-term effects on learners' SDL and engagement and the generalization of findings. While the short-term nature of this study provided valuable insights into the immediate outcomes of gamification, we agree that future research should adopt a longitudinal approach to evaluate the lasting impacts of such interventions. Extended studies across multiple terms or academic years could provide deeper insights into how sustained gamification influences learners' motivation, SDL skills, and academic performance over time. Furthermore, longitudinal research could explore potential challenges, such as novelty effects or diminishing engagement, to refine and optimize gamification strategies for long-term implementation.

We further acknowledge that Classcraft, as a gamification platform, has been discontinued since this research was conducted. Other gamification platforms, such as Habitica, where learners can engage in role play and develop self-directed learning habits, are recommended.

This study establishes gamification as a tool with promising prospects for enhancing SDL amongst Generation Z learners when facilitating theoretical content. Thus, the use of technology and gamification to intrinsically motivate learners and ignite their curiosity can help improve the learning process and enhance SDL. These results provide important implications for the design of engaging teaching and learning environments to develop SDL of Generation Z learners.

Author Contributions: Conceptualization, J.H.S., B.B. and S.v.Z.; methodology, J.H.S., B.B. and S.v.Z.; validation, J.H.S., B.B. and S.v.Z.; formal analysis, J.H.S., B.B. and S.v.Z.; investigation, J.H.S.; resources, S.v.Z.; data curation, J.H.S., B.B. and S.v.Z.; writing—original draft preparation, B.B. and S.v.Z.; writing—review and editing, J.H.S., B.B. and S.v.Z.; supervision, B.B. and S.v.Z.; project administration, J.H.S., B.B. and S.v.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the North-West University Education Management and Economic Sciences, Law, Theology, Engineering, and Natural Sciences Research Ethics Committee (NWU-EMELTEN-REC) of the NORTH-WEST UNIVERSITY (ethics number NWU-01116-20-S2 on 12 October 2020).

Informed Consent Statement: Informed consent was obtained from participants' parents or guardians, and all participants involved in this study provided consent to participate.

Data Availability Statement: Data can be made available upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

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