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Integrating Gamification into Middle School Mathematics Curriculum: Game-Based Learning Approach in Namibia

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Abstract: The urge to integrate gamification into the traditional curriculum as a new educational technology tool has garnered widespread popularity throughout the years. In that light, unknown is the degree to which Namibia can adopt game-based learning in its educational system, precisely the middle schools. Consequently, the purpose of this study was to ascertain the perceptions of learners and teachers toward the effective integration of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. Grounded in the pragmatism philosophy, the study adopted a mixed research method in which quantitative data were obtained from 876 learners in middle school grades while qualitative data were acquired from 29 mathematics teachers using questionnaires with close-ended and open-ended questions, respectively. To dive into the phenomenon, the study analyzed quantitative data using structural equation modeling in the LISREL program, while qualitative data were analyzed using coding and reflexive thematic analysis with direct quotations in ATLAS.ti software. Based on the findings, learners and teachers in Windhoek expressed positive perceptions of integrating gamification into the middle school mathematics curriculum. However, the study also reveals the possibilities of gamifying the mathematics curriculum to be merely effective at the first stage of implementation, but other subjects are at stake, and not inclusive-friendly to learners from previously disadvantaged backgrounds, as emerged from the qualitative aspect of the study. Thus, the research calls for cohesive support in terms of financial support, non-financial support, and human capital support from the private sector, government, and international organizations to ensure the effective integration of gamification without jeopardizing other subjects and the inclusivity of vulnerable learners and those in remote areas.

Keywords: Integrating gamification in mathematics curriculum, Game-based learning in Namibia, Teachers' perception of gamification, Learners' perception of gamification

1. Introduction

The foundational information that students receive in middle school is highly regarded as a stepping stone for their future vocations and lives. Thus, various factors connected with varied cultures, social life, and technological advancement, among others, play prominent roles in determining the learners' learning processes (Marn-Daz et al., 2020). In this context, it is now apparent that the digital age and the use of smart gadgets are also a part of the learners' daily life since numerous learners have begun to utilize them for various purposes (Ortiz-Colón et al., 2018). Hence, it is important to consider taking the advantage of the benefits such as games, which come with digital devices, by including them in the educational space as a strategy to facilitate the teaching and learning processes. Moreover, the culture of constant technological advancement has spawned a new ecosphere of knowledge in which young people are more concerned with the delivery of education, which has affected the interest of learners as they pursue their studies. Hence, a demand to research innovative techniques and resources to increase the involvement and motivation of school students (Ortiz-Colón, 2018).

In the literature, there are a number of scholarly articles published between 2017 and 2021 that discuss the usage of gamification, participation, and encouragement throughout the preceding five years. This is in accordance with the directive of Werbach and Hunter (2012) that underscores the need to investigate the game's mechanics, dynamics, and aspects in light of the constant development of technology. In that vein, Werbach and Hunter (2012) believe that gamification procedures in education provide significant benefits to students, although they come with certain challenges.

Nevertheless, there appears to be a paucity of evidence that addresses the effectiveness of gamification in the education system, not only in Namibia, but also in Africa as a whole, and generalizing the findings from other continents could lead to inaccurate conclusions due to the differences in settings, economic stability, and technology. Relying on the taxonomy of Miles (2017) on research gap, this implies an empirical gap. Thus, it is essential to investigate the efficacy of gamification in education to get a wide matrix of techniques designed to promote engagement, boost learning, and uncover new educational models. In this regard, the purpose of this study was to delve deeper into the phenomenon to determine the extent to which gamification can be incorporated into the mathematics curriculum for middle school learners in Namibia, using Windhoek as the case representative.

In general, gamification has positive effects on teaching and learning, including collaborative learning, increased participation, and sustained interest and pleasure (Briffa et al., 2020; Tung et al., 2022; Urh, Vukovic and Jereb, 2015; Kocadere and Çağlar, 2015; Marchiori et al., 2012; Öztürk and Korkmaz, 2020; Şahin and Namli, 2016; Yığ and Sezgin, 2021). In detail, it enhances task performance by providing external incentives in the form of game components such as points, leaderboards, badges, levels, and special challenges, among others. Nevertheless, the effects on internal motivation are questionable, since specific game characteristics do not seem to influence people's interest, motivation, or well-being (Mekler et al., 2017). Consequently, there is an ongoing discussion over the effectiveness and ethical consequences of introducing entertaining strategies into the education system, which, when employed incorrectly, can have harmful impacts on learning (Kim and Werbach, 2016; Langendahl et al., 2016).

While incorporating gamification into the traditional curriculum as part of a new educational technology tool has so far gained significant acceptance, uncertain is, however, the extent to which Namibia can integrate gamification into its educational system. Against that background, the primary objective of this research was to investigate the feasibility of incorporating gamification into the middle school grades' mathematics curriculum, utilizing schools in Windhoek as the testing location from both qualitative and quantitative standpoints. To attain that, the study determined the perceptions of middle school learners from the quantitative perspective and mathematics teachers from the qualitative perspective on the effective integration of gamification into the middle school mathematics curriculum. In this respect, the findings of this research offer policymakers in the education sector crucial assistance for devising or assimilating policies designed to promote the ease of teaching and learning processes in a world characterized by technological development and cultural diversity. Additionally, the novelty of this research helps to narrow the empirical gap in the literature concerning the feasibility of incorporating gamification into the middle school grades' mathematics curriculum within the Namibian context.

2. Literature Review

2.1. The Concept of Gamification

Gamification is the incorporation of game design elements into non-gaming contexts, such as the workplace and educational settings (Nikolaou et al., 2019). Additionally, it is a strategy for enhancing the appeal and ease of use of a product, as well as the engagement and commitment of its consumers (Mekler et al., 2017). In this perspective, gamification approaches include gaming components, such as the application of game rules to non-gaming situations, and give a reward for attaining certain grades and passing levels in a certain topic area (Jayasinghe and Dharmaratne, 2013). In addition, they use a trial-and-error dynamic that permits failure, gives feedback, fosters a feeling of learners' development, employs a narrative, and offers various options, special challenges, competition, and fun (Langendahl et al., 2016). Besides that, Langendahl et al. (2016) further elucidate that the components of games are distinguished by their individuality. Hence, the implementation of such elements influences how people learn.

2.2. Elements Influencing Gamification

It is widely accepted that gamification has the potential to play a vital role in education. That being so, the objectives of educational games ought to correspond to the learning assignment to ensure that the game's academic foundations are

met (Marchiori et al., 2012). Asides from that, Brom et al. (2011) underscore that since the friction between the goal of the game and the learning outcome can reduce the game's learning effectiveness, then the fit between a learning task and the game is critical. In that respect, Fang and Chan (2013) identify the key elements that influence gamification as clear goals, feedback, concertation, immersion, control autotelic experience, and challenge.

i) Clear goals

Firstly, clear goal-based learning is a goal-directed process and gaming is a goal-oriented experience (Bellotti, et al., 2013). Thus, to support high-quality education, games must have goals (Gaisch et al., 2019; Jovanovic et al., 2011). However, individuals may misinterpret the game's actual goal because of games with unclear objectives, resulting in bad learning results (Charoenying, 2010).

ii) Feedback

Secondly, feedback is a very essential component of the learning process that the learners to mitigate the gap between their real knowledge and their desired knowledge (Butler, et al., 2013). In detail, such feedback that the player receives during the game allows them to keep track of their progress toward the game's goal (Cornillie, et al., 2012; Erhel and Jamet, 2013). Moreover, instant feedback also enables the learners to acquire specific ideas that can help them to improve their areas of weaknesses (Jong and Hodges, 2013). Thus, Walter (2013) asserts instant feedback as an advantage.

iii) Concentration

Thirdly, concerning concentration, Khanlarian and Singh (2014) highlight that the student's learning process is influenced by his or her concentration on a specific issue. Thus, when there are distracting stimuli outside of the focal area, then concentration suffers (Middendorf and Pace, 2014). This is because human memory can devote all of its attention to a single thing rather than multiple items (Janczyk and Grabowski, 2011).

iv) Immersion

Fourthly, immersion refers to the extent to which the individuals get engaged in the action (Whitton, 2011). In that line, the greater the level of interaction during the game, the greater the level of immersion (Li, et al., 2014). However, players can get emotionally invested and cognitively engaged because of the game (Besharat, et al., 2013). They can also immerse themselves in an alternate universe through games (Besharat, et al., 2013). According to Lee (2010), an immersion of players in an alternate universe promotes learning while increasing the player's enjoyment (Poels, et al, 2012). Lastly, Walter (2013) underscores that immersion is highly advantageous for the next generation which is thought to have a shorter attention span.

v) Concentration

Fifthly, Fang and Chan (2013) highlight the importance of the users of the game feeling that they are in control of their behavior and the environment because it explains several methods where learners can traverse access and manipulate the learning content within a specified learning environment. Moreover, the degree to which a player can control and alter the game's material is directly related to the game's interactivity, which makes it more interesting (Shafer et al., 2011). Similarly, such interactivities give the user control over the game's speed and content (Domagk et al., 2010). Lastly, being in control, striving to obtain control, or even the suspense of losing control make significant contributions to the enjoyment of a game (Poels et al., 2012).

vi) Control autotelic experience

Sixthly, autotelic experience is also a critical component that determines excellent experience, which is an end (Fang and Chan, 2013). They further added that the action becomes consuming and inherently rewarding. Thus, intrinsic motivation which is the internal urge to engage in behavior for the sake of pleasure, interest, enjoyment, and/or challenge is required (Moos and Marroquin, 2010). Also, the interest of an individual is required to keep rolling as they are completing the activities (Cerasoli and Ford, 2014). Thus, the ability to stay motivated to complete activities is especially vital for the net- generation, which is prone to boredom. (Walter, 2013).

v) Challenge

Finally, concerning the challenge, Gotsis et al. (2010) state that a task that gives challenges results in higher levels of learning, making the challenge a vital aspect of a learning environment. According to Feng (2011) the curiosity of a player gets piqued by the challenges that the game comes with, which eventually results in additional exploration of the game; thus, maximizing learning. For the next generation that is curious and prefers discovery, a challenge is a key aspect of games for them (Skiba and Barton, 2006)

2.3. Designing Game-based Assessments

While constructing game-based evaluations, three factors must be considered to produce a successful strategy. They consist of dynamics, mechanics, and constituents. First, particular dynamics must be constructed. According to

Werbach and Hunter (2012), the significant dynamics include the introduction of limits to challenge the participant, emotions to attract and maintain interest in the gamified assessment, stories to create a storytelling effect, progression, and the opportunity to build connections or status. Regarding education, evaluators may evaluate an individual's thought processes and school engagement based on their behaviors and interactions with these dynamics of growth (Wiklund and Wakerius, 2016). For example, if a player is aware that he or she is being monitored and evaluated, he or she is more likely to compete, which may be tracked using the dynamics.

In addition, a gamified environment has mechanisms that encourage player engagement. A reward that is a mechanical process, for instance, may inspire the player's sentiments of satisfaction, achievement, or curiosity (Wiklund and Wakerius, 2016). In addition, a game must include challenges, opportunities to promote competition and collaboration, feedback, rewards, transactions, and resource accumulation in order to contribute to the motivating component necessary for a person to take an examination (Werbach and Hunter, 2012). Levels, for instance, indicate the player's function in the game and may be used as a feedback system. However, product activation, which necessitates that a person achieves specific conditions to advance, is a difficult undertaking (Werbach and Hunter, 2012). In addition, medals may be used to establish objectives, offer explanations for previously taught behaviors, identify individual players, provide feedback, and promote competition (Wiklund and Wakerius, 2016).

Lastly, the dynamics, mechanics, and components of a game-based assessment are analyzed since they build the exam's context and enhance the assessment's objective and gamified experience (Werbach and Hunter, 2012). Lower anxiety, increased motivation, and a feeling of flow are all markers of a superior gamified experience, which results in more informed decisions. In a nutshell, gamified assessments diverge from conventional evaluations in such a manner that they place a greater emphasis on the overall assessment experience and the encouragement of user participation rather than just the final scores (Lopes et al., 2019).

2.3. Empirical Literature

The literature offers empirical research on gamification in learning and teaching environments. In that context, Şahin and Namli (2016) conducted a study on gamification and its impacts on students' scientific lesson success in Turkey from the quantitative viewpoint of the learners. The findings suggest that the gamification of scientific classes has the potential to lead to significant increases in the candidate's problem-solving abilities (Şahin and Namli, 2016). More, Öztürk and Korkmaz (2020) investigated the influence of gamification activities on academic accomplishment for students in the area of social studies in Turkey as well as their attitude toward the course and cooperative learning. The study was quantitative in nature and employed a semi-experimental research methodology on 60 pupils. The results demonstrate that gamification in social studies education provides considerable contributions to the attitudes of the students towards the course, as well as to their cooperative learning abilities and academic accomplishment compared to the conventional technique (Öztürk and Korkmaz, 2020).

Using a mix of social network analysis, computerized lexical analysis, and content analyses, Yığ and Sezgin (2021) undertook an exploratory holistic study of digital gamification in mathematics education to establish the problems, goals, and trends through a literature review. Apart from motivation and engagement, the study also reveals that gamification enhances mathematical problem-solving, mathematical attainment, and mathematical performance (Yığ and Sezgin, 2021).

Additionally, Karamert and Vardar (2021) studied the influence of gamification on the accomplishment of 46 mathematics learners and their perspectives on mathematics as a course. Using a quasi-experimental approach, the research discovers significant statistical differences in favor of the experimental group on the achievement test, but no significant changes on the attitude scale (Karamert and Vardar, 2021). Moreover, Briffa et al. (2020) examined the impact of gamification in education using a meta-analysis and 21 studies published between 2012 and 2018. Overall, the research demonstrates that the performance of learners may enhance by 50% for gamified courses (Briffa et al., 2020).

Similarly, Babeer (2021) evaluated the influence of gamification on the performance and mathematical abilities of high school pupils from a teacher's perspective. The research was quantitative in nature where data were obtained through a questionnaire from 169 randomly chosen mathematics teachers. The study's findings suggest that teachers are in favor of applying electronic gaming apps for teaching mathematics and learning abilities in remembering and

comprehending, analyzing, problem-solving, and making decisions (Babeer, 2021).

Following these results from the empirical literature, data from many nations demonstrates that gamification plays a key role in enhancing students' academic performance and attitudes about gamified topics. Nonetheless, there is a dearth of research evaluating the impact of gamification in the context of Africa and Namibia in particular. Hence, the rationale for conducting this study within the Namibian setting is to fill the vacuum in the current literature.

2.4. Theoretical Literature

2.4.1. Self-determination Theory

The Self-determination theory was developed by Deci and Ryan in 2000 (Antin, 2012). The most comprehensive application of this theory involves four steps, which include the identification of the goal of gamification, identification of the intrinsic motivational factors in gamification, identification of how the game mechanics map onto self-determination concepts (need for autonomy, need for competence, and need for relation), and the evaluation of the framework in applied research (Aparicio et al., 2012). Frequently, the focus is on intrinsic and extrinsic motivation, with gamification purportedly able to shift extrinsic motivation for a task to intrinsic motivation using intrinsically motivating game elements (Aparicio et al., 2012; Blohm and Leimeister, 2013; Nakajima, and Alexandrova, 2012; Nicholson, 2012). However, this assumption is problematic because it believes that all game features are inherently motivating and pleasant, even though the perceptions of an application for a game are subjective and hard to design (GartnerInc., 2012). In addition, this approach makes it seem that intrinsic motivation alone will be sufficient to make gamification effective, even though a high proportion of gamification apps fail due to poor design (GartnerInc., 2012).

2.4.2. Maslow's Hierarchy of Needs

Maslow's hierarchy of needs (1987) and its revision by Alderfer (1969) have also been used to frame gamification, with the hypothesis that game mechanics may map onto either Maslow's five stages of needs or Alderfer's three categories of existence, relatedness, and growth (Kim, 2013; Lin and Zhu, 2012). Maslow has been criticized for being reductionist and his theory for being impractical (Geller, 1982; Neher, 1991). This criticism can be extended to Alderfer (1969), making these theories appealing to non-psychologists because they are simple to understand and implement.

2.5. Conceptual Model

While various studies (Kocadere and Çağlar, 2015; Marchiori et al., 2012; Öztürk and Korkmaz, 2020; Şahin and Namli, 2016; Yığ and Sezgin, 2021) agree that gamification improves the teaching and learning processes in other countries, there remains a paucity of studies, which addressed the phenomenon within the Namibian context. Therefore, it was vital to conduct this study to assess the feasibility of integrating gamification into the mathematics curriculum for middle school learners in Namibia. In so doing, the study used a mixture model, which is a special structural equation model that accommodates a combination of both categorical and continuous variables.

As illustrated in Figure 1, the mixture model observed 6 variables comprising the desire for gamification (DG), gender, often use (OU), enhanced performance (EP), ease of use (EU), and cost efficiency (CE) that define two latent variables, made up of Learners' Perceptions (LP) and Effective integration of gamification (EIG), which could not be measured directly. The independent variable, LP was measured by DG (continuous variable), gender (categorical variable), OU (continuous variable), and EP (continuous variable) while the dependent variable, EIG was measured with EU and CE both continuous variables. This model was tested using structural equation modeling in LISREL software to determine the feasibility of integrating gamification in the mathematics curriculum for middle school learners in Windhoek, Namibia.

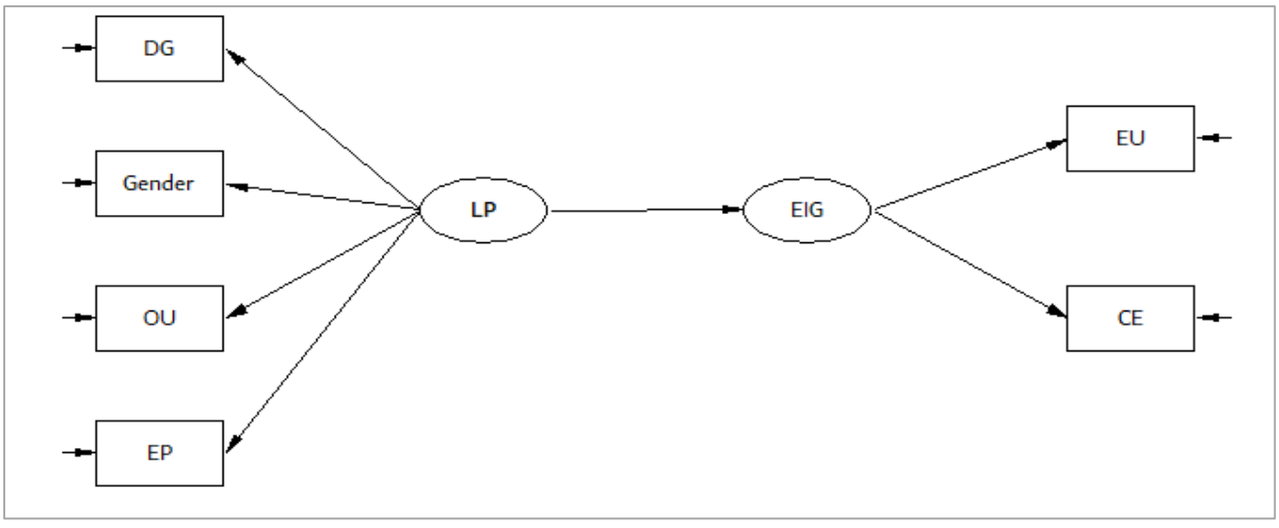

Figure 1: Testable conceptual mixture model
Source: Authors' construction (2022)

3. Research Methodology - Materials and Methods

This research was based on the pragmatism paradigm, which asserts that ideas are more valid when they facilitate action (Leavy, 2017). Hence, pragmatists claim that there are different ways to perceive the world and conduct research, implying that a single perspective cannot effectively give deep knowledge and multiple realities of the investigated phenomena (Nautwima and Asa, 2021). Moreover, the study adopted an explanatory research design to investigate the phenomenon from a quantitative perspective to a qualitative perspective.

In that sense, quantitative data were collected using a questionnaire with close-ended questions from 876 learners who were randomly selected from middle schools in Windhoek while qualitative data were gathered using a questionnaire with open-ended questions from 29 mathematics teachers in Windhoek, who were purposively sampled. For the quantitative aspect of the study, the data were analyzed using a Mixture model of the Structural Equation Modelling (SEM) in LISREL software, where the covariance matrix was generated using Statistical Package for the Social Sciences (SPSS). Finally, the study analyzed qualitative data in ATLAS.ti software using a combination of coding and reflexive thematic analyses with direct quotations, which, according to Nautwima and Asa (2022), enable the researcher to comprehend the results without diverting from the participants' original meaning.

Finally, to ensure reliability, this study used Cronbach's Alpha in SPSS on a pilot study that was conducted with schools that did not make part of the final sample study. This was essential to make sure that the questions in the questionnaire are understandable to mitigate ambiguity and provision of further clarifications that may be required (Nautwima and Asa, 2021). In this case, a high alpha of at least 0.70 is preferred as it indicates the internal consistency of the instrument (Hair et al., 2017). Thus, only constructs with an alpha coefficient of at least 0.70 were constituted in the instrument.

4. Empirical Results

4.1. Learners' Perceptions of Gamifying Mathematics

The quantitative aspect of the study sought to analyze the perceptions of learners on the effective integration of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. Based on the data collected from 876 learners in middle schools located in Windhoek, Namibia, using a structured questionnaire with open-ended questions, the frequency analysis shows that 43% of the participants represented female learners while 57% represented male learners as depicted in Table 1.

This shows a fair distribution of gender in the study, indicating that the data are not skewed to a specific gender, which enhances the accuracy and makes the results reliable and generalizable across gender. Also, important to note, 87% of the learners indicated that they are faced with challenges in mathematics. These results are in line with the postulation of Abdullah and Yang (2019) that highlights that mathematics is a challenging subject for students to grasp. Finally, 81% of the students indicated that they prefer gamification to be incorporated into the mathematics curriculum.

Table 1: Frequency analysis

1. Gender	**Female**	**Male**
	43%	57%
2. Facing challenges in mathematics	**Yes**	**No**
	87%	13%
3. Prefer gamification	**Yes**	**No**
	81%	19%

Source: Authors' compilation from the analysis (2022)

4.2. How Learners Perceive Effective Gamification of Mathematics

To analyze the perceptions of learners on the effective integration of gamification into the mathematics curriculum for middle school learners in Namibia, the study tested the developed mixture model in Figure 1, using Structural Equation Modeling in LISREL with a covariance matrix created in SPSS software. In the model, LP is the latent variable, which represents the Learners' Perceptions as the independent variable, while EIG is the dependent variable representing the Effective Implementation of Gamification, also a latent variable.

However, after running the analysis to test the initial mixture model, the results indicate an insufficient fit of the model, given Chi-square = 22.13, df = 8, p = 0.00468, as shown in Figure 2. In addition, the values of the Goodness of the Fit Index (GFI) and Comparative Fit Index (CFI) are also low at 0.231 and 0.174, respectively. This is against the rule of thumb that illustrates that the Chi-square should be low, although there is no internationally recognized apogee for it, while the GFI and CFI must be close to 1 to indicate the goodness fit of the model. Thus, the modification indices suggested the addition of the error covariance between DG and OU. After the modification, a new model was created, shown in Figure 3.

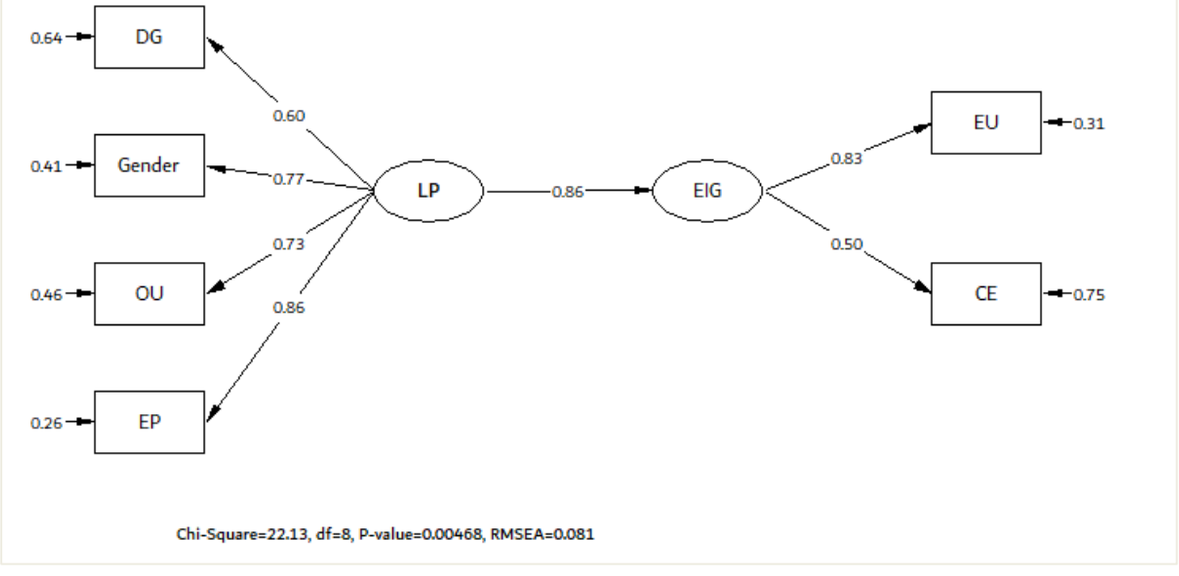

Figure 2: Initial mixture model
Source: Authors' extraction from the analysis (2022)

Since the initial model was not acceptable, given a high Chi-square value and low values of the GFI and CFI, the study modified the model as suggested by the modification indices, which reduced the Chi-square value to 6.03, which is substantial to the model fit. Moreover, the results also reveal high GFI and CFI, showing 0.974 and 0.984, respectively, which are acceptable for a model fit criterion. The combination of these indicates that the model is a good fit for the data. As depicted in Figure, 3 the measurement equations indicate that enhanced performance (EP) loads the highest on Learners' Perceptions (LP) regarding the integration of gamification into the mathematics curriculum for middle school learners, accounting for 86%. This is also statistically significant, given a t-value of 9.804 that exceeded the threshold of 1.96, according to the rule of thumb, as detailed by Nautwima and Asa (2021).

This was followed by gender, often use (OU), and the desire for gamification (DG) that load 77%, 73%, and 59%, respectively, on LP, which were all proven to be statistically significant at t-values of 9.29, 9.344, and 10.267, correspondingly.

Moreover, the R^2 of 0.743 on EP, 0.588 on gender, and 0.529 OU indicate a moderate confidence interval while the R^2 of 0.353 on DG implies a low confidence interval. Regarding the two observed variables of EIG, the ease of use (EU) for gamification defines the effective integration of gamification (EIG) the highest, accounting for 83% while cost-efficiency (CE) defines it as 50%, which was also proven to be statistically significant at t-values of 7.821 and 6.96, respectively. Lastly, the relationship between the latent variables shows that the learners have strong positive perceptions of the effective integration of gamification in terms of its ease of use and cost efficiency, which is predicted at 86% and proven to be statistically significant with a moderately high confidence interval, given a t-value of 4.965 and an R^2 of 0.745.

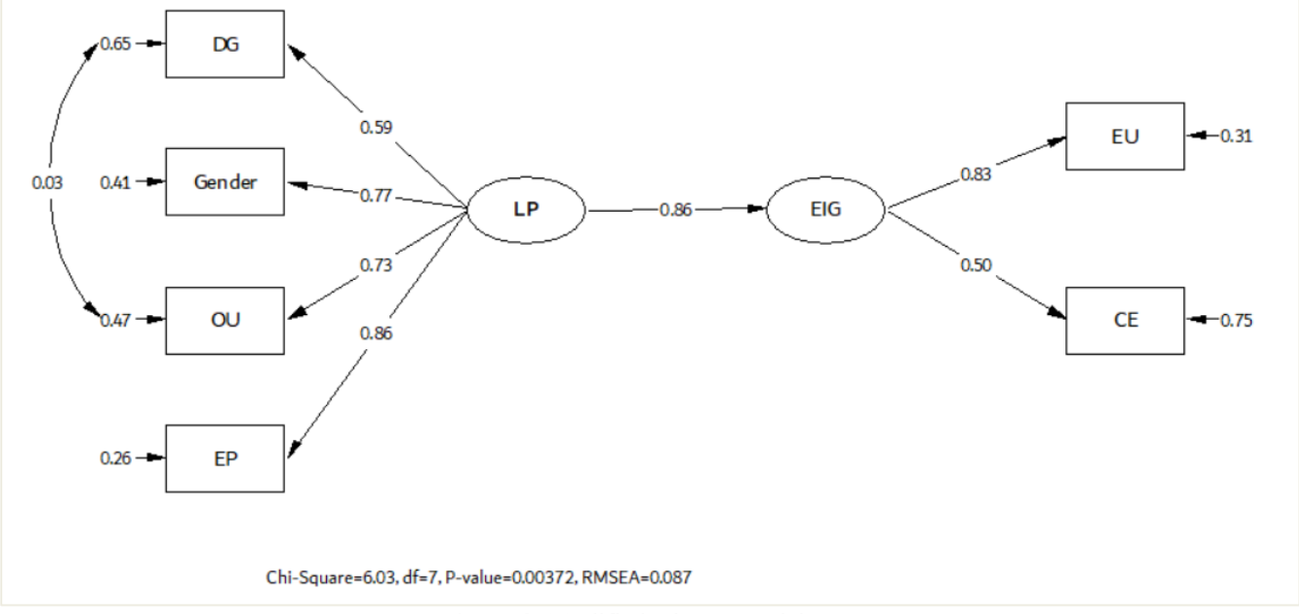

Figure 3: Modified mixture model
Source: Authors' extraction from the analysis (2022)

4.3. Teachers' perceptions of gamifying mathematics

The qualitative aspect of the study sought to explore the perceptions of teachers on the integration of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. In so doing, the study relied on the data collected from 29 mathematics teachers using a questionnaire with open-ended questions and analyzed the data using coding and reflexive thematic analysis with direct quotations. Before delving deeper into the teachers' perceptions of gamifying mathematics, the study explored the challenges that teachers are faced with when teaching mathematics the traditional way.

4.3.1. Challenges Faced by Teachers when Teaching Mathematics the Traditional Way

To understand the challenges that mathematics teachers are faced with when traditionally teaching the subject, the study used coding analysis with direct quotations in ATLAS.ti software to analyze the data. As shown in Figure 4, four codes emerged from the analysis, which illustrates that the traditional way of teaching mathematics is very tiring, time-consuming, uncomfortable, and inflexible, as it is practically based. The codes are backed up with two direct quotes, which demonstrate that the traditional way of teaching mathematics makes it tedious for the teachers as they spend the whole day writing on the board, and the learners when they begin to lose concentration.

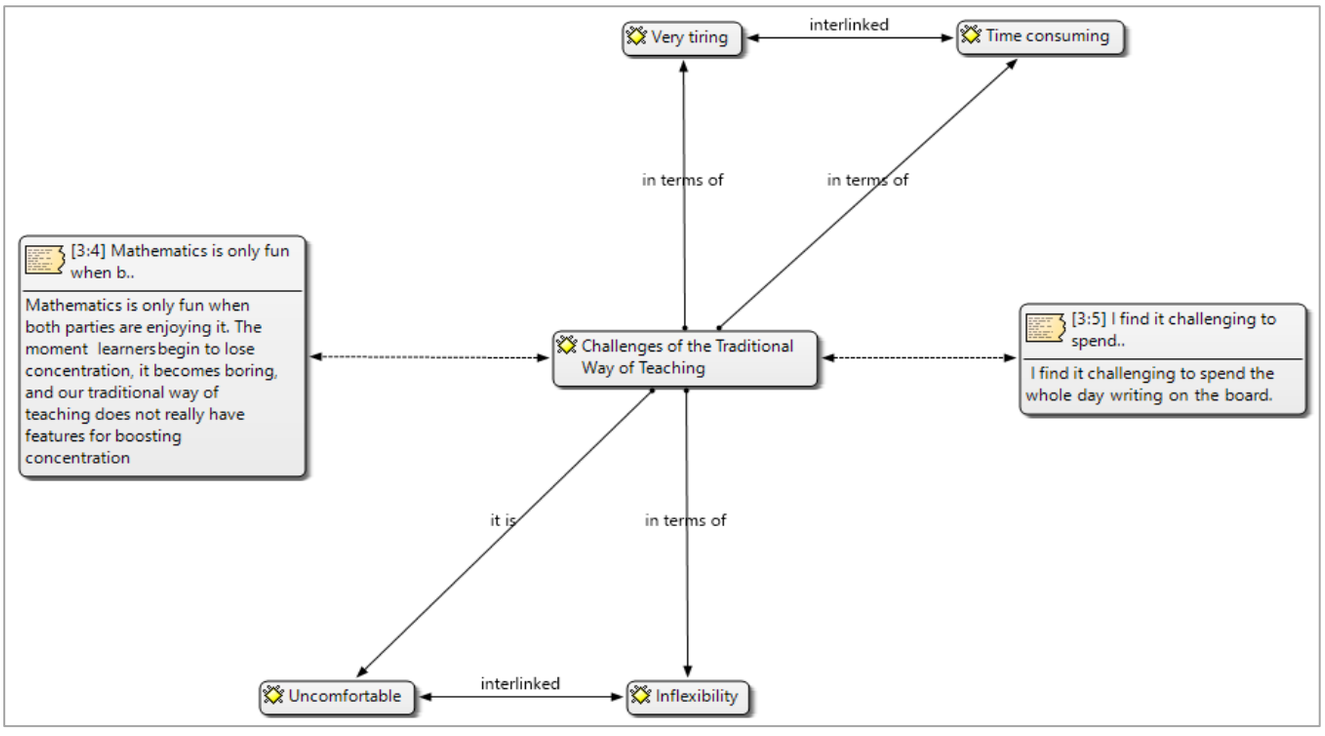

Figure 4: Challenges faced by teachers when teaching mathematics the traditional way
Source: Authors' extraction from coding analysis (2022)

4.3.2. How Teachers Perceive Gamification in Mathematics

After exploring the challenges that mathematics teachers are faced with when teaching mathematics the traditional way, the study sought to explore the perceptions of teachers regarding the integration of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. This was on the basis that gamification eases the teaching and learning processes, making it a key driver for learners' improved performance, and positive attitudes towards the gamified subject in other countries (Briffa et al., 2020; Tung et al., 2022; Urh, Vukovic and Jereb, 2015.; Kocadere and Çağlar, 2015; Marchiori et al., 2012; Öztürk and Korkmaz, 2020; Şahin and Namli, 2016; Yığ and Sezgin, 2021), as transpired from the literature. To attain this, the study used thematic analysis with direct quotations in ATLAS.ti software. In this regard, two themes emerged, which grouped the perceptions of teachers into two categories as displayed in Figure 5.

The first theme signifies the positive perceptions of teachers toward gamification of the mathematics curriculum, which is illustrated by two direct quotes, indicating that they prefer gamification as they have only adopted the traditional way due to the unavailability of alternatives. In addition, teachers have also indicated that gamifying mathematics will improve the teaching and learning processes by making the class interesting with high interaction from the learners and eventually making them perform better, predominantly those who believe that mathematics is a difficult subject. Against the positive perceptions of teachers, the second theme demonstrates the negative/neutral perceptions of teachers toward the gamification of mathematics, which emerged with three direct quotes. The first quote indicates that gamifying mathematics will only work in the beginning and slowly begin to become boring as time goes on. The second one illustrates that it will not work well for vulnerable learners, while the third one demonstrates that it will put other subjects at stake.

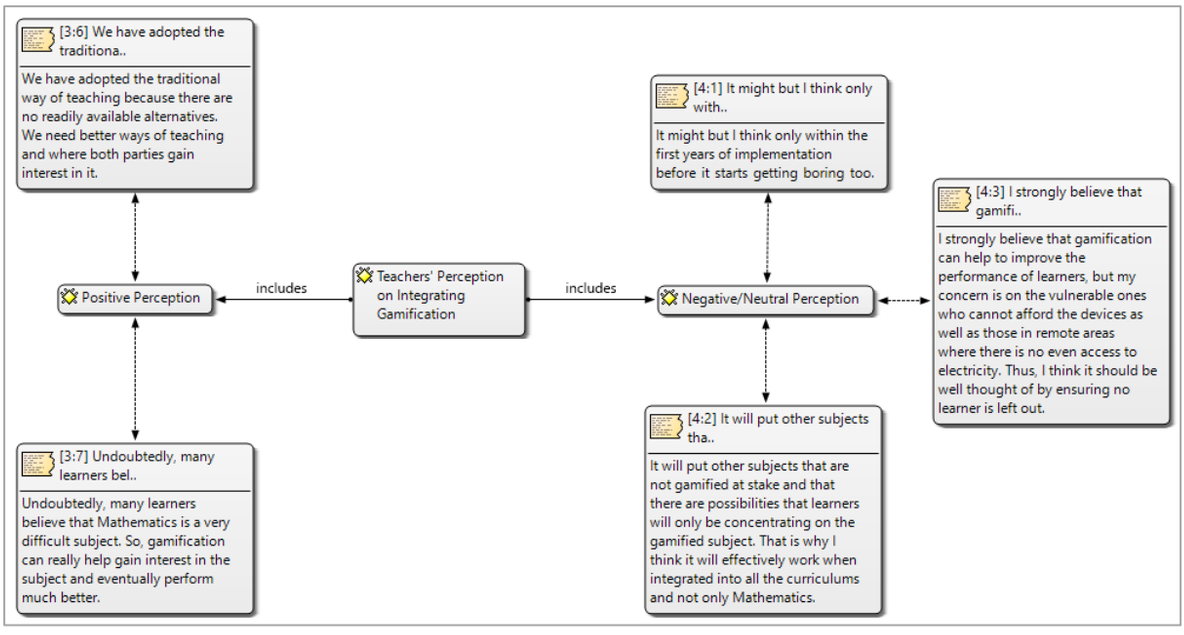

Figure 5: Teachers' perceptions of gamifying mathematics
Source: Authors' extraction from thematic analysis (2022)

4.3.3. Recommendations on the Way Forward

Finally, the study sought to explore the opinion of teachers on the way forward for effective implementation of the integration of gamification into the mathematics curriculum for middle school learners. In this regard, the study used thematic analysis, which emerged with two themes complemented by one direct quote as depicted in Figure 6. The first theme and its codes indicate the need for funding and support in terms of financial support, human skills, and non-financial support such as computers and other equipment, which is essential for learners from previously disadvantaged backgrounds to ensure inclusivity. This could be done through partnerships between the government, the private sector, and international organizations. Lastly, the direct quote demonstrates the need to consider the integration of gamification into the entire curriculum to curb the issue of students' interest diversification from other subjects to mathematics only.

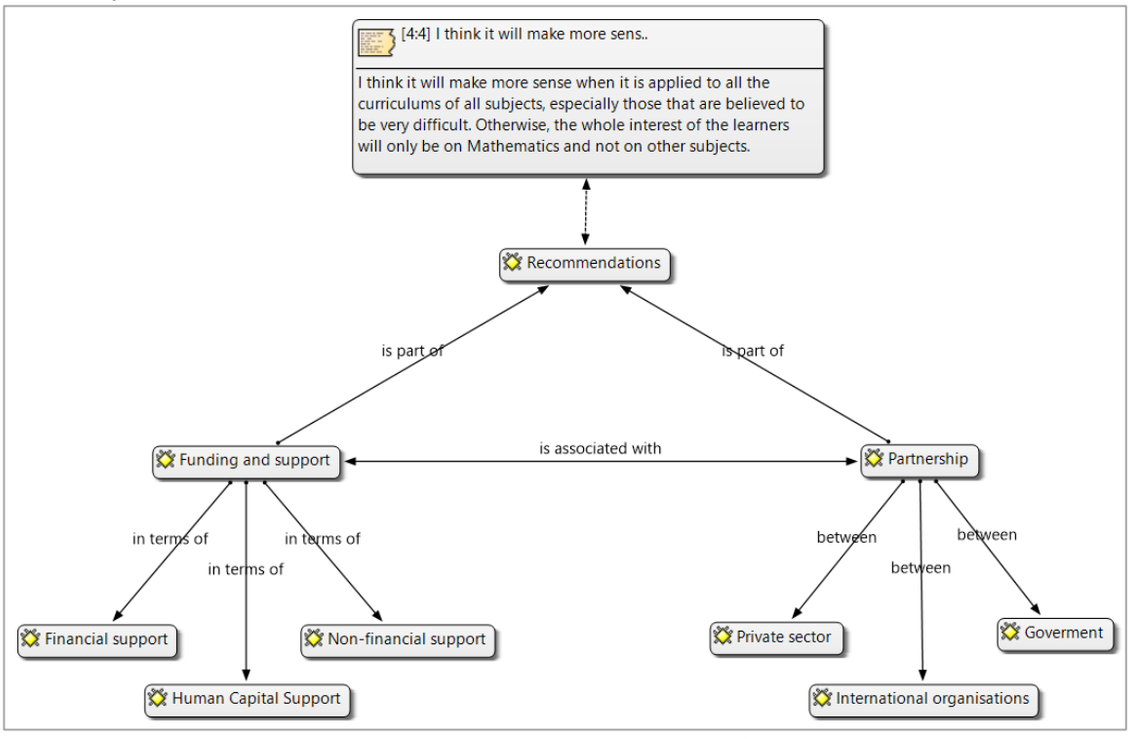

Figure 6: Recommendations on the way forward
Source: Authors' extraction from thematic analysis (2022)

5. Discussion

Early studies (Briffa et al., 2020; Tung et al., 2022; Urh, Vukovic and Jereb, 2015; Kocadere and Çağlar, 2015; Marchiori et al., 2012; Öztürk and Korkmaz, 2020; Şahin and Namli, 2016; Yığ and Sezgin, 2021) confirm the positive influence of gamification on teaching and learning, including collaborative learning, increased participation, and sustained interest and pleasure. Based on that, this study investigated the perceptions of learners and teachers on the effective integration of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. Overall, the results of this study indicate that learners have strong positive perceptions of the effective integration of gamification in terms of its ease of use and cost efficiency. These results are consistent with the findings of Briffa et al. (2020), which highlight that the performance of learners can improve by up to 50% for gamified subjects. Similarly, Tung et al. (2022) also found gamification to be a prominent tool in enhanced motivation and improved performance for students in high-learning institutions. Furthermore, this study reveals that the traditional way of teaching and learning mathematics is challenging. In cases like this, innovation becomes crucial (Asa et al., 2022). Thus, the positive perceptions of teachers towards the integration of gamification into the mathematics curriculum for the betterment of teaching and learning processes, citing that gamification can boost the learners' interest in the subject. These results are in line with the findings of Öztürk and Korkmaz (2020), which underscore that gamification can enhance cooperative learning skills more than the traditional method could. Similarly, Urh, Vukovic and Jereb (2015) also illustrate that gamification tackles the issue of learner distraction while stimulating their involvement in the course. They are also corresponding to the findings of Babeer (2021), which reveal a positive agreement of teachers toward the implementation of electronic gaming applications in teaching mathematics. However, other teachers revealed limited confidence in the gamification of the mathematics curriculum, citing the unsustainability of the positive influence of gamifying the mathematics curriculum in the long term, the issue of putting other subjects at stake, and the probability of not attaining inclusivity.

6. Conclusion

This study assessed the perceptions of learners and teachers on the effective integration of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. In that frame of reference, this study found that learners have strong positive perceptions toward the effective integration of gamification in terms of its ease of use and cost efficiency. From the teachers' point of view, the study found mixed perceptions of teachers toward the effective implementation of gamification into the mathematics curriculum for middle school learners in Windhoek, Namibia. That is, while some teachers believe that gamification will address the challenges of the traditional way of teaching mathematics by boosting the interest of learners in the subject and easing the teaching process, which will result in improved performance, others were not certain, elucidating that it will only be effective in the beginning, but put other subjects at stake, and learners from previously disadvantaged background are likely to be left out. Therefore, to ensure that these possible challenges of gamification are curbed, teachers recommend the integration of gamification into the entire curriculum instead of just the mathematics one. This could be attained through collaborative support in terms of financial support, non-financial support, and human capital support from the private sector, the government, and international organizations.

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