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Enhancing Grade XI Students' Learning Outcomes Through the Gamified Use of the Kahoot Application

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Abstract

The purpose of this study was to establish whether the Kahoot application can serve as a gamification tool that would improve the academic achievement and engagement of students. A total sample of 64 Grade XI students was selected from Daga Higher Secondary School in Dagana. This study employed a quasi-experimental design within the Action Research framework. A mixed-methods approach was used for data collection, with quantitative data collected through participant observations, pre-and post-tests, and surveys, and qualitative data gathered through semi-structured interviews. Quantitative analysis included means, standard deviations, and t-tests, whereas thematic analysis was used for qualitative data. The findings showed that there was a statistically significant difference in mean scores between the experimental and control groups at a medium to large effect size, using Cohen's d = 0.72. These findings show that the Kahoot application enhanced classroom participation and academic performance of students at a great scale, which might be an efficient pedagogical tool in high school education.

Keywords
Gamification
Kahoot
Learning Achievement
Quasi-experimental design
Teaching and Learning

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Introduction

Since the dawn of modern education in Bhutan in the 1950s, with only 440 students enrolled in 11 primary schools in 1959 (RGoB, 2000), there are now over 1,55,159 children studying in approximately 679 schools as of 2023 (National Statistics Bureau of Bhutan, 2023). This represents approximately 30 per cent of the total population, and this number continues to grow annually. The education sector has achieved tremendous growth in terms of numbers; however, the quality aspect of it has gained considerable controversy. For instance, the transition rate of primary to lower secondary is 89.44 % in 2023, whereas the transition rate of lower secondary to middle secondary is just about 55.33% (National Statistics Bureau of Bhutan, 2023). This discrepancy highlights a critical gap in educational attainment. Likewise, recent assessments reveal troubling proficiency levels among students. For instance, only 19% of Class 10 students reached proficiency in English, and a mere 4% did so in Mathematics during the 2013 National Education Assessment. In addition, results from the Bhutan Certificate of Secondary Education exams in 2014 indicated that only 6% of students scored above 55% in English and 3.65% in Mathematics (Jamtsho, 2017). These figures suggest that

while students may be attending school, the quality of education they are receiving is inadequate. Furthermore, the level of learning of Bhutanese students is found to be lower than average international levels, as represented by studies like the Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading and Literacy Skills (REC & Educational Initiative 2011).

Measuring the quality of education is complex as it is a multidimensional concept (Rodríguez et al., 2022). There are multidimensions to be considered to measure the quality of education. One of the important dimensions is the educators or teachers. For instance, studies have found a correlation between the social status of teachers and the quality of teaching and education in general (Lutfiu & Hoxha, 2024). Likewise, the social status of teachers is correlated with the student's learning (Ali et al., 2022). In the context of Bhutan, due to the declining social status of the teachers in the society, Yezer (2020) argues that the quality of education is deteriorating, while Wangdi (2015) disagrees. Yezer (2020) in his study found that the social status of teaching professionals is low compared to other civil servants in Bhutan. Therefore, he posits that the quality of education cannot surpass the quality of teachers, and in turn, the quality of teachers is closely linked with the social status of the teachers. Whereas Wangdi (2015) argues that the quality per se is not deteriorating rather, the tradition of paying respect to teachers as a profession is dwindling. However, the recent Royal Kasho (Kuensel, 2021) on education reform issued on February 2, 2021, exhibits the stark concern about the inability of education to suffice the needs of changing society and contemporary problems of the 21st century.

In the present technological revolution era, integrating technology in education has gained much popularity for its effectiveness in improving learning outcomes and involving students meaningfully in learning (Ares et al., 2018; Wang & Tahir, 2020). However, in the context of Bhutan, according to Sharma (2023), when it comes to integration of ICT in Bhutanese classrooms, there are several challenges, such as low internet bandwidth, inconsistent internet service, poor infrastructures and lack of training in ICT pedagogy. Likewise, a study by Dhendup and Sherab (2022) reported that slow internet connection and high internet data subscription charges are impeding factors in integrating ICT in teaching. In addition, Dhendup and Sherab (2022) reported that the Technological Knowledge (TK) of Bhutanese primary teachers were low, and their proficiency with basic technology and internet applications was just at a moderate level. In a similar study, Chophel (2021) recommended that teachers' TPACK knowledge needs to be improved through professional development. This concern is also reflected in the Royal Kasho on education reform (Royal Kasho, para 7, 2021):

> In preparing our youth for the future, we must take advantage of available technologies, adopt global best practices, and engineer a teaching-learning environment suited to our needs. Technology is the argument of our time and a major indicator of social progress. The irony in our context is the absence of technology in classrooms for a generation of students who are exposed to and live in the digital age. To ensure that teachers are not

> disconnected from their students, the professional development of teachers should integrate technology, digitalisation, artificial intelligence, and automation.

In this fast-changing educational landscape, one thing that requires undivided attention is the changing needs and the living style of the learners. As they are exposed to modern facilities and swept by Westernisation, there is a noticeable change in their habits and thinking processes. It is important that the education system attunes to this important shift in the nature of the learners as the 21st-century learners are digital natives, and most of the time they spend fiddling with gadgets (Dei, 2024). Therefore, education should be revamped to incorporate students' love for modern technology. Considering their expertise with smartphones and games, educators need to use gaming mechanics to foster meaningful engagement in learning.

Likewise, Royal Kasho on education reform also emphasised the need to make STEM subjects everyday language for students, as reflected in the following lines (Royal Kasho, para 6, 2021):

> We must prioritise self-discovery and exploration and involve learners in the creation of knowledge rather than making them mere consumers of it. We must make STEM subjects part of their everyday language.

Thus, this study attempts to integrate technology into education. In particular, the study attempts to leverage technology to enhance the engagement and learning outcomes of the students. The study uses the Kahoot application to gamify the lesson.

Research on gamification in general and particularly in educational contexts is gaining popularity (Luo, 2022). Video and computer games can now be employed in classroom activities to boost learning processes. Gaming has recently become a mobile learning tool that can accommodate many participants in a single game via a single platform due to the availability of Internet-accessible digital tools such as smartphones, iPhones and tablets. As a result, not only does this help to improve learning, but it also makes the teaching and learning process much more efficient and modern (Lin et al., 2018).

Likewise, younger ones often engrossed themselves in gaming and spent hours playing it. Humans learn via play, and one of the most effective ways to learn is through failure in low-stress scenarios, which may be presented in the classroom using a gaming tool like Kahoot (Jenkins & Mason, 2020). Play is said to aid in the development and encouragement of imagination, creativity, and spontaneous learning (Jenkins & Mason, 2020), as children prefer to learn in a humorous, engaging, and interesting manner. Through play, they feel more engaged and have a better evaluation of what they have learnt about, resulting in deeper and more enduring knowledge and substantial learning (Álvarez-Herrero & Valls-Bautista, 2021; Cruz & Roleda, 2018). Similarly, Mao et al. (2021) found that game-based learning had a significant positive overall effect on students' critical thinking.

Furthermore, gamification can motivate students to learn (Alasmari, 2020; Kim et al., 2020; Wu et al., 2018). For instance, Alasmari (2020) reported that there is a significant effect of gamification on motivation. Similarly, Wu et al. (2020) in their study also found that gamification positively affects intrinsic and extrinsic motivation, and it can sustain the motivation of the students throughout the semesters (course). However, in the context of Bhutan, there is limited literature on the use of gamification in education. Likewise, the ban on the use of mobile phones during school hours in Bhutanese schools (Dorji, 2020) poses a unique challenge in terms of using gamification in Bhutanese classrooms. Despite the administrative issues, it is imperative that 21st-century learners are exposed to 21st-century learning strategies such as gamification using technology. Therefore, in this study, the teacher researcher used the Kahoot application to gamify the chemistry lesson for class XI students to enhance students' learning.

Research Question

1. How effective is the Kahoot app in improving the learning outcome of the students?
2. How far does the Kahoot app improve the participation of the students in learning?
3. What are the opinions of the students towards the use of Kahoot?

Theoretical underpinning: SAMR Model

Integration of technology in teaching has the potential to improve learning outcomes. However, the way in which the technology is used will determine the effect it will have on the learning outcomes. According to the SAMR model of technology integration, the integration of technology can consist of four stages (Nyayu et al., 2019). First level: Substitution- Technology is used as a direct substitute for traditional methods without significant changes. Example: Using digital textbooks instead of printed ones. Second level: Augmentation- Technology enhances the learning experience, providing functional improvements. Example: Using collaborative online documents to enhance student engagement. Third level: Modification - Technology allows for significant redesign of tasks, fostering more meaningful learning. Example: Students collaboratively create multimedia presentations instead of traditional reports. Fourth level: Redefinition - Technology enables tasks that were previously inconceivable, transforming the learning process. Technology helps in immersing the learners in a learning experience which was never done before. Example: Virtual simulations that provide immersive learning experiences. Educators around the world are increasingly aware of the importance of technology (Maddux & Johnson, 2010). Likewise, generally, Bhutanese teachers are aware of the importance of technology in education (Kuenga, 2023). However, many still primarily engage in substitution and augmentation rather than fully redefining tasks through technology (Boonmoh & Kulavichian, 2023; Chou & Block, 2018). As an educator, we use technology however, most often, we use the technology at a lower level (substitution and augmentation), so as an educator, it is advisable to make an effort to use higher levels (modification and redefinition) of technological integration.

The use of the Kahoot! application in gamifying lessons falls under the "Modification" level (See Figure 1). This level involves technology not just enhancing the task but significantly

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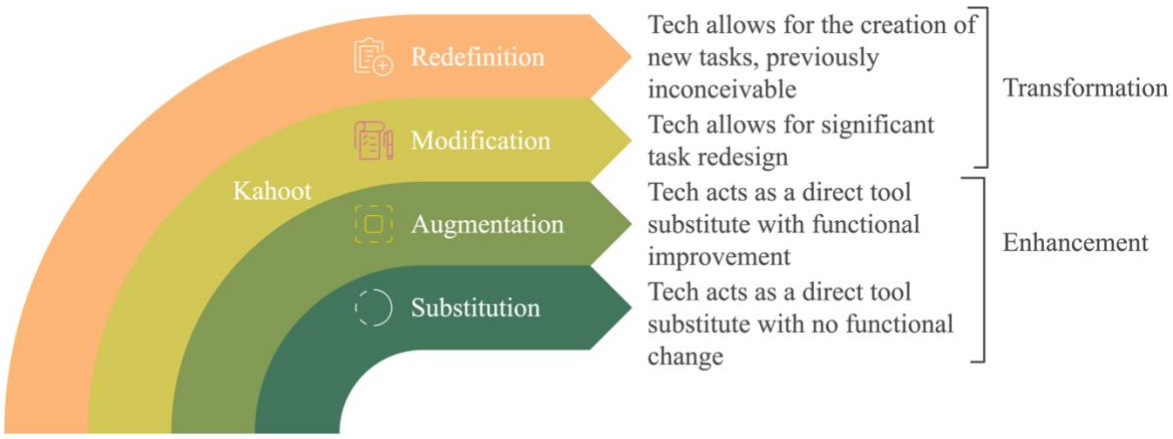
transforming it. Kahoot! goes beyond simply substituting traditional quizzes; it modifies the learning experience by introducing interactive and engaging elements through gamification, fostering a more dynamic and participatory environment (Plum & Larosa, 2017). Thus, the Kahoot application was selected to be integrated into lessons to bring improvement in the learning outcomes of the students.

Figure 1

Kahoot and the SAMR Model



(Adapted from Nyayu et al.,2019).

Literature review

What is gamification?

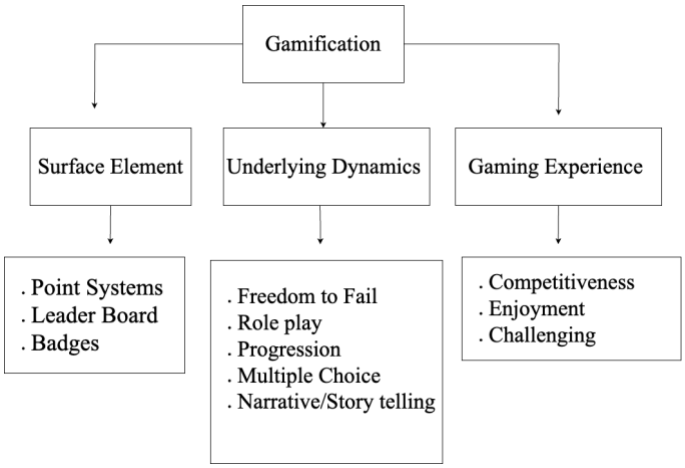
Gamification was initially discussed in 2008, and since then, a lot of work has been done, and several papers have been produced on the subject. With the widespread acceptance of new technologies by the public, gamification is an effective technique for attracting new users and retaining existing ones. Gamification uses game mechanics to turn a learning experience into a game. The basis of gamification is that it occurs in a non-game context (Delgado-Algarra, 2022), which means it would be applied without disrupting current learning practices but rather by making them more interesting involving HOTs (higher-order thinking skills) for students. Gamification is a technique used in education to promote students' engagement and learning (Lin et al., 2018). Thus, gamification can be defined in the context of education as the integration of gaming aspects into traditional classrooms, current training materials, and learning management systems (LMS) (Scepanovic et al., 2015) or in other words it can be defined as the usage of pedagogical systems that are built using gaming designs but implemented within non-game contexts.

There might be several reasons for spending considerable time playing games. Whether it is for sheer enjoyment, relaxation or the need to feel competitive, the basic principle of the game is to reach a certain goal. It does not matter if the aim is to earn a prize, complete an

assignment, defeat an opponent, or be the first on the scoreboard. It is, without a doubt, a motivation-related mechanism which engages emotion and a certain style of behaviour (Yee, 2006). Essentially, the gaming elements employed in gamifying the teaching come in the form of point systems, badges, and leaderboards (see Figure 2). The underlying dynamics of gamification is that students have the freedom to fail, to get access to immediate feedback, and to be aware of their progress. In addition, they can role-play and make choices and narratives. Furthermore, learners are hooked on games because gamification can offer a competitive atmosphere with a mixture of fun and challenges (Kusuma et al., 2018) (see Figure 2).

Figure 2

Summary of Mechanism of Gamification



(Adapted from Kusuma et al., 2018)

Understanding the meaning of Kahoot

Kahoot is a unique game concept born out of the Lecture Quiz Research Project at the Norwegian University of Science and Technology, which began in 2006. It is a free game-based learning platform that strives to make learning enjoyable across all topics and languages, and it works with a variety of digital devices (Lin et al., 2018). This platform has gained wide acceptance globally, with over 30 million users worldwide (Plump & Larosa, 2017). Kahoot can be customised to suit students of all ages. The platform allows teachers and students to interact in a variety of classroom settings using competitive knowledge games and current infrastructure (which should include a good Internet connection). The embedded graphical interfaces and audio aspects provide a game environment that has the capacity to motivate and educate pupils (Lin et al., 2018; Plump & Larosa, 2017).

It is a free platform that allows teachers to either design their quizzes and surveys or use existing quizzes and surveys that have been made publicly available. After each game, the scores are displayed, and teachers can save the information in a digital document. Learners (players) are not required to create a Kahoot account; instead, they will be given a game PIN prior to participating in a specific game as advised by their teacher (game host). Gamification

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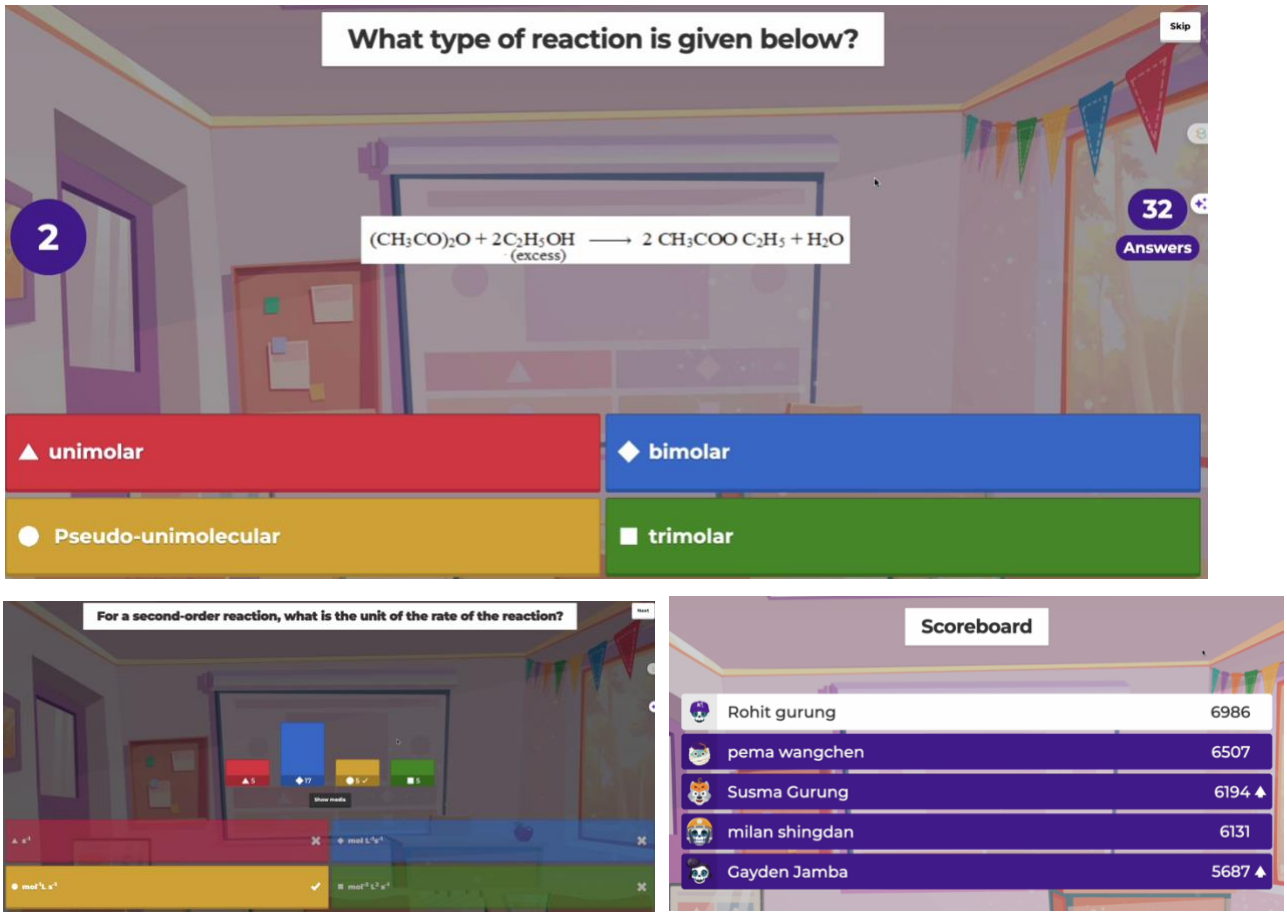
operates on the individual's drive to accomplish the desired result. This urge is, however, reliant on the individual's level of excitement. Kahoot promotes both cooperation and autonomy in the class. Game-based learning activities such as quizzes serve the purpose of reviewing content based on information taught (Figure 3).

Figure 3

Screenshot of Answering, Distribution of Answers and Scoreboard



What does the existing literature say about the use of Kahoot as a gamifying tool in teaching and learning?

Wang and Tahir (2020), in their literature review on Kahoot, reported that eighty-four studies found Kahoot to be effective in enhancing learning outcomes compared to traditional teaching. Likewise, Ares et al. (2018) also reported that the use of the Kahoot questionnaire as a gamifying tool enhanced students' chemistry learning at the university level.

Similarly, the majority of the existing literature supports the view that gamifying the lessons produces better learning outcomes (Chans & Castro, 2021; Cruz & Roleda, 2018; da Rocha Seixas et al., 2015; Hasan et al., 2017; Jamaluddin et al., 2017; Lutfi & Hidayah, 2021; Turan et al., 2016). For example, Jenkins and Mason (2020) in their study found that those

students who are taught using games outperformed those students taught with traditional teaching methods in learning chemistry. In addition, the attitude towards gamifying the lesson was also found to be favourable. A similar result was reported in Turkey by Turan et al. (2016), where they found a significant difference in academic achievement between traditional teaching and gamified teaching with 6th-grade students.

In addition, gamifying teaching has a positive effect on the learning outcome across various levels of education. For example, Hasan et al. (2017) also found that gamification using leaderboards and points elements enhanced learning and motivation at the university level. Likewise, Chans and Castro (2021) found that the gamification strategy enhanced the learning of chemistry at the University of Mexico. In addition, da Rocha Seixas et al. (2015) found that when the badging platform (gamifying) is used in elementary school, the students who received more rewards from the teachers got significantly better average performances. Furthermore, Cruz and Roleda (2018) found that the 10th-grade students' academic performance increased significantly after gamifying the physics lessons through the use of points and a reward system. Likewise, Lutfi and Hidayah (2021) also found that a significant difference in the pre-test and post-test was recorded after gamifying the science lesson in grade 9th students in Indonesia.

On the other hand, some studies reported that gamifying teaching does motivate students to learn but does not necessarily enhance their academic outcomes (Balci et al., 2022; Wang et al., 2016). For instance, Wang et al. (2016) found that when students are taught using a game-based students response system (Kahoot), students were more engaged, motivated and concentrated and enjoyed it compared to paper forms and a simple non-game-based students response system (clickers). However, no statistically significant difference was found in their achievement test. Likewise, Balci et al. (2022) found that the use of leaderboard and badge systems in gamifying learning doesn't improve academic performance. However, it boosts the motivation of the learners to learn the subject as it is associated with fun.

Statement of Hypothesis

A successful learning outcome is not guaranteed by the simple act of integrating ICT technologies into the learning process. Therefore, it is necessary to investigate its effects. The utilisation of Kahoot in gamifying the lesson has been shown to optimise classroom engagement and learning (Ares et al., 2018; Chans & Castro, 2021; Cruz & Roleda, 2018; Wang & Tahir, 2020). Thus, the study accepted the premise that using Kahoot as a gamifying tool in teaching will improve student learning achievement and classroom interaction based on the aforementioned assumption.

Methodology

Research Design

This action research employed a quasi-experimental design for the intervention process, utilising a mixed-methods approach for data collection. Quantitative data were collected through participant observations, pre-and post-tests, and surveys, while qualitative data were

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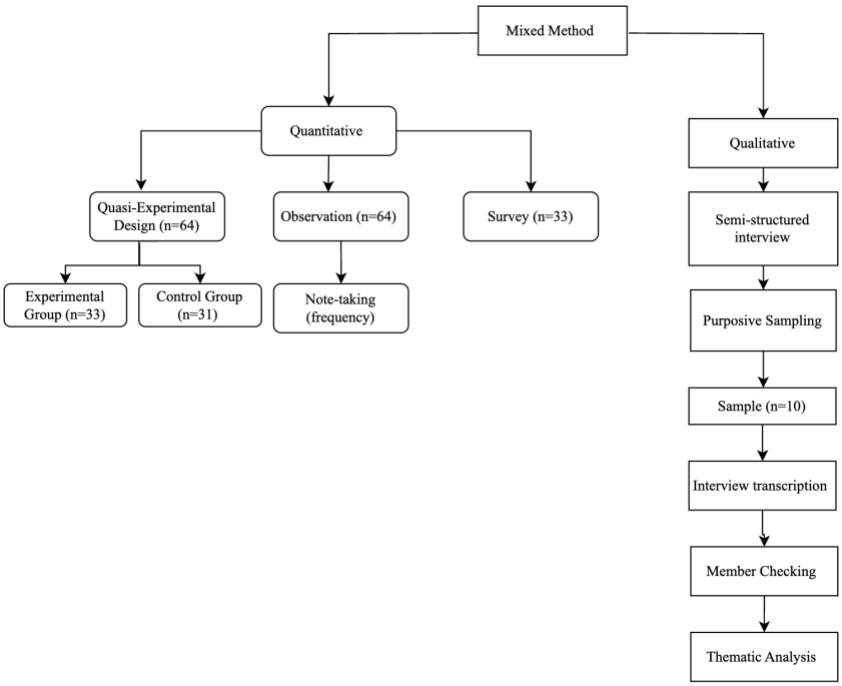
gathered via semi-structured interviews. A comprehensive overview of the study's methodology is illustrated in Figure 4.

Figure 4

Summary of the Methodology



Participants of the study

A non-probability purposive sampling technique was employed to identify the sample for the study. The study selected one section of XI Science (n=33) to be the experimental group while the other section to be the control group (n = 32) as per the convenience of the teacher researcher. The study involved 64 students (sample N=64). For the interview, ten students from the experimental group (n=33) were selected.

Research Instrument

The study employed four instruments for collecting the data, as discussed below:

i. Achievement test: The pre-test and post-test items, each consisting of 20 marks, were developed and administered to compare the achievement level before and after the intervention. The pre-test was administered at the beginning of the study and was later used to compare with the post-tests administered at the end of the intervention.

ii. Note-taking: Observations were documented to record the frequency of individual student engagement during lessons conducted with and without the use of Kahoot

iii. Survey: A custom-designed survey was developed and administered to meet the objectives of the study. The survey consisted of different question formats, such as multiple-choice, rating scale, and open-ended questions, to assess the effectiveness

of Kahoot as a gamification tool in teaching chemistry. In this study, 'effectiveness' refers to Kahoot's ability to achieve the desired outcomes, particularly enhancing student engagement and academic performance.

iv. Semi-structured Interview: Semi-structured interviews were conducted to gather students' opinions and attitudes regarding the use of Kahoot as a gamification tool in teaching.

Validity and Reliability

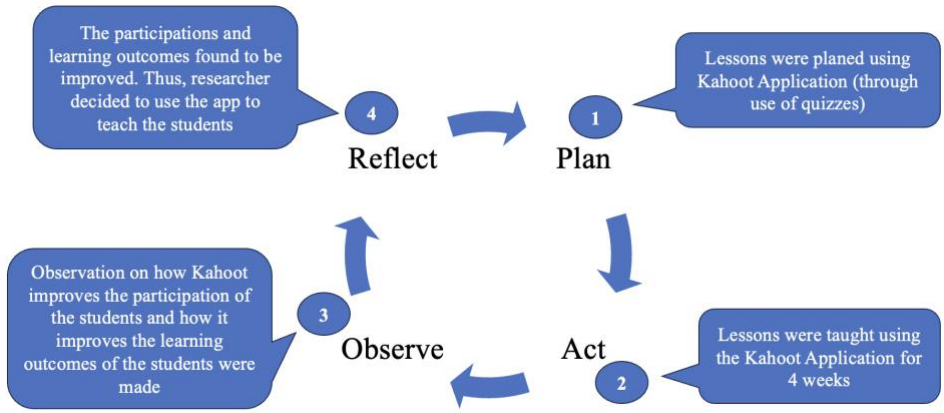
The achievement test items were evaluated for face and content validity by three senior chemistry teachers and a co-researcher. Likewise, survey items were pilot-tested and modified for clarity. The guiding interview questions for semi-structured interviews were also revised and pilot-tested to enhance their clarity.

Research Process

The study followed the popular cyclic action research process proposed by Kemmis and McTaggart (1988) (see Figure 5). The details of some important aspects of the action research process are discussed in turn below.

Figure 5

Summary of Action Research Process



(Adapted from Kemmis & McTaggart, 1988)

Uniformity test/Equivalent test

To ensure internal validity, the two groups were pretested to check that the groups were equivalent before assigning them to the experimental group and control group. The t-test was computed to see if the two groups statistically significantly differ, upon analysis, the test was found to be insignificant, assuring that the groups do not differ significantly in their academic performance. So, the teacher researcher decided to assign one class as an experimental and another as a control group as per convenience since no statistically significant difference in their academic performance was recorded (see Table 1).

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Table 1

Summary of Independent Samples T-test for the Equivalent Test

		Statistic	df	p	Mean difference	SE difference
Pretest	Student's t	0.433	62.0	0.666	0.298	0.688

Note. H_a $\mu_1 \neq \mu_2$

Intervention

The intervention was carried out for four weeks (6 periods per week, each period of 40 minutes) from the first week of August till the fourth week of August by using the Kahoot platform as a gamifying tool for teaching chemistry. From the three main gamification elements, i.e., Points, Levels, and Leaderboard, the study adopted only two aspects of gaming elements, i.e., points and Leaderboard. Activities such as quiz games and jumble board games were created by the teacher researcher and used to gamify the lessons in the experimental group. The leaderboard was shown to them to make them aware of their progress and to provide motivation to work hard. The points element informed the participants of their weaknesses and strengths, and it served as direct feedback to students. Likewise, the leaderboard served as the immediate formative assessment for the students. The teacher-researcher prepared the quiz using the Kahoot application, and then students were made to join the quiz using the unique PIN code automatically generated by the application. Some students joined the quiz using their smartphones, while others used the desktop from the school ICT room. Since the use of smartphones during school hours is prohibited, the teacher-researcher obtained permission from the school administration to allow mobile phone usage for this study. The teacher-researcher personally monitored and supervised the usage of smartphones. While most students owned smartphones, those without access used computers provided in the school's ICT room.

Post-test

The post-test was conducted after the intervention to understand the effect of Kahoot as a gamifying teaching tool in chemistry in improving students' learning achievement.

Observation

The purpose of the participant observation was to note how frequently each student interacted with the lessons in the class. The students were taught using the usual technique (mostly lectures) in the control group, while the experimental group was taught using the Kahoot application. The intervention started in the first week of August and continued until the fourth week of August. Throughout the four weeks of the AR, notes were made about how frequently each student interacted with the class.

Interview

After the intervention, a semi-structured interview was conducted to learn more about the students' attitudes and opinions regarding the use of Kahoot as a gamifying tool in teaching chemistry.

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Data Analysis

To validate the results from various sources, the data from the experiment, participant observation, and interview were triangulated. In order to conduct a parametric analysis, the data from the quasi-experiment was examined for normality. The normality of the data was confirmed using the Shapiro-Wilk test, which yielded a test statistic of 0.971 and a p-value of 0.14. The descriptive analysis using mean and standard deviation was then calculated, followed by an independent t-test to compare the means of the experimental group (taught using Kahoot) and control group (taught without using Kahoot).

Result

The data collected via different instruments is first analysed in silos before being triangulated depending on the responses to the three research questions that the study aimed to address.

Quantitative analysis of test results and classroom interaction

The mean, standard deviation (SD), and significance level p-value were compared between the pre-and post-tests. The mean difference between the experimental and control group was 10.6 and 8.61, respectively (see Table 2), and this resulted in a significance value t (62) = 2.90 p = .005 (p <.05), indicating that the students' post-test scores between the experimental group and control group are statistically significantly different, favouring the experimental group with large mean than the control group. Furthermore, the study's statistical significance was confirmed by calculating the effect size. The effect size serves as a gauge for the efficacy of the intervention. A greater effect size indicates greater effectiveness of an intervention. A medium to large effect size was observed in the study (Cohen's d = 0.72) (see Table 3). This demonstrated that there was a significant difference between the post-test mean score between the two groups and that the intervention (using Kahoot as a gamifying tool) was successful in improving the post-test mean score.

However, the SD of the experimental group (2.83) was slightly higher than the SD of the control group (2.58), showing that the students' scores in the experimental group were a bit more widely dispersed from the mean score compared to that of the control group. This indicates that the use of Kahoot favoured some learners more than others, this is possibly due to differences in their learning style, where the ones who loved learning digitally may have outperformed the ones who do not fancy digital learning and gaming.

Table 2

Descriptive Statistics of the Post-test

	Group	N	Mean	Median	SD	SE
Students test score	With Kahoot	33	10.6	12.0	2.83	0.492
	Without Kahoot	31	8.61	9.00	2.53	0.463

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Table 3

Independent t-test

		Statistic	df	p	Mean difference	SE difference		Effect Size
Students test score	Student's t	2.90	62.0	0.005	1.96	0.678	Cohen's d	0.724

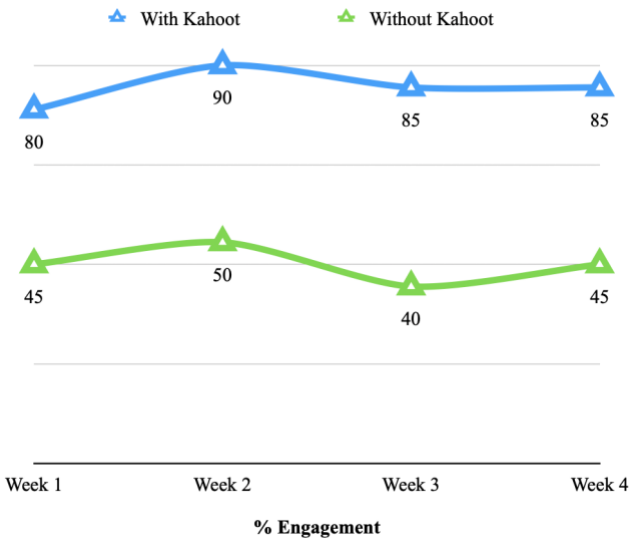
Note. H_a $\mu_{With\ Kahoot} \neq \mu_{Without\ Kahoot}$

In comparison to other ways of teaching (mostly lectures) methods, the observation data collected through note-taking revealed that when students were taught using the Kahoot application, there was a drastic increase in students' classroom participation.

Figure 6 shows the difference in engagement percentage between the two groups. The experimental group, which was taught with Kahoot, saw massive engagement. For instance, in the experimental group, students' engagement started at 80% in week 1, peaked at 90% in week 2, and remained steady at 85% in both weeks 3 and 4. The dip in the latter weeks, i.e., weeks 3 and 4, is an interesting observation because it might be because of the inability of the Kahoot application to sustain the interest of the students or maybe the topics discussed during those weeks were difficult. However, it is beyond the scope of this paper to ascertain that. On the contrary, the percentage of engagement during lectures and other traditional methods is low, with week 2 being the highest with 50% engagement, followed by 45% in both week 1 and week 4 and lowest in week 3, with 40% of students' engagement (See Figure 6).

Figure 6

A Summary of Percentage Engagement of Students in the Classroom



Qualitative analysis

The three overarching themes that emerged from the thematic analysis of the interview transcripts were the students' attitudes toward using Kahoot as a gamifying tool, the difficulties involved during the use of Kahoot and the advantages of Kahoot over the traditional teaching and learning method.

Attitudes of students towards using Kahoot as a gamifying tool in teaching chemistry

All the students (n = 10) agreed that Kahoot is a fun tool to make lessons interactive and engaging. For instance, Student 4 (S4) stated that "Kahoot makes lessons more engaging and fun as we are competing with friends". Likewise, S8 also concurs with the above opinion; he stated, "Learning through Kahoot is fun because it promotes competition and a sense of fun". Similarly, S1 added that it was a new thing that she tried using, and it was fun; she stated, "I am using Kahoot for the first time, and it is a new method of learning where we can compare among each other and learn through fun".

Perceived advantage of Kahoot as a gamifying tool

When asked about their perceived advantages of using Kahoot as a teaching tool, students opined that Kahoot makes learning fun with the elements of a game and is good at creating a competitive learning environment with fun. For instance, S2 expressed:

> Kahoot is a fantastic application where we get to choose our avatar and participate in a fun game-like learning where our knowledge is tested, and if correct, we are rewarded with points, and every now and then, we get to see our progress through the scoreboard/leaderboard. This promotes a sense of competition among us and makes me want to win and come first on the scoreboard.

Likewise, S9 echoed the above opinion:

> Kahoot is a wonderful tool that drives engagement and keeps us engaged in the lesson. The report that is produced can also be used by the instructor to gauge our comprehension and involvement levels. This is much more fun than a lecture or flipping the pages of the textbooks.

Challenges faced by students using Kahoot

When enquired about the challenges faced while using the Kahoot application, the majority of the students (n = 7) reported that the game-based questions were time-based and it was not sufficient to answer the questions within the allocated time. For instance, S3 expressed that:

> Although learning with Kahoot was fun, it could have been even more relaxed and fun if the quiz questions were not time-bound. I could not answer a few of the questions because I couldn't compute the answers within the stipulated time. If we had more time for each question, we could have done much better.

Likewise, S7 expressed a similar experience:

> It was a pleasant experience with Kahoot. We could have benefited more if we could get more time for each question. As some of the questions demand solving them

mathematically, it takes more time than the allocated time for the questions, which leads to leaving the questions unattended.

In addition, some of the students faced difficulty in reading the answers as they appeared quite small in the common display or projector, and the Kahoot features give only shapes as the possible answers in the MCQ quizzes. S5 commented that:

> Overall, I liked the features of the Kahoot. However, I faced difficulty reading the answers to the quiz as I stayed far away from the projector. In my display, the answers to the questions are all just shapes, and I had a difficult time not being able to see the answers to the questions. It would be nice if the Kahoot application could improve this feature and allow the display of the answers on individual screens rather than centralising one screen.

Table 4

Summary of Data Triangulation

Research Question	Data Source 1: Experiment	Data Source 2: Observation	Data Source 3: Interview	Data Source 4: Survey
How effective is the Kahoot app in improving the learning outcome of the students?	A significant difference between the two groups during the post-tests showed that Kahoot as a gamifying tool led to higher performance during the test in the experimental group.	-NA-	-NA-	93.8% of the students in the experimental group reported that Kahoot creates a fun learning environment.
How far does the Kahoot app improve participation of the students in learning?	-NA-	During the observation of the classes with and without using the Kahoot (40-50%), the classes using the Kahoot had the maximum percentage of student's engagement (80-90%).	Thematic analysis of the interview transcripts revealed that use of Kahoot app is fun and engaging.	Survey analysis also revealed that 78.9% of the students in the experimental group reported that Kahoot is engaging and interactive
What are the opinions of the students towards the use of Kahoot?	-NA-	The increase in the engagement percentage shows that the students enjoy using Kahoot.	Thematic analysis revealed that they enjoyed using Kahoot, and they are willing to use it in the future as well. The students' attitude towards using Kahoot as a gamifying tool to teach chemistry was positive.	None of the participants (0%) reported that they didn't enjoy using Kahoot

Discussion

In a typical Bhutanese classroom, the teacher takes centre stage, delivering lessons while students are expected to quietly absorb the information (Ghalley & Rai, 2019). However, given the changing landscape of education, there is an urgent need for pedagogical transformation. Technology has made significant contributions to education through platforms such as massive open online courses (MOOCs) and virtual learning environments (VLEs) (Ip et al., 2018). As educators, it is our moral responsibility to accept this technological revolution and integrate it into the teaching and learning process. One of the tools is Kahoot, a web-based and stand-alone application that gamifies lessons through elements such as point systems and leaderboards. Kahoot makes the lessons more engaging and fun, which greatly enhances the motivation and participation of the students (Lin et al., 2018).

Data triangulated from four sources revealed that Kahoot served to effectively improve engagement and learning outcomes for students both ways (see Table 4). Gaming elements in Kahoot, such as points and leaderboards, helped to create fun and a sense of competition for the students, thus keeping them fully involved in solving the tasks. This finding is supported by the study of Hasan et al. (2017), who reported that gamification features such as points and leaderboards improve learning and enhance motivation among students. The same results were also presented by Chans and Castro (2021) in the University of Mexico, whereby Kahoot increased student interest and motivation. Wang (2015) also points out that Kahoot steadily enhanced the level of involvement and motivation among students without significant decline even after extended usage spanning five months. Mohd Muhridza et al. (2018) note that Kahoot is an effective tool for promoting a higher level of student response while engaging in language learning. However, there are contradictions in some findings. For instance, it has been concluded by Balci et al. (2022) and Wang et al. (2016) that a leaderboard and point system, such as Kahoot, did not significantly enhance the learning outcomes of students. Such discrepancies may result from differences in sample selection or contextual factors. For example, the present study only had two groups, one experimental and one control, while the study by Balci et al. (2022) had four groups with different treatments: badges only, leaderboard only, leaderboard and badges, and a control group. While the reasons for this inconsistency are beyond the scope of this study, it is important to note that the two studies agree that the attitude of students towards Kahoot as a teaching tool is positive and favourable. Indeed, such a positive reception could be attributed to its interactive and enjoyable learning features.

In spite of the foregoing positive outcomes, there were several challenges reported. Students wanted to be given more time to answer quizzes, especially those requiring math problem-solving. This could be resolved by making time adjustments in the settings on the Kahoot application. Students also reported a limitation regarding the display of answers on individual screens, and such problems could be overcome with Kahoot's other modes being used instead of the classic teacher-led mode. While there are different opinions about Kahoot's effectiveness, the general findings of this study confirm Kahoot as an effective gamifying tool in enhancing students' engagement and learning outcomes, especially in creating an interactive and entertaining learning environment.

Conclusion and Recommendation

This study explored the use of Kahoot as a gamification tool in teaching chemistry to maximise student engagement and improve learning outcomes. The findings showed that learning with Kahoot significantly enhanced both student engagement and academic achievement compared to traditional teaching methods. Precisely, student engagement nearly doubled when Kahoot was used, whereby students became immersed in friendly competition to solve quizzes. The leaderboard feature further motivated and reinforced their efforts. Such enjoyable and interactive Kahoot sessions have contributed to improving learning outcomes, as evidenced by higher post-test scores.

However, the scope of the current study limits its findings. The study, being a pilot, was conducted in one school and with a small sample; thus, generalising on larger populations is not feasible. Future studies could further this research by expanding the sample size and diversifying the pool across more schools and grade levels. While the current study has focused on short-term outcomes within a four-week period, longitudinal studies are needed to assess the long-term impact of Kahoot gamification on student learning.

In spite of all these limitations, the results of the present study support findings from existing literature and also establish Kahoot as a highly effective pedagogical tool that can be used to positively influence classroom engagement and learning outcomes. Its actual classroom usage is of practical relevance and extends a number of pedagogical implications. Educators are hence encouraged to try using it to make learning more fun and engaging.

Teachers are recommended to provide sufficient time, depending on the complexity of the questions, so that the students do not face any problems during quizzes. Also, since the study has found that technology helps in improving student outcomes, it recommends allowing smartphones in educational institutions. This would help teachers to incorporate technology easily into their classrooms and ultimately help students to learn better.

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Conflict of Interest

There is no conflict of interest associated with this research.

Ethics Statement

Ethical approval from all the participants and the relevant agencies were obtained.

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