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Game-based science learning: What are the problems with teachers practising it in class

Avdiu Schabas [1*]
University of Mitrovica, Kosovo, Serbia [1*]

Abstract
The primary focus of middle school scientific education is to promote class literacy by emphasizing independent, integrated learning that primarily relies on textual resources, with minimal incorporation of hands-on activities during the learning process. Contemporary scholarship in literary studies reveals ongoing transformations within education and pedagogy. Over an extended period, using play as a pedagogical approach has been widely acknowledged as a highly productive method of knowledge acquisition. This study aims to gain insight into the pedagogical approaches employed in play-based learning and to ascertain the significance of these approaches in the instructional practices within Secondary schools. The present study encompassed a sample of five educators from multiple secondary educational institutions in Serbia. The data collection methods employed in this research were semi-structured interviews, researcher observation, and active engagement in classroom activities. The findings of this study are derived from a descriptive analysis conducted from the instructor's viewpoint. The research findings and expert opinions suggest that game-based learning is widely embraced as a practical pedagogical approach in secondary schools in Austria. This instructional method fosters an engaging and suitable learning environment for pupils. Furthermore, the findings of this study elucidate the instructional practices employed by the instructor, illustrate the functioning of the mechanism, identify the challenges encountered, delineate the strategies employed across various disciplines, and elucidate the disparities in the cognitive and motor proficiencies children acquire through play. As per educators, the use of play as a pedagogical approach consistently presents issues about research, the development of diverse play activities, and the customization of learning experiences to align with students' unique needs and interests.

Keywords — GB Learning, Teacher problems, Science learning.

Introduction

Experts widely consider game-based learning as a learning approach that encourages active engagement among children, encouraging collaborative efforts that facilitate the development of their skills (Delgado-Algarra, 2021; Plass, 2015), abilities, and positive values (Jääskä et al., 2021; Ke & M. Clark, 2020). Game-based learning integrates subject matter information into educational games (Franciosi, 2017; Wang, 2015). Students do not experience a learning process during play (Hung, 2018; Jabbar, 2015), although the knowledge gained through play experience tends to last longer than alternative learning methods. According to (B. et al., 2019), games can successfully implement strategies that encourage students to acquire knowledge and skills, facilitating learning (Huang, 2018; Yang, 2021).

In secondary education, children gain skills in reading, arithmetic, and various other subjects. However, acquiring these skills and establishing positive social relationships with peers are fostered and enhanced during the early stages of childhood through play (Ramli et al., 2020). This means that involvement in play activities provides pleasure and directly destroys future academic achievement (Carpenter, 2021; Santos, 2023).

The curricula for secondary education in Austria and Indonesia place significant emphasis on the curricula implemented in regular secondary schools,

incorporating a differentiation in mathematical instruction for Grades 7 and 8, wherein students are exposed to two unique levels of educational content: "basic" (Cardinot & Fairfield, 2019; Tsai, 2020), and "extended" (M. et al., 2015; Qian & Clark, 2016) This distinction represents the further education students pursue upon completing their secondary education. Secondary education is commonly known as the combination of middle school and high school. Post-secondary education encompasses many institutions, such as universities, colleges, trade schools, and vocational schools. Utilise play-based learning methodologies and instructional resources to cultivate practical pedagogical approaches for junior high school students, emphasizing scientific education, which often encompasses theoretical concepts and practical applications. The objective of this method is to establish a learning environment that is both dynamic and engaging. Educators are responsible for imparting instructional methodologies tailored to the unique circumstances of secondary school education. The successful implementation of relevant learning methods at the specified educational level necessitates a comprehensive examination and utilization of various approaches (Lin et al., 2013; Park, 2020).

Education aims to provide focused science instruction in junior high schools to facilitate students' comprehension and proficiency in natural phenomena. The study of scientific disciplines holds significant importance. One of the advantages associated with pursuing scientific knowledge is the capacity it provides individuals to comprehend the diverse phenomena present in our surroundings. For instance, what is the underlying cause of the sun's luminosity, what constitutes the moon, and what is the scientific explanation for the nocturnal radiance of stars? Engage in a rational and systematic thought process.

This educational approach also seeks to empower students to actively integrate games into the learning process (Casanovas, 2022), particularly in supporting students' development of new skills. Establishing a suitable pedagogical framework that emphasizes professional training rather than mere recreational play during the development of educational games is of utmost importance. Attaining this objective using advanced game development tools is deemed unattainable (Hussein, 2019). Incorporating games and game-based learning in educational environments has exhibited effectiveness and is increasingly embraced by students. Nevertheless, it is imperative to acknowledge that the successful implementation of this technique necessitates a significant level of commitment and exertion. Despite the significance of game-based learning, a substantial proportion of educators, precisely over 80% (Zulkiply, 2019), perceive games as a daunting hindrance when attempting to include them in the curriculum and effectively utilize them within the classroom setting (Bakri et al., 2020; Kanjug, 2018).

Based on researchers' findings, secondary schools strive to enhance student proficiency by offering a comprehensive range of resources, instructional modules, and assessments for every academic discipline. Students also acquire and develop specific fundamental talents that have been or will be attained. Schoolchildren are given opportunities to enhance their cognitive (Zhang, 2021), emotional (El-Yamri, 2019), affective (Soeiro et al., 2012), social (J. Zhou, 2020), and physical development (Elosúa, 2015) and attain a prescribed level of essential information (Edhirej, 2017). Secondary education presents itself as an educational institution

that (Filiz, 2019), via the utilisation of many scientific disciplines (Kolář, 2019), offers the opportunity to cultivate diverse cognitive abilities, hence facilitating the cultivation of reflective and critical thinking skills (Wilhelmi, 2019). In addition, formative assessment in educational settings serves as a means to systematically monitor and enhance the learning process and evaluate the attainment of predetermined learning objectives. Formative assessment can be conducted at the onset and throughout the learning journey in alignment with its intended goals.

They emphasized the significance of engaging in game-related activities during childhood. According to (Takaya, 2008), games can liberate humans from contextual restrictions. During playing, individuals focus on the task rather than contemplate the underlying motivations driving their actions. Consequently, we become deeply absorbed in the game, experiencing a sense of liberation from our surroundings. According to (Darmayanti et al., 2023), the effectiveness of game-based learning is influenced by five key dimensions: the learning environment (Chang, 2016), the learner (L. Zhou et al., 2021), the pedagogy (Berti, 2021), the context (Herlina et al., 2021), and the teacher (Wijanarko, 2021).

This study explores game-based learning as a significant concern in the current Secondary Education Curriculum context. It acknowledges that teachers encounter obstacles in effectively integrating many activities and approaches to sustain students' engagement and curiosity. Thus, the research seeks to comprehensively understand game-based learning as a prominent aspect of this educational landscape. In the current landscape of education. Hence, the primary inquiry for the present investigation is, "What are the methodologies employed in game-based learning within secondary educational institutions?" The categorization of teacher question categories is informed by suggested multi-year definitions (Bozkurt, 2018), including Games that can be effectively incorporated into the current curriculum (Annetta, 2020; Phillips, 2021), Games that align with the learning objectives of the specific subject matter (Kalleny, 2020; Lim, 2017), and the perspectives of secondary school educators regarding game-based learning as an instructional approach (An, 2018; Suteja et al., 2022).

Numerous comprehensive investigations have explored the contextual dimensions of game-based learning. Nevertheless, a notable distinction in this study is the selection of research participants from two distinct nations, specifically Austria and Indonesia. This study encompassed educators from secondary schools in Austria and Indonesia. Furthermore, the curriculum employed is tailored to correspond with the distinct curriculum of each respective country. Another distinction lies in the sample criterion employed for schools, wherein the chosen schools are predominantly state-funded institutions with a more extended historical presence.

Moreover, the criteria for selecting teachers are established based on their educational background, age, and teacher education level, including both Bachelor's and Master's degrees. Moreover, a range of criteria, such as the educational setting, instructional methodology, contextual elements, and instructor impact, play a crucial role in determining the most favorable results regarding the effectiveness of students' utilisation of game-based learning. Significantly, the research subjects utilised in this study were science subject teachers.

Method

The research employed qualitative methodologies as its primary research approach Figure 1.

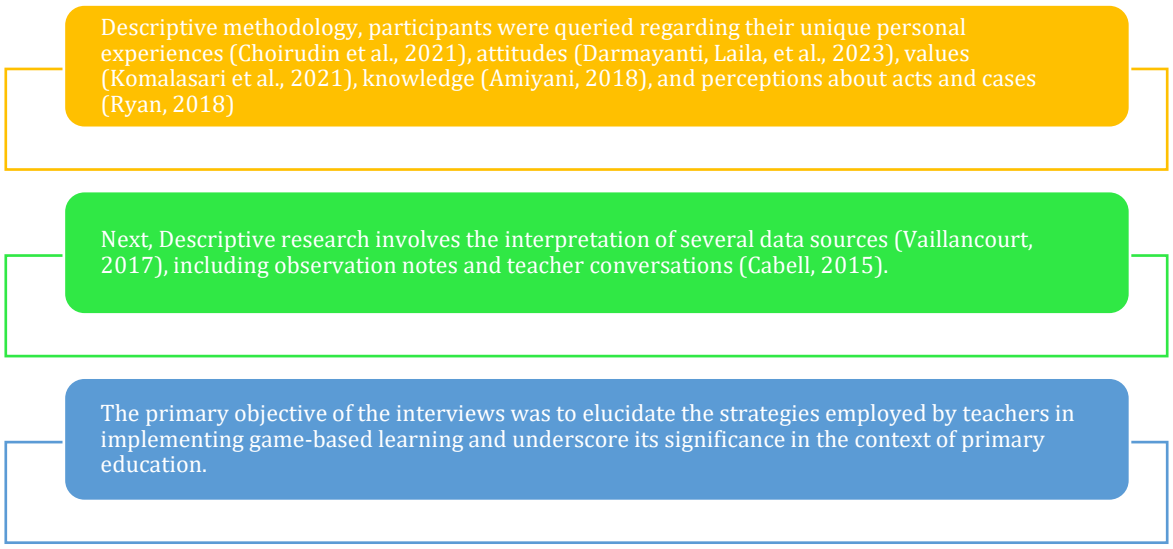

Figure 1. Methodologies as its primary research approach

The persons who took part in the study were designated as participants. A comprehensive examination of teacher interviews was conducted at ten secondary schools in Austria, encompassing three distinct educational institutions. Similarly, an extensive investigation of teacher interviews was undertaken in four secondary schools in Indonesia, totaling twenty interviews. The researchers utilized a sampling view in Figure 2.

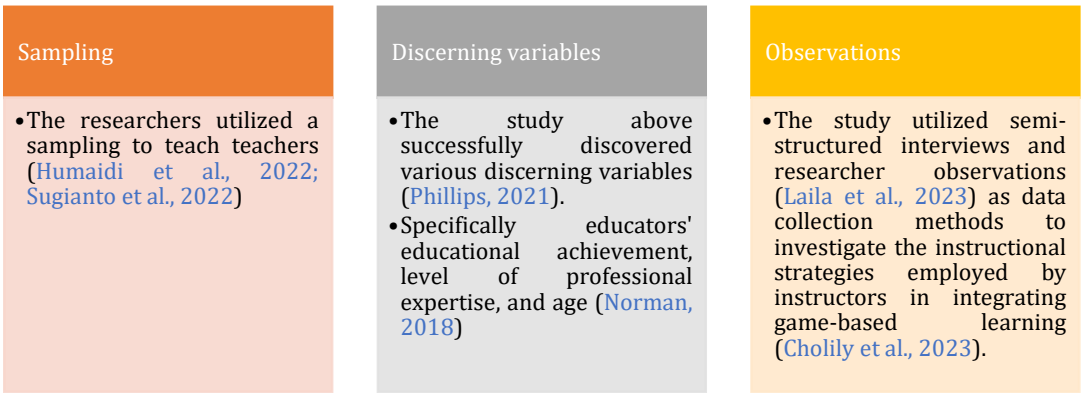

Figure 2. The researchers utilized a sampling

The principals were contacted via electronic mail, following which the teachers recommended by the principals had interview assessments. The educational institutions in Austria had regular monitoring for two months, specifically during July and August of 2023. Similarly, an observation period of three

months, specifically from July to September of 2023, was conducted to oversee educational institutions in Indonesia. Teachers were subject to periodic interviews during the latter weeks of each bi-monthly school visit. During conducting classroom observations, it is essential to consider various additional factors. These factors include the overall atmosphere within the classroom, the different types of games and materials used by teachers during their instructional practices, the strategies employed for grouping students during game-based learning activities, the dynamics of collaboration observed during gameplay, the tools and resources utilized for academic tasks, the physical arrangement of the classroom, and other factors that are not explicitly addressed in the scope of this particular research study. The main aim of this study is to investigate the specific research questions under consideration. However, it is essential to acknowledge that supplementary observations conducted during this specific period, which were not the main emphasis of the study, had a vital role in deepening the understanding of teachers' methodologies and establishing correlations with the data obtained from their firsthand encounters. Using game-based learning in educational contexts presents obstacles and notable concerns, particularly about the timely response and effective prioritization of issues.

They examined and interpreted data to uncover patterns, relationships, and insights. The investigation employed the descriptive analysis method. The interviews were conducted in an organized manner, both in person and through the messaging application WhatsApp. The responses provided by the teachers were documented, and subsequently, the collected data was analyzed. The duration of the interview varied between 25 and 30 minutes. In the present study, the identities of the interviewed teachers were anonymized by assigning a code consisting of the initial letter of their respective names, which was then documented. Age is a crucial factor in this study as well. The analysis begins by examining educators' narratives, which detail various teaching techniques and principles. These narratives frequently provide concrete examples of these practices and ideas in classroom settings (Darmayanti, 2023; Khoiriyah et al., 2022). The calculation of research reliability was conducted using the formula proposed by Miles and Huberman (Inganah et al., 2023), which involves dividing the Agreement by the sum of the Agreement and Disagreement and multiplying the result by 100. It was determined that the research dependability yielded (Galan, 2023). The subsequent section contains findings from the research inquiries, informed by teachers' interpretations and supported by examples of learning scenarios in their classrooms.

Result and Discussion

The following section presents the outcomes of the data collected through interviews conducted with teachers from two nations. The responses to each interview question are shown in Table 1.

Table 1. The responses to each interview question

No	Content of game-based science learning in junior high school education	Respon 1 (Master's degree)	Respon 2 (Bachelor's degree)	Respon 3 (age/length of teaching)
1	The definition is provided by educators (Kim, 2021).	Acquiring a Master's degree involves using experiential and activity-based learning methods, which cannot be acquired solely through theoretical knowledge. This approach emphasizes the importance of enjoyable and motivating strategies to facilitate children's learning (Constantiou, 2015).	A Bachelor's degree program emphasizes active learning through hands-on experiences and the utilization of practical knowledge. It promotes using engaging and interactive strategies to enhance learning (Clark, 2016).	The duration of teaching experience is closely associated with the teacher's role as a valuable learning resource. This role is contingent upon the teacher's mastery of the subject matter and ability to foster an understanding of various concepts. Furthermore, it facilitates direct experiences that enhance students' capacity to comprehend, retain, and apply learned concepts. This type of learning is grounded in scientific principles, processes, and attitudes (Baskin, 2015; Beavis, 2017).
2	Teachers' views on the importance (Annetta, 2020).	Improving learning, learning to understand, developing skills (problem-solving, critical thinking), and opportunities to integrate teaching objectives, skills, and or any behavior can be tested through games, finding the meaning of games for children (Bhagat, 2015).	Develop skills and social relationships, achieve learning goals, foster interest in learning, and improve student learning (Reynolds, 2018).	Science learning implemented in schools should be a means and tool for teachers to teach students to recognize themselves and the environment. Apart from that, learning methods must be adapted to the student's character. It can also be their learning style, especially looking for appropriate methods and models that match the material's content (Christina et al., 2019; Supeno, 2019).
3	Several instances exhibit a higher level of integration with the teaching subject.	The Master's Degree program incorporates various instructional strategies such as card games, label games, clothesline (teaching human organs), interactive videos, TPAK (Technological et al.	On the other hand, the Bachelor's Degree program employs instructional techniques such as label games, crossword puzzles, power points, memorization, guessing activities,	Regarding teaching experience and duration, individuals with a longer teaching tenure tend to rely more on lecture methods, rote memorization, and using models with a scientific approach.

No	Content of game-based science learning in junior high school education	Respon 1 (Master's degree)	Respon 2 (Bachelor's degree)	Respon 3 (age/length of teaching)
		Knowledge), and practice exercises.	and picture guessing exercises.	
4	Educators' perspectives regarding their selection process for instructional games employed in the classroom.	The selection and design of a Master's Degree program consider various factors such as students' interests, curriculum, needs, levels, and alignment with learning objectives.	The development of a Bachelor's Degree program considers factors such as the student's level, the interrelation with other subjects, the teaching character, appropriateness to learning objectives, and alignment with learning objectives.	The age and length of teaching are influenced by factors such as time availability, physical condition, understanding of the nature of educational games, challenges in selecting games suitable for science material, limited availability of tools and materials, and associated costs.
5	Educators' perspectives regarding the challenges of using game-based science learning in junior high school education.	The Master's degree program focuses on various aspects, including time management, the variability of student outcomes, equipping teachers with innovative game ideas, managing student behavior, and effectively managing classroom activities.	The Bachelor's degree program emphasizes time management, addressing challenges related to students' ability to handle competition and potential disappointment, the unpredictability of student outcomes, the importance of teachers' efforts and skills in designing diverse games, and strategies for managing students with disruptive behavior.	The age and length of teaching experience can bring about fatigue, the need to repetitively teach previously covered material, and the utilisation of assignments to facilitate student comprehension of unfamiliar concepts—providing sourcebooks for students to engage in scholarly study.

From an educator's perspective, game-based learning encompasses using activities, enjoyment as a means of learning, experiential learning, and implementing engaging pedagogical strategies. Table 1 reveals that implementing game-based learning entails inspiring children to engage in desired activities, with play being seen as the most straightforward approach. Due to the innate desire of children to engage in play and the educational objectives of instructors, a dynamic exists wherein the former seek recreational activities. At the same time, the latter aims to facilitate learning. The outcomes will likely exhibit higher success if the two variables are integrated. In addition, it has been shown that children do not perceive learning through games as a deliberate educational activity even though they acquire knowledge and skills. Moreover, game-based learning encompasses acquiring knowledge through experiential learning, facilitating social interaction

during the learning process, and integrating novel aspects that engage children's enjoyment and enthusiasm for learning.

Table 1 presents the findings from analyzing teachers' responses regarding their perspectives on the significance of game-based science learning in junior high school education. The results indicate that using games in instructional practices primarily centers around attaining educational objectives, enhancing learning outcomes, and cultivating students' skills. However, the goals of certain teachers may differ. Educators must employ strategies that encourage independent discovery among students. The teacher does not perceive themselves as a facilitator of motivation through gamification and information dissemination, deeming it non-essential for the child's development. Instead, the teacher endeavors to comprehend the game from the children's perspective, employing inquiry-based methods to achieve this objective. What are the reasons for undertaking this task? What is the objective you are aiming to achieve? What methods or strategies can be employed to accomplish this objective?

Furthermore, what strategies would you employ to attain this objective? Subsequently, we engage in the activity. The curriculum necessitates the implementation of teaching and learning strategies, with an emphasis on immediate measurability of outcomes. In this regard, game-based science learning is an efficient approach for scientifically and organically assessing various skills and behaviors. Engaging in recreational activities within the school environment holds significant value for children, as it allows them to comprehend that the educational institution encompasses more than just regulations, inquiries, and responses. Instead, it fosters an atmosphere of enjoyment, stimulating children's curiosity and enthusiasm. The establishment of context is essential in facilitating interest, particularly in the realm of game-based science learning. The fourth question in Table 1 indicates that teachers prioritize using specific game types, particularly in language-based courses like tag games, which are subsequently incorporated into science disciplines.

Next, the fifth question in Table 1 reveals that the teacher modifies the learning character game and tailors it to accommodate the student's individual demands and knowledge levels. Nevertheless, most educators assert that the key to selecting games is in avoiding repetitive usage but instead in amalgamating diverse concepts from many disciplines to stimulate students' curiosity and establish meaningful connections. This exercise aims to rephrase the user's text more academically. The revised version is as follows: According to several educators, an emerging instructional approach known as the "think and choose" model has recently been introduced in schools. Under this framework, students can select their preferred play materials upon entering the classroom, resulting in positive outcomes. The previous inquiry indicates that the challenges faced by the instructor primarily revolve around issues related to time management, the teacher's proficiency and dedication in developing diverse educational activities, disruptive student conduct, and the occasional misalignment between the desired outcomes and the actual achievements of the students. A teacher possessing a Master's degree expressed that they frequently use outdoor games in their instructional approach, dividing pupils into two groups - one inside the classroom and the other outdoors.

However, they noted that the absence of a second teacher in the classroom poses challenges in effectively managing these activities. According to confident educators possessing Bachelor's degrees, it has been observed that certain pupils encounter challenges when confronted with defeat during competitive activities. In response, these teachers endeavor to impart to these students the significance of comprehending and assimilating that experiencing failure is an inherent aspect of life.

Regarding the teacher's perspective on age and teaching experience, the general sentiment expressed was that games were deemed unproductive and occasionally appropriate for both the subject matter and the students. Educators are more inclined to adopt this pedagogical technique to instruct pupils in science. The age element is a significant determinant, particularly for more experienced teachers with a longer tenure in the profession. Individuals often require additional time to develop their innovative and creative ideas effectively. This is due to the need for a comprehensive understanding of the effective integration of innovation, including technology, props, and appropriate game models. Educators prioritize strategizing effective instructional methods to ensure the timely completion of the curriculum. The requirements of teacher administration can serve as a catalyst for instructors to engage in innovative practices due to the limited timeframe available for school administration completion. The teacher's perception that parental lack of financial resources, support, and trust in their education impacts their inclination to innovate is also accompanied by the belief that parental complaints to the principal have emerged as a novel challenge. This phenomenon engenders hesitancy and trepidation among educators when it comes to embracing novel approaches.

Game-based learning in science education has the potential to foster an interactive learning environment by necessitating active student engagement in the learning process, akin to that of game players. Enhancing the learning environment's pleasantness, promoting student engagement, and improving learning efficacy can be achieved by ensuring that the studied material is easily retained. Game-based learning has been shown to enhance students' motivation to learn and facilitate their comprehension of various ideas (Hamari, 2017; Zhu, 2015). Educational games are a somewhat effective instructional technique that fosters students' engagement in comprehending scientific concepts.

Educators commonly conceptualize game-based learning as an instructional approach that combines the elements of enjoyment, active participation, and experiential learning to facilitate the acquisition of knowledge and skills. According to (2019 Hsu, 2017), game-based learning is characterized in the literature as a pedagogical approach incorporating elements of competition, interactivity, and enjoyment for students, facilitating knowledge acquisition. Educators prioritize that games serve as a source of motivation for children. When teachers establish educational objectives within games, children perceive the learning experience as enjoyable and engaging (Fitzgerald, 2020; Lamb, 2018). This implies that students engage in collaborative activities during the learning process, particularly when encountering subjects that present difficulties in comprehension. Educators emphasize the value of game-based learning, particularly in attaining educational objectives, enhancing learning outcomes, and cultivating students' aptitudes.

The educators elucidated that the significance of game-based learning resides in allowing youngsters to ascertain the underlying significance of the game independently (Astuti et al., 2023; Sugianto, Syaifuddin et al., 2022). Many educators employ game-based approaches to elicit student outcomes, particularly by utilizing games that foster enjoyment, emotional expression, skill development, and safety (Fikri et al., 2023; Sousa, 2021). Research has demonstrated that game-based learning can enhance students' positive attitudes toward the learning process and foster the development of memory abilities. Additionally, game-based learning holds promise in facilitating student connectivity and promoting the construction of knowledge (Guerrero, 2020; Sugianto, Darmayanti et al., 2022; Vidyastuti et al., 2018).

Conclusion

Educators from both primary and secondary education levels have reached a consensus over their practice of modifying games to align with the curriculum. Games are utilized as a means to fulfill the requirements of the curriculum and facilitate the enhancement of logical thinking and skills in youngsters. It can be argued that the children's desires were also considered alongside the instructional material, allowing for a harmonious integration of both elements within a flexible lesson plan. During the game, the teacher strategically incorporates various elements within the learning context that pertain to the children's existing knowledge or lack thereof. Often, the child remains unaware of the teacher's evaluative role or that mutual evaluation occurs among the participants. According to teachers, it is evident that the curriculum mandates practical teaching and learning methods with immediate measurability of outcomes. However, teachers emphasize the importance of designing highly engaging games for children to transfer necessary information and achieve educational objectives effectively. Identify and establish objectives. The researcher's observations further indicate that using games as an instructional tool is prevalent within the educational institutions under investigation. The presence of parental support and the establishment of trust in instructors are crucial factors in attaining educational objectives.

In a broad sense, educators encountered challenges with time management, students exhibiting subpar behavioral norms, and the ongoing necessity to constantly attain desired outcomes. The authors also emphasized their endeavors and obstacles in the continuous endeavor to develop play games, exploring how they might be engaged with and considering the feasibility of their inclusion, considering students' varying interests and requirements. Another factor the teachers had to consider was ensuring that each lesson was engaging enough to foster the students' curiosity towards the learning process. This was a significant difficulty for the teachers. Conversely, it is necessary to segregate and oversee specific actions by two distinct educators, hence occasionally posing a predicament due to the unavailability of dual instructors inside the classroom.

According to the researcher's observations in the present study, using game-based learning is a prevalent pedagogical approach educators employ. This observation was further substantiated by a query posed to the students inquiring

about the frequency of game utilisation within the classroom. Regrettably, the students were unable to respond. The instructor explained that students face discerning between play and learning due to their continuous involvement in game-based educational activities.

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