

# STUDENTS' INTRINSIC MOTIVATION USING GAME-BASED ACTIVITIES

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## Abstract

*This study sought to determine the effects of game-based activities (GBAs) on students' intrinsic motivation. The study employed a sequential explanatory mixed-methods approach using quantitative and then qualitative data to explore the impact of GBAs on intrinsic motivation. It also utilized lessons integrating GBAs into an ecosystem curriculum developed and adapted by the researcher for the study. Sixty-nine Grade 7 students from two sections of a public secondary school in Sorsogon, Philippines, participated in this study. One section with 34 students was assigned to an experimental group and exposed to GBAs developed for ecosystem lessons. The 35 students in the other section were assigned to a control group and taught with games using traditional teaching methods. Respondents completed a survey on the intrinsic motivation inventory (IMI) after the intervention. The survey results revealed a significant difference in the IMI scores of respondents ( $u = 327$ ,  $N = 69$ ,  $p = 0.05$ ), and the integration of GBAs in ecosystem lessons for Grade 7 significantly improved students' intrinsic motivation. Qualitative data analysis also revealed that GBAs specifically addressed students' psychological needs in terms of interest or enjoyment, perceived competence, effort or importance, value or usefulness, and relatedness, which ultimately improved students' intrinsic motivation. Integration of GBA into ecosystem lessons can improve students' intrinsic motivation when GBAs align with learning goals and include interactive and engaging game elements. This study emphasized the effects of GBAs on intrinsic motivation and delved deeper into the specific context of science education in Grade 7, providing insights on how to harness GBAs effectively in specific educational settings. This study recommends the integration of GBAs into science education to enhance students' motivation and improve their learning experiences and outcomes. A more comprehensive study of the effect of GBAs on students' learning experiences is also recommended.*

**Keywords:** Game-based activities; IMI; Intrinsic motivation; Science education; Sequential explanatory design.

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## 1. INTRODUCTION

Game-based activities (GBAs) in education relate to the integration of particular game components into academic contexts in an effort to pique students' interest (Pan et al., 2021; Van Roy & Zaman, 2018). This may include elements of competition, a point-and-reward system, and feedback loops. The driving principle of using GBAs in education is their inherent potential to interact with learners in a diverse and engaging manner. Learning through GBAs is not only about creating games for learners to play with but also includes framing the games or game-based activities to gradually introduce concepts and help learners achieve predetermined learning outcomes (Chen et al., 2018). GBAs can assist not only in creating a more engaging and motivating learning environment but also in influencing different aspects of the teaching and learning process. As a result, the use of game-based activities in learning, or simply, game-based learning (GBL), has become an educational tool and strategy that involves students in the learning process (Bado, 2022; Falciani, 2020; Tokac et al., 2019; Trajkovik et al., 2018).

In science education, GBL has previously been applied to support students by capturing their interest and providing them with fun, game-like experiences (Macayan et al., 2022). Several studies also suggest that the pedagogical use of games in science education can facilitate student learning and may lead to active participation (Dabbous et al., 2022; Huotari & Hamari, 2017; Koivisto & Hamari, 2019) and improve students' academic performance (Lasala, 2023). These outcomes can be attributed to the close relationship between game-based learning and active learning (Lasala, 2022). Game-based activities are generally known for their ability to excite and engage learners when they actively participate in tasks and work toward attaining learning goals (Dabbous et al., 2022; Huotari & Hamari, 2017; Koivisto & Hamari, 2019). In addition to allowing students to experience and apply knowledge, game-based learning activities offer a stimulating, individualized, interactive, and enjoyable learning environment (Chang & Yeh, 2021; Lampropoulos et al., 2019). Through game-based activities, students become more hands-on with their learning, whether as individuals or as a group (Lasala, 2022). GBAs provide a unique learning and teaching framework to support a variety of teaching strategies, infuse them with fun, and spark creativity and innovative thinking while still focusing on academic content. The aim is to help students better understand the subject matter rather than emphasizing competition and task difficulty (Adipat et al., 2021; Zhong, 2019). Thus, game-based activities are especially effective for dealing with problem-solving and key concepts; hence, they can also be integrated into subjects such as science.

The use of game-based activities in science education has been found to be effective in capturing students' attention, time, and commitment (Scherer, 2017), motivating them to learn and participate in the lesson (Funa et al., 2024; Kandemir & Kose, 2019), evoking feelings of self-efficacy and control over their own learning (Sailer & Homner, 2020), and fostering a positive attitude toward it (Hebert & Jenson, 2019). However, although GBL has been found to positively impact and increase students' motivation and participation (Hartt et al., 2020; Zimmerling et al., 2019), some research suggests otherwise, claiming that games do not improve students' intrinsic motivation

and linking GBL to novelty expiry and decreased satisfaction and excitement over time (Lasala, 2023; Leitão et al., 2022; Mekler et al., 2017). Moreover, although it is commonly known that game-based activities increase students' motivation, the majority of studies either do not distinguish between extrinsic and intrinsic motivation or only discuss extrinsic motivation. This is because GBL in education is widely associated with external motivation only because of the presence of an external point-and-reward system (Gilyazova & Zamoshchanskii, 2020). Both extrinsic and intrinsic motivation can potentially improve students' performance; however, extrinsic motivation could encourage rivalry, which has various effects on students' performance, while only intrinsic motivation is explicitly linked to significantly enhanced mental health, creativity, learning outcomes, and long-term engagement in an activity (Cerasoli et al., 2014, as cited in Kalogiannakis et al., 2021; Ryan & Deci, 2017).

Although the use of GBAs can improve both the extrinsic and intrinsic motivation of students, past studies have focused more on the effects of GBAs on extrinsic motivation. This global trend is also evident in Philippine education, with more focus on digital GBAs and their effects on extrinsic motivation (Conte, 2017; Hernando-Malipot, 2022; Macayan et al., 2022). Previous studies left a significant gap in understanding the effects of nondigital game-based activities on the intrinsic motivation of students. In light of this, the researcher believes that determining the effects of game-based activities on students' intrinsic motivation is critical. This study is relevant for enhancing the use of game-based learning activities in science education, improving our understanding of this methodology, and expanding on previous research to allow reviews and analyses of the relevant literature. The aim of this study is to determine the (1) effects of GBAs on Grade 7 students' intrinsic motivation in terms of (a) interest/enjoyment, (b) perceived competence, (c) effort/importance, (d) pressure/tension, (e) perceived choice, (f) value/usefulness, and (g) relatedness, and (2) students' attitudes and behavior toward the use of GBAs. This study provides empirical evidence on the impact of GBAs on intrinsic motivation and, consequently, the learning process.

## **2. LITERATURE REVIEW**

There is a large body of research and growing interest in the effects of game-based learning and intrinsic motivation in academic contexts. The comprehensive exploration of these intertwined themes illuminates the value of intrinsic motivation in the learning process and examines the different ways game-based activities can both leverage and improve intrinsic motivation, thus creating a more effective and engaging learning experience.

### **2.1. Game-based learning as a pedagogical strategy**

Game-based learning has become a dynamic instructional strategy that uses games and simulations to pique students' interest in learning. Several studies have explored the effectiveness of GBL across academic levels and subjects. For higher education, studies show that GBL, or the use of game-based activities, increases students' interest, cognitive ability, and critical thinking skills, thereby improving their learning outcomes. Using

GBL as a pedagogical strategy creates a fun and dynamic environment, especially at higher education levels (Jain et al., 2022; Wardoyo et al., 2020). Studies have also revealed that GBL can improve students' self-efficacy, cognitive knowledge, and skill acquisition in science and other academic subjects (Hamden Hamid et al., 2022; Wang & Zheng, 2021).

A quasi-experimental study conducted by Chung et al. (2017) revealed that using GBL as a pedagogical strategy through nondigital game-based activities improved learning outcomes in spatial mathematics for Grade 9 students in Taiwan. The authors noted that GBL allows greater and better interactions with and among the students and promotes teamwork. GBL also enhances students' decision-making and information evaluation skills. The environment GBL creates helps students acquire all these skills, which improve their learning.

For elementary students, studies show that GBL promotes and develops students' positive attitudes toward learning, growth mindsets, and positive work ethic. Studies have also noted that students' engagement, problem-solving skills, and sense of fairness improve through the use of GBL (Atienza & Andal, 2023; White & McCoy, 2019).

The intentional alignment of game elements and learning goals is necessary to gain educational leverage from game-based learning. While GBL offers great advantages, challenges persist, and its integration into existing curricula remains a prominent concern (Krath et al., 2023). The impact of GBAs on learning remains a compelling area of exploration, especially with its potential to improve learning outcomes and experiences.

## **2.2. Role of intrinsic motivation in learning**

Deci (1971, as cited in Mauck, 2022) defined intrinsic motivation as the motivation that pushes a person to do something for the sake of the act itself without being enticed by any reward or external factors. It is divided into seven subscales, including interest/enjoyment, perceived competence, effort/importance, pressure/tension, perceived choice, value/usefulness, and relatedness (Ryan, 1985, as cited in Martínez-Rodríguez et al., 2021).

The interest/enjoyment subscale is generally accepted as a self-reported indicator of intrinsic motivation. According to theory, pressure/tension is seen as a negative predictor of intrinsic motivation, but perceived choice and perceived competence are thought to be positive predictors of both self-reported and behavioral measures of intrinsic motivation. Because effort is a distinct variable pertinent to some motivational concerns, it is employed when appropriate. The idea behind the value/usefulness subscale is that people internalize and develop self-regulation over activities that they see as worthwhile or useful for themselves. The relatedness subscale is also employed in research on friendship development and other topics involving social interactions (Deci et al., 1994, as cited in Clancy et al., 2017). These subscales represent the inherent psychological needs of an individual. In education, fulfilling these needs leads students to engage in their learning process effectively.

Studies by Lo et al. (2022) and Mastur and Suriaman (2021) confirmed the positive link between intrinsic motivation and effective student learning. Intrinsic motivation not only improves students' knowledge acquisition and academic performance but also allows them to take on challenges, welcome healthy competition, and persist in their learning process (Singh et al., 2022; Taufan, 2017). Moreover, a descriptive study by Oclaret (2021) on the effect of intrinsic motivation on high school students in the Philippines showed that intrinsic motivation has a significant impact on academic performance. Students who are intrinsically motivated perform better. The author also highlighted the need for meaningful and engaging learning lessons and activities to keep students intrinsically motivated.

### **2.3. Game-based activities and intrinsic motivation**

A growing body of literature has explored the relationship between game-based activities and intrinsic motivation in academic settings. Self-determination theory (SDT), developed by Deci and Ryan in 1985, has provided a theoretical framework for understanding how GBAs might encourage learners' intrinsic motivation. GBAs must fulfill the psychological needs of students, as indicated by the seven subscales of intrinsic motivation, to improve intrinsic motivation and learning experiences (Proulx et al., 2017).

Studies by Ahn et al. (2019), Ling (2018), and Rogers (2017) asserted that lessons integrating GBAs highlight elements of SDT such as relatedness, autonomy, and competence, thereby improving students' intrinsic motivation. The findings of these studies also suggest that the reward-and-point system, immediate feedback, game rules, and choices embedded in GBAs can significantly contribute to students' intrinsic motivation. Furthermore, Balakrishna (2023), in her study on the impact of non-digital GBAs, argued that maintaining the balance of the integration of GBAs with a formal curriculum and having challenge-based GBAs can effectively increase students' intrinsic motivation, as they provide students with a sense of progress and achievement. The existing literature emphasizes the effectiveness of GBAs as a potent instrument for improving intrinsic motivation in educational settings, with significant implications for creating meaningful learning experiences.

## **3. METHODOLOGY**

### **3.1. Research design**

This study employed a sequential explanatory mixed-methods approach to explore the effects of game-based activities on students' intrinsic motivation, attitude, and behavior toward the use of GBAs in lessons. This research design provides a comprehensive and nuanced understanding of the impact of GBAs on students' intrinsic motivation. The quantitative phase of the study provides a quantitative framework for analyzing preliminary results and determining statistical significance following a rigorous scientific inquiry (Creswell & Creswell, 2017). The subsequent qualitative phase allows a deeper investigation of the underlying mechanism and contextual factors affecting intrinsic motivation and strengthens the quantitative findings (Draucker et al., 2020). This

two-phase technique allows for a deeper understanding of the phenomenon being studied by integrating quantitative evidence with relevant qualitative information, thereby increasing the validity and reliability of the findings.

### **3.2. Respondents and locale**

The respondents in this study were 69 Grade 7 students from two special science sections of one of the biggest public secondary schools in Sorsogon City, the Philippines. The selected school offers a special program for science education, highlighting the study's focused subject, and the two sections purposively selected belonged to the special science program. These sections were chosen because their program provides more focus on science subjects and has homogenous knowledge and performance in science education that could help provide reliable and meaningful data and insights for the study. One section of 34 students was assigned to the experimental group, and the other section of 35 students was assigned to the control group. The Grade 7 students and their parents consented to take part in this study. Student-respondents had the same exposure, training, and attributes. They came from a group of students who completed a series of interviews and qualified in entrance examinations for the special science program at their school. Their section is classified as homogeneous.

Three biology teachers at the school, two Master Teachers and one Teacher III, all of whom have taught for more than five years, were invited to monitor and provide feedback, comments, and recommendations on the integration of GBAs. This was done to obtain expert opinions on the impact of GBAs on students' intrinsic motivation.

### **3.3. Data collection procedure**

To follow ethical procedures, permission was requested from the school's principal to conduct the study. The science class adviser and department head were consulted once permission was given. Afterward, letters were sent to the students' parents, asking for their consent to allow their children to be respondents in the study. The students without signed consent forms from their parents or guardians were allowed to participate in the study. However, only the information from the participants whose parents gave their consent was examined during and after the intervention. Likewise, COVID-19 guidelines and health protocols were strictly observed to ensure the safety of the students. Throughout the activity, students were encouraged to wear face masks, even though doing so has become voluntary.

The implementation of game-based activities in classroom lessons ran from the second to the fourth week of October 2022. Grade 7 students were undertaking ecosystem lessons at that time, to which the GBAs were adapted. Table 1 shows the schedule of the study on the integration of GBAs into ecosystem lessons. The table also reflects the competencies related to the lessons, as indicated in the curriculum guide for Grade 7 science.

**Table 1. Schedule of the study on GBA integration**

Lesson/GBA	Learning Competency	Lesson Component					Time Allotment	Date
		Engage	Explore	Explain	Elaborate	Evaluate		
LESSON 1: Components of the ecosystem	Differentiate biotic from abiotic components of the ecosystem				Game 1: THE CONQUEST: Saving SNHS Forest		2 hrs.	October 14, 2022
LESSON 2: Ecological relationships	Describe the different ecological relationships found in an ecosystem		Game 2: ECO-DRAMA				2 hrs.	October 17, 2022
LESSON 3: Energy transfer through trophic levels and the effect of changes in one population on another population in the ecosystem	Predict the effect of changes in one population on other populations in the ecosystem				Game 3: The ECO-CHALLENGE		3 hrs.	October 19, 2022
LESSON 4: Effect of changes in abiotic factors in the ecosystem	Predict the effect of changes in abiotic factors on the ecosystem				Game 4: ECO-WARRIOR: Saving the Animals from Extinction		3 hrs.	October 24, 2022

The study lasted for three weeks as planned, and a total of ten hours of instruction was allocated to finish all topics, as prescribed by the Department of Education (DepEd). Both the control and experimental groups received the recommended strategy for the ecosystem topics. However, GBAs were integrated into each lesson for the experimental group. The control group used suggested activities from the curriculum guide. Likewise, to avoid experimenter bias, the researcher requested a science teacher to teach both classes.

After every lesson, students from the experimental group were tasked with writing in their journals about their learning experiences, either at school or in the library, and informal follow-up interviews were held with the students during their free periods. After the intervention, both groups were also given the intrinsic motivation inventory (IMI). The gathered data were prepared for tabulation, analysis, and interpretation.

### 3.4. Research instruments and data analysis

#### 3.4.1. Research instruments

The study employed four instruments: Game-based activities, an intrinsic motivation inventory, teachers' observations, and students' reflective journals. The study utilized four game-based activities: (1) The Conquest, (2) Eco-Drama, (3) Eco-Challenge, and (4) Eco-Warrior. These GBAs were integrated into four different ecosystem lessons for Grade 7 biology in a study by Lasala (2022).

For the study, these four GBAs were anchored in different topics and learning competencies in the ecosystem lessons by adapting popular games. The researcher developed separate games for the students in the control group, such as modified UNO cards, LUDO King, and a Jeopardy game, which were integrated into the next competencies and lessons after the ecosystem topics, as reflected in the K-12 science curriculum guide. These games covered the same content areas as the GBAs but used traditional teaching methods, ensuring that both groups had a comparable learning experience in terms of subject matter coverage and investigating the effects of GBAs on intrinsic motivation.

The second instrument is an intrinsic motivation inventory (IMI). It is a multidimensional, 45-item, 7-point Likert-scale questionnaire developed by Ryan and Deci (2000) to assess post-experimental intrinsic motivation. On the Likert scale, 7 is the highest possible score and 1 is the lowest possible score. Items marked with an "R," or reverse symbol, were scored in the reverse direction to assess the dependability of student responses and avoid "straight-line" replies. Rescoring was therefore required to match the reversed items with the non-reversed items, with 7 replaced by 1 and 1 replaced by 7. The reversed items could then be treated as normal for easier analysis. Several studies confirm the validity of questionnaire surveys such as the IMI in measuring various desired variables with high internal consistency (Cocca et al., 2022; Rasul & Schwaiger, 2023). The following scale was used to evaluate the IMI mean values: strongly agree (6.6–7.0), agree (5.6–6.5), somewhat agree (4.6–5.5), neutral (3.6–4.5), somewhat disagree (2.6–3.5), disagree (1.6–2.5), and strongly disagree (1.0–1.5). The IMI scale interpretation was proposed by Deci and Ryan (2000).

A teacher's observation guide from the London Business School based on Tenenberg (2016) was adapted for this study. This allowed teachers to take note of relevant observations and feedback during and after every lesson integrating GBAs. This was done to further validate and support the responses of the students in their journal logs regarding their experiences with the game-based activities and to determine their attitudes and experiences with using GBAs.

The students' reflective journals were also examined in the study with their permission. The journals were provided by the researcher to allow students to record their experiences and learnings in class. Students were free to write in any language, dialect,



or style they chose. The journals were voluntarily shared with the researcher to provide qualitative data for the study.

### *3.4.2. Data analysis*

The data gathered for the study were subjected to analysis. A comprehensive data analysis procedure for quantitative data was used to determine the effects of game-based activities on students' intrinsic motivation, as measured by the intrinsic motivation inventory. Multiple statistical techniques were used to assess the differences between the experimental and control groups. First, the mean ratings of the IMI subscales for both groups were calculated to obtain an overview of their intrinsic motivation levels. Next, the Mann-Whitney U test, a nonparametric test, was employed to determine if there were statistically significant differences in intrinsic motivation scores between the two groups. Since the Mann-Whitney U test can handle non-normally distributed ordinal data and is robust against outliers, it is a suitable tool for comparing the impact of game-based activities on intrinsic motivation between the experimental and control groups (Laerd Statistics, n.d.; Sundjaja et al., 2022). Cohen's  $d$  was computed as a measure of the effect size and to assess the practical significance of any observed differences. To establish statistical significance, the alpha level was set at 0.05. Standard deviations were calculated to better understand the variability of the ratings within each group. This multidimensional method ensured a rigorous assessment of the impact of GBAs on intrinsic motivation from both a statistical and practical perspective.

Thematic analysis was employed as the primary method of qualitative data analysis to extract meaningful patterns, themes, and insights from the journal entries of the students and the observation notes of the teachers. The study used Delve software, a qualitative data analysis software application, to help in the thematic coding of data. This approach allowed for a thorough understanding of how game-based activities influenced the students' intrinsic motivation through systematic organization and recognition of recurring themes in the qualitative data (Dawadi, 2021). By combining thematic analysis with quantitative data, the study provides a comprehensive understanding of the effects of GBAs on students' intrinsic motivation, adding to the depth of this research.

## **4. RESULTS AND DISCUSSION**

### **4.1. Effects of GBAs on students' intrinsic motivation**

For the quantitative phase, the intrinsic motivation inventory was used to determine the effects of game-based activities on the intrinsic motivation of the Grade 7 students. The seven subscales of intrinsic motivation measured with the IMI are highlighted in the discussion of the quantitative data analysis results.

Table 2 summarizes the students' intrinsic motivation results for the experimental and control groups.

**Table 2. Summary of the results of students' intrinsic motivation**

Learning Motivation Component	Control Group (N = 34)			Experimental Group (N = 35)			U test	p-value	Cohen's d	Interpretation
	Mean	SD	Interpretation	Mean	SD	Interpretation				
A. Interest/Enjoyment	5.63	1.14	A	6.69	0.43	SA	266	0.000	1.24	VL
B. Perceived Competence	5.18	1.31	SmA	6.07	0.64	A	331	0.006	0.87	L
C. Effort/Importance	5.36	0.88	SmA	5.91	0.50	A	346	0.009	0.77	L
D. Pressure/Tension	3.96	2.02	N	5.20	0.82	A	330	0.006	0.81	L
E. Perceived Choice	4.89	1.6	SmA	6.32	0.53	A	234	0.000	1.21	VL
F. Value/Usefulness	6.37	0.62	A	6.83	0.30	SA	257	0.000	0.95	L
G. Relatedness	5.91	0.93	A	6.44	0.53	A	381	0.034	0.70	L
Overall	5.33	1.20	SmA	6.20	0.51	A	327	0.005	0.95	L

Notes: SA–Strongly Agree; A–Agree; SmA–Somewhat Agree; N–Neutral; VL–Very Large; L–Large.

Given that the computed p-value is less than the level of significance ( $u = 327$ ,  $N = 69$ ,  $p = 0.05$ ), it can be deduced that there is a significant difference between the IMI scores of the two groups of respondents. Additionally, the standard deviation for the experimental group (0.51) compared with the control group (1.20) also indicates greater consistency in the perceived effect of lessons integrating game-based activities on improving students' motivation. It was observed that the students exposed to game-based activities were better motivated toward learning than those taught the subject matter in the usual way.

This was further supported by the Cohen's  $d$  value of 0.95, which implies a large effect size. This implies that the game-based activities integrated into the ecosystem lessons were effective in motivating students. This supports the claims made by Hartt et al. (2020), Jääskä et al. (2022), Lasala (2023), and Ratinho and Martins (2023) that games can be intrinsically motivating when integrated as instructional materials in teaching and learning and when the psychological needs of students, as reflected in the subscales of IMI, are considered.

Furthermore, the effect size values show that among the seven components of the intrinsic motivation inventory, interest/enjoyment had the highest effect size of 1.24, which indicates a very large effect. This is significant because, out of all IMI subscales, interest/enjoyment is the only component that directly reflects self-reported intrinsic motivation (Martínez-Rodríguez et al., 2021). Game-based activities positively influenced the interest or enjoyment felt by students on a large scale, which indicates the

effectiveness of GBAs in enhancing students' intrinsic motivation to support learning (Lasala, 2023).

Value/usefulness and perceived choice are the other components of intrinsic motivation that show a very large effect size, with Cohen's  $d$  values of 0.95 and 1.21, respectively. These results indicate a substantial impact of GBAs on the perceived value of the activities by students and their sense of autonomy during the lessons, thereby improving their intrinsic motivation. Pechenkina et al. (2017) also suggested that students' desire to engage in lessons or activities is increased if they are given the opportunity to decide for themselves and can see the benefits of engaging in such learning activities. The use of GBAs increases such desire by highlighting the two aforementioned components of intrinsic motivation.

Moreover, the integration of GBAs also yielded an intriguing result for the subscale of pressure or tension. Notably, the findings showed that students had a neutral reaction to this specific component, indicating that the inclusion of GBAs did not significantly enhance students' feelings of pressure or tension in the classroom. This conclusion is significant in the context of promoting intrinsic motivation because the internalization of motivation might be negatively impacted by feelings of pressure (Ryan & Deci, 2017). The large effect size (Cohen's  $d = 0.81$ ) linked to this subscale suggests a significant shift in the absence of pressure or tension, highlighting the positive effect of GBAs in fostering a stress-free and enjoyable learning environment. This aligns with the principle of improving intrinsic motivation, which lowers stress and provides sufficient challenges to keep students motivated (Káčovský et al., 2023).

Similarly, perceived competence has the same Cohen's  $d$  value (0.87), indicating a large effect size. This suggests that the use of GBAs in the lessons may develop students' competence in the experimental group toward the concepts. According to Tsai et al. (2020), GBAs may be more likely than conventional teaching techniques to help students enhance their competencies. The results of this study show that the use of GBAs has the potential to bolster the 21<sup>st</sup>-century skills of students, such as collaboration, communication, and independent learning, which are necessary for the students to become more competent learners. Effort/importance also shows a large effect size (Cohen's  $d = 0.77$ ). This implies that students view their participation in game-based learning as requiring more work, which enhances their intrinsic motivation in general.

Relatedness is the subscale least affected by the use of GBAs, as shown in the results of this study. With a moderate effect size indicated by the Cohen's  $d$  value of 0.70, GBAs have a discernible effect on students' intrinsic motivation. This suggests that students participating in game-based learning experiences have a significant increase in their levels of intrinsic motivation. This subscale implies the social need for students to be intrinsically motivated. The evident and positive social connections and interactions within the game-based learning environment are shown by the high ratings. According to Zhang and Yu (2022), relatedness is highly associated with intrinsic motivation. The feeling of belonging to the group increases intrinsic motivation, as shown by the results of the GBA study.

## 4.2. Students' attitudes and behavior toward the use of GBAs

The qualitative phase supports the initial findings from the analysis of qualitative data through the exploration of students' attitudes and behavior toward the use of game-based activities. The qualitative data from students' reflective journals and teacher-observers' observation notes were thematically analyzed using Delve qualitative data analysis software. Overall, seven themes reflecting the seven subscales of intrinsic motivation are reported in this section.

Students' journal entries and teachers' observations offer compelling evidence of the impact of GBAs on intrinsic motivation regarding students' interest or enjoyment. Student journal entries frequently expressed a heightened sense of curiosity and enthusiasm when engaging with GBAs, as they described lessons integrating GBAs as fun and not boring. One student wrote, "The lesson was fun. The game-based activities made it fun and not boring. It also made it easier to learn because it motivated me to learn more about the topic" (Student Journal Entry 1, personal communication, 2022). Sentiments such as these were also reflected in the observation notes of the teacher-observers, who were able to observe students' heightened engagement during GBAs. Students usually cheered and clapped their hands during the GBAs. This underscores the significant ability of GBAs to capture students' attention and interest, making learning a fun experience. This is consistent with the various studies that show that GBAs used in teaching may not only significantly increase students' understanding of the concepts but also their interest in them, as it is generally known to excite and engage learners when they actively participate in tasks and work on attaining learning goals (Dabbous et al., 2022; Huotari & Hamari, 2017; Koivisto & Hamari, 2019; Lasala, 2022).

Another theme of the study is the increased perceived competence of the students attained through GBAs. The teacher-observers identified "I can moments" as noteworthy observations related to this theme. These are occasions in which students demonstrate assurance, readiness, and competence during educational tasks. They are frequently accompanied by declarations such as "I know this one," "let me try," "*ako na* (let me do it)," "*madali lang yan* (that is easy)," and participation in peer corrections. Teacher-observers also noted that more students volunteer during the GBAs (Teacher Observation 1, personal communication, 2022). These observations are indicative of student confidence, which is closely associated with perceived competence and motivational effects (White & McCoy, 2019).

The increased perceived competence is also reflected in students' journal entries. One student wrote, "Instead of the teacher saying it, we find it [possible] for ourselves to easily understand it. I have learned that all things are connected, forming an ecosystem" (Student Journal Entry 2, personal communication, 2022). This not only shows competence but also implies that when students learn the concepts by themselves, they are more likely to retain that information. Collectively, it can be inferred that GBAs may potentially help students develop 21<sup>st</sup>-century skills, such as collaboration, communication, and independent learning, which are necessary for the students to become more competent in mastering the concepts learned. According to Tsai et al.

(2020), GBA may be more likely than conventional teaching techniques to help students enhance their competencies.

Effort or importance is also a visible theme of the study. The journal entries demonstrate that the students devoted much of their energy to the games. These efforts developed a positive mindset among the students, as highlighted by a student in his entry, “Lessons with games are very challenging and fun. We move a lot and think a lot. There’s even time that we hardly get the task, but it motivated me to do it and learn” (Student Journal Entry 3, personal communication, 2022). It is worth noting that besides completing and winning the game and its tasks, the students were engaged and saw the importance of GBAs in keeping them driven to learn and be better. These findings resonate with various studies on GBAs. Balakrishna (2023) and Rahimi et al. (2021) found that game-based instruction directly focuses on active learning. This is because game-based activities/instruction can promote engaging and effective experiences that lead to learning. Games, especially when used in education, are predicted to increase the level of effort exerted by students.

Another theme is positive pressure or tension. Although both groups of students expressed that they felt pressured in some way during the lessons, students from the experimental group noted that the pressure helped them perform better and become more engaged in the lesson. A student declared, “Lessons with game-based activities are surely fun, and it motivated me to learn better, even if it caused me [to feel] pressure to complete the task and compete with others” (Student Journal Entry 4, personal communication, 2022). The student asserted that the presence of pressure and tension due to competition and tasks made the game more thrilling, enjoyable, and conducive to learning. These remarks resonate with the claim of Lasala (2023) that the effects of pressure or tension can be good or bad depending on the person, and given the right amount, they can elevate the learning experience.

Additionally, value/usefulness is also a recurring theme in the qualitative data, especially in the students’ journal entries. One student noted, “The objective of the game was to save the animals from dying, so we acted as heroes in the game and saved as many animals as possible from destruction by humans. This made me think that we have to change our ways before it’s too late” (Student Journal Entry 5, personal communication, 2022). Student journals revealed that the students exposed to GBAs realized their value and usefulness not just to win the game but also to better understand the lesson and apply it to their lives (Bullard, 2016). The lessons integrating game-based activities were developed using an active and collaborative learning approach, allowing the students to create meaning and discover information with their peers, thereby making the lesson more meaningful and useful to them.

Lastly, relatedness is also evident in the study. The students’ journal entries (personal communication, 2022) and teachers’ observations (personal communication, 2022) made it clear that GBAs helped students develop teamwork and collaborative skills. As one student wrote, “[Game-based activities] are helpful, not just in learning but also in building relationships (friendship) with one another” (Student Journal Entry 6, personal

communication, 2022). A teacher-observer also noted, “I observed the increase in learning involvement. Some of them are not fond of working with others, but the game encouraged them to collaborate and interact with others in a friendly and fun environment” (Teacher Observation 2, personal communication, 2022). This could be attributed to the collaborative characteristics of the lessons integrating game-based activities, as they emphasize the importance of learning together as part of the learning process, thereby encouraging students to relate to each other. These student responses and teacher observations support the notion that educational games allow students to interact and build positive relationships (Gulinna & Lee, 2020). Likewise, Sung et al. (2017) claim that sharing and organizing information and facilities through collaboration improves students’ learning achievements. Students have developed a close link with one another, which some referred to as “family,” as a consequence of GBAs. As a direct result, the process of comprehending the concepts becomes less difficult and more fun for them.

## 5. CONCLUSIONS AND RECOMMENDATIONS

This study used GBAs developed and adapted by the researcher on selected ecology topics for Grade 7 students to investigate the effects of game-based activities on students’ intrinsic motivation. The results show that the integration of GBAs into the lessons had significant and positive effects on the students’ intrinsic motivation in terms of interest/enjoyment, perceived competence, effort/importance, pressure/tension, perceived choice, value/usefulness, and relatedness. Quantitative data revealed that the integration of GBAs into the ecosystem lessons for Grade 7 helped improve students’ intrinsic motivation. Qualitative findings also highlight the potential of GBAs in enhancing students’ intrinsic motivation, especially in terms of interest/enjoyment, perceived competence, effort or importance, value or usefulness, and relatedness. With the integration of GBAs, students are encouraged to put more effort into the learning tasks, take on challenges, participate willingly in the lessons and activities, recognize the value or importance of the topics being studied through the game-based activities, and develop a sense of community among themselves. For each subscale of intrinsic motivation observed during the study, it can be concluded that the integration of GBAs into the lessons improved the students’ understanding and learning experience and made the lessons more meaningful and engaging for them.

This study offers practical and research-based insights into how GBAs affect students’ intrinsic motivation in the context of science education. This research shows that GBAs have a large positive impact on students’ intrinsic motivation in terms of interest/enjoyment, perceived choice, value/usefulness, perceived competence, pressure/tension, and effort/importance, and a discernable positive effect on relatedness as a subscale of intrinsic motivation. The positive results of the effects of GBAs on students’ intrinsic motivation help to advance the rapidly developing field of game-based learning. However, it is important to note the limitations of this study, as it only focuses on one grade level and relies on anonymous journal entries, which may limit the ability to explore individualized analyses in depth. Future studies should include more detailed and personalized feedback through interviews or focus group discussions or explore the long-term effects of GBAs in academic settings.

This study also recommends several actions to leverage the potential of GBAs in education. The study encourages innovative and responsive teaching practices and strategies to provide learners with engaging and meaningful learning experiences. As GBAs inherently promote 21<sup>st</sup>-century learning skills, such as autonomy, problem-solving, critical thinking, and collaborative skills, they should be considered a part of the curriculum framework and adapted as a common pedagogical approach to improve the learning process and outcomes. Teachers should also learn how to integrate GBAs into their lessons and utilize available resources and technology in doing so.

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