GAME-BASED ACTIVITIES IN GRADE 9 MATHEMATICS

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ABSTRACT

This study developed game-based activities (GBA) in Grade 9 Mathematics. Respondents were 133 Grade 9 Mathematics Teachers from the Division of Batangas Province. The authors applied a descriptive-correlational research design where the questionnaire was used as main instrument to gather the data. Correspondingly, frequency distribution, percentage, weighted mean, composite mean, and chi-square were utilized to treat gathered data. Findings revealed that majority of Mathematics teachers were early adult female with 5 years and below teaching experience, have attended seminars/training on the pedagogical approach, and holders of bachelor's degree. GBA were utilized by the teachers in motivation, engagement, performance, and application. It was revealed that there is a significant association between extent of utilizing GBA for motivation and the highest educational attainment (HEA) and seminars/training, between extent of utilizing GBA for engagement and sex, HEA, and teaching experience (TE) and between extent of utilizing GBA for performance and age, HEA, and TE. On the other hand, there is no a significant association between extent of utilizing GBA for motivation and age, sex and TE, between extent of utilizing GBA for engagement and age and seminars/training, and between extent of utilizing GBA for performance and sex and seminars/training. Lastly, there is no significant association between the extent of utilizing GBA for application and age, sex, HEA, TE, and seminars/training.

Keywords: application, engagement, game-based activities, performance, motivation

INTRODUCTION

One of the most essential knowledge or concepts a student should learn is Mathematics. It is because Mathematics skills can be used in daily lives and needed in the field of work. Mathematics knowledge or concept helps students to solve problems, helps them reason logically, and develop other skills in Math that they could integrate into other field and in real-life situations. Moreover, understanding and carrying mathematics skills are important means in achieving quality education and in shaping students' success in the future.

At present, the low performance of Mathematics is of concern all over the world. Studies revealed that among the reasons for the decrease in mathematics performance is because students consider mathematics as a difficult and boring subject. With that, they suffer from math difficulties or math learning difficulties.

Mathematics difficulties encountered by the students include incomplete mastery of number facts where basic computations are required to memorize at the earliest grades at the elementary level and failed to retain at the higher level (Ocadiz, 2017). Computational weakness is also considered. Some student make an error in basic computation because they misread signs or carry numbers incorrectly (Barringer, Polhman, & Robinson, 2020).

Additionally, inattentiveness during classes causes difficulties in understanding Math. Students who are not interested and not engaged in the lesson will result in poor performance (Ocadiz, 2017). Another difficulty

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that was commonly experienced by students with Math problems is the inability to connect Math concepts in real-life. This is because some complex concepts in math are hard to relate to. According to Felton (2014), teachers must use problems in the lessons that are authentic and can encourage students to draw out on their real-world experiences, hence, students could see the relation of the concept to their daily experiences.

Studies revealed that many of the students have negative attitudes towards Mathematics. Changing this outlook from negative to positive is a crucial role of teachers. According to Digitale (2018), teachers should try to incorporate teaching strategies and techniques that highlight the value of mathematics, help develop students' math skills, and increase their self-esteem in learning concepts in math. Through collaborative or cooperative learning, self-confidence of all members of the group will be boosted and they are encouraged to work as a team, share their ideas, successes, and failures together (Nurhayati, Rosmaiyadi, & Buyung, 2017). This could be achieved through the use of GBA in teaching.

Nowadays, people of all ages love to play games that are fun, interesting, and motivating. Using fun-filled undertakings and game activities, students may develop his or her social skills (Mary, 2019). Games provide opportunities for students to learn while engaging in a competition. Factors in games like competition among students help to be motivated to attempt and complete the given task (Raudys, 2018). Games also allow students to work with the material, instead of being presented with the facts and asked to memorize it.

Based on the observation of the researchers with High School students of Tipas National High School (Grade 7 – 12), Math difficulties include: lack of interest in learning that leads to poor understanding of math concepts; lack of students' engagement, difficulty in solving word problems; and difficulty in the application of Math in real-life. These learning difficulties range from mild to severe and need instructional attention and various methods of teachers in teaching the learning subject.

Accordingly, this study addresses the difficulties of learning Mathematics. This is aligned with the Division Memorandum 101 S. 2018, the program of The Utilization of Oral and Written Numeracy Assessment Tools and e-Games for Diverse K to 12 Leaners was implemented in the Division of Batangas. This program aims to increase students' achievement in Mathematics specifically, it aims to help slow learners master skills through activities suited to their learning styles. GBA could be utilized as a learning tool for the educational process. The purpose of the particular game-based activities would be to support the teaching of grade 9 mathematics and could enhance students' motivation, engagement, performance, and application with the subject.

OBJECTIVES

This study developed game-based activities in Grade 9 Mathematics. Specifically, it aimed to: 1) describe the profile of the respondents in terms of age, sex, highest educational attainment, teaching experience, and seminars/ training attended; 2) assess the extent of the respondents' utilization of game-based activities for motivation, engagement, performance, and application; 3) ascertain if there is a significant relationship between the respondents' extent of utilization of game-based activities and their profile variables.

METHODOLOGY

This study is a descriptive-correlational research design that aimed to develop game-based activities in Grade 9 Mathematics. The subjects of the study were 133 Grade 9 mathematics teachers of Secondary Public Schools in the Division of Batangas Province. The total number of grade 9 math teachers gathered from the Division Office of Batangas Province was 201. Through the Rao soft Sample Size Calculator, the researcher was able to identify the 133-sample size of respondents that

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were used in the study. The researchers gathered information through reading books, articles, magazines, and other related literature in designing the questionnaire and gathered the primary data from the viewpoints of the Grade 9 Mathematics Teachers through the questionnaire, interview, and observation and from the ideas found from books, articles and other related studies.

The researchers transferred the constructed and validated questionnaire in google forms to create a questionnaire online. They prepared a letter to the school's division superintendent asking permission to administer a questionnaire online to the grade 9 mathematics teachers of Public Secondary Schools in the division of Batangas Province. They secured the list of Public Secondary Schools and the respective name of principals from the division office. They waited for two weeks to retrieve the approved letter and the list of schools. The researcher started to search the name of the principal of each school through Facebook and personally messaged them through Messenger to ask permission and help to disseminate the questionnaire online to the grade 9 math teachers and ask them to answer it. The researchers monitored the google forms and checked it from time to time. It took six (6) weeks from the third week of November 2019 to the first week of January 2020 to complete the 133 responses. They took and downloaded the summary of collected responses from google forms in excel format. Data collected collected were tallied, classified, and tabulated. Frequency distribution, percentage, weighted mean and chi – square was utilized as statistical tools to treat gathered data.

RESULTS AND DISCUSSION

1. Profile of Grade 9 Mathematics Teachers

The profile of Grade 9 Mathematics teachers such as age, sex, highest educational attainment, teaching experience, and seminars/training attended was gathered and analyzed in this study to have accurate information of the respondents. The results are shown in Tables 1 to 5.

1.1 Age. As exhibited in Table 1, the highest number of respondents which was 39 with 29.32 percent were in the group of 26 – 30 years old. It was followed by the age bracket of 31 – 35 years old with 26 respondents which were equivalent to 19.55 percent.

Tablen1
Profile of Grade 9 Mathematics Teachers in terms of Age

Age	Frequency	Percent
21 – 25nyears old	24	18.05
26 – 30nyears old	39	29.32
31 – 35nyears old	26	19.55
36 – 40nyears old	19	14.29
41nyearsnold and above	25	18.80
Total	**133**	**100**

Twenty-five Grade 9 Math teachers or 18.80 percent were on the age bracket of 41nyearsnold and above. Also, there were 24 respondents, or 18.05 percent on the group of 21 – 25 years old, 19 respondents or 14.29 in the bracket of 36 – 40 years old, and no respondent in the age bracket 20 years old and below. This indicates that then teachers were in the middle of the '20s to '30s that are professionals and may have acquired more than a year of experience of teaching Mathematics. This finding affirms with the idea of Mift as cited by Makalintal (2018) that the teachers in field of teaching isnmostlynagesn20 to 40, they particularly doing the utmost level of performance in those ages.

1.2 Sex As can be seen in Table 2, out of 133 Grade 9 Mathematics teachers, the majority of the teachers were female with 97 or 72.93 percent. Otherwise, only 36 male teachers with 27.07 percent. The data indicates that most Mathematics teachers were female because the education field is commonly dominated by females. This is similar to the findings of the NCES [14] that there was 76 percent of female Secondary education teachers in the Philippines.

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Table 2
Profile of Grade 9 Mathematics Teachers in terms of n Sex

Sex	Frequency	Percent
Female	97	72.93
Male	36	27.07
Total	**133**	**100**

1.3 Highest Educational Attainment. As shown in Table 3, 96 mathematics teachers with 72.18 percent were Bachelor of Secondary n Education degree or Baccalaureate degree graduates. Thirty-three of them with 24.81npercent were master's degree graduates and the rest of them which was four with 3.01 percent were finished doctorate degrees. The findings establish that the majority of Grade 9 mathematics teachers were baccalaureate degree holders.

Table 3
Profile of Grade 9 Mathematics Teachers in terms of Highest Educational Attainment

Degree	Frequency	Percent
Baccalaureate Degree	96	72.18
Master's Degree	33	24.81
Doctorate Degree	4	3.01
Total	133	100

However, some graduated masters and doctorate degrees. This conforms to the study of Albert (2013) that public secondary teacher lacks advanced degrees. Only faculties from higher education or less than half have degrees beyond the bachelor's degree. Only about 10 percent hold a doctorate. Teachers especially from public schools were studying not just for their professional growth but also for the promotion of their position.

1.4 Teaching Experience. It can be gleaned in Table 4 that the highest number or 46 teachers or 34.59 percent were 5 years and below. It was followed by 36 teachers or 23.31 percent under the group of 6 – 10 years. Next were, 19 or 14.29 percent from 11 – 15 years, 15 teachers with 11. 28 percent from 26 years and above, and 14 or 10.53 percent under the group of 16 – 20 years.

Table 4
Profile of Grade 9 Mathematics Teachers in terms of Teaching Experience

Years in Service	Frequency	Percent
5 years and below	46	34.59
6 - 10 years	31	23.31
11 - 15 years	19	14.29
16 - 20 years	14	10.53
21 - 25 years	8	6.02
26 years and above	15	11.28
Total	**133**	**100**

Lastly, 26 years and above teaching experience with 8 teachers or 6.02 percent. The data affirm that most of the teachers earned 5 years and below teaching experience. This was similar to the study of Kini and Podolsky (2016) that a greater proportion of the teaching workforce has less than five years of experience in the United States.

1.5 Seminars/Training Attended. As depicted in Table 5, out of 133 teachers, 65 or 48.87 percent were attended seminars/training regarding pedagogical approaches.

Tablen5
Profile of Grade 9 Mathematics Teachers in terms of Seminars/Training Attended

Themes	Frequency	Percent
Pedagogical Approaches	65	48.87
Teaching Strategies	33	24.81
21st Century Teaching	35	26.32
Total	**133**	**100**

Thirty-five teachers or 26.32 percent were attended 21st-century teaching and 33 teachers or 24.81 attended seminars/training focusing on teaching strategies. It can be inferred from the table that most of the mathematics teachers were attended pedagogical approaches in teaching. As revealed from those who have been interviewed that pedagogical approach was commonly the topic, they have learned in the learning action cell sessions in their respective school.

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2. The Extent of Utilizing Game-Based Activities

2.1 Motivation. Based on the results, the assessment of the teachers in utilizing GBA in establishing a good introduction to a new lesson was utilized to a very great extent. This obtained the highest weighted mean of 3.56 among thirteen items. It implies n that Mathematics classes will be alive and interesting when teachers started the lesson with fresh and new activities. This affirms with the idea of McGraw-Hill (2019) that Math games provide a more engaging context for introducing and practicing new skills. Also, as revealed by those who have been interviewed that games were integrated into the motivation part of the lesson to catch the students' interest in learning math

Least rated by the teachers were directing and sustaining good behavior of the students and helping students build self – esteem in learning. These two items got a weighted mean of 3.41 was assessed by the teachers to a great extent. Two items were the least rated but still to a great extent implies that games could direct students' desire to learning math concepts but sometimes do not sustain or happened throughout the class period due to some hindrances or barriers. Also, there were elements of the games or kinds of games that rarely help students build self - esteem. As revealed by those who have been interviewed that using games does not consistently get the attention of the students for the whole period.

As a whole, the composite mean of 3.45 indicates that the extent of utilizing GBA in terms of motivation as assessed by Mathematics teachers was great. It shows that the use of GBA in teaching mathematics helps students to be motivated in learning. It is supported by the idea of Victoria (2017) that by playing games, students become more motivated to learn, pay attention, and participate in set tasks.

2.2 Engagement. Based on then findings, engaging students in enthusiastic learning activities and giving opportunities for students to work collaboratively as a group was utilized to a very great extent. Both items obtained a weighted mean of 3.53. The results revealed that utilizing games in the lesson will let the students be engaged in enthusiastic games activities and let them work cooperatively with their group members. This affirms with the idea of EdTech Review (2013) that students will have interaction and collaboration with each other to provide view point to the experience of playing the game.

Least rated by the teachers among eleven items was utilized to a great extent which is initiating interactive learning experience among students. This was obtained a weighted mean of 3.46. These results revealed that games will give cooperative experience where students can work and learn as a group. This is relative to the idea of Teed (2018) that game-based learning is an engaging educational activity that can be utilized in the classroom to promote collaboration among students.

In summary, the composite mean of 3.50 establishes that the items of utilizing games in terms of engagement were utilized to a very great extent. The respondents believe that the students are engaged when games are used and incorporated in the discussion. This affirms with the idea of Groff, Howells, & Cranmer (2010) that game-based learning needs to be planned well and concepts must be organized to engage all students in learning and produce good outcomes.

2.3 Performance. Based on the outcomes, increasing the probability of the students responding repeatedly was utilized to a great extent. This obtained a weighted mean of 3.47 and top on the list. This implies that the games can help students to continually respond to the teachers during the discussion. This conforms to the idea of Hovhannisyan (2018) that classroom games give instant, valuable feedback on how well students are doing.

Least among fifteen items, increasing Mathematical proficiency of students was assessed to a great extent with a weighted mean of 3.34. Despite that this item is considered least rated, still, the games contributed to the mathematical proficiency of students. It indicates that games provide mathematical concepts that

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help students to be proficient. This is relative to the study of Naik (2016) that non-digital game-based learning is both motivational and has a positive impact on learning outcomes where it increases the proficiency of math skills.

To sum up, the composite mean of 3.41 indicates that the utilization of the GBA in terms of performance in math was assessed by the teachers to a great extent. This implies that game-based activities help the students to perform better in class. This finding is relative to Turgut & Temur (2017) that using games in the Mathematics teaching process generally affects students' academic achievement positively.

2.4   Application. Allowing students to explore things relevant to the lesson, enhancing students' ability to apply math concepts to different learning experiences and helping students to apply math learning in a real-life context gained a weighted mean of 3.47 and were assessed to a great extent. This indicates that the use of games in the learning process helps students to apply math concepts to their daily living and learning experiences. It conforms to the idea of Denham, et.al, (2016) that using a game as part of teaching let the teacher build on students' ideas and make connections with real-world examples.

Having a weighted mean of 3.35, enabling students to easily transfer math learning to a real-world environment, and applying math learning in different contexts were the least rated and were assessed by the teachers to a great extent. This means that game-based activities integrated to lesson help students to relate some math concepts in different real-life contexts. As revealed by those who have been interviewed that the games, they are using in the lesson include real-life problems that could be solved by the students.

As a whole, the composite mean of 3.43 justified that the extent of utilizing GBA in terms of the application was achieved to a great extent. Through the use of games, students can easily connect and integrate math concepts into their daily living. This is similar to Peters (2019) idea that games are designed typically at different levels of ability that aims to help the players to

retain the information that they learn and apply it to other problem-solving real-life situations.

3.   Relationship of the extent of utilization of GBA to the profile variables

3.1 Motivation. Reflected from Table 10 that the computed chi-square value of 7.409 yielded a p-value of 0.4933, and 3.061 yielded a p-value of 0.2164, and 12.578 yielded a p-value of 0.1272 which are greater than 0.05 level of significance indicates that the null hypothesis of no significance is failed to be rejected for age, sex, and teaching experiences.

Table 10
Relationship of the Extent of Utilization of GBA in term of Motivation to their profile variables

Variables	Chi-square values	p-values	Decision	VI
Age	7.409	0.4933	Failed to Reject	Not significant
Sex	3.061	0.2164	Failed to Reject	Not significant
Highest Educational Attainment	12.145	0.0163	Reject	Significant
Teaching Experiences	12.578	0.1272	Failed to Reject	Not significant
Seminars and Training Attended	12.114	0.0165	Reject	Significant

Thus, there is no significant association between the teachers' extent of utilizing GBA in terms of motivation and age, sex, and teaching experiences, respectively. These findings indicate that age, sex, and teaching experiences of the teachers do not have something to do with how they utilized game-based activities.

The computed chi-square value of 12.145 n yielded a p-value of 0.0163 for the highest educational attainment and 12.114 yielded a p-value of 0.0165 are less than 0.05 level of significance. These indicate that the null hypothesis of no significance is rejected respectively. Thus, there is a significant association between teachers' extent of utilizing GBA in terms of motivation and the HEA and

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seminars/training attended. These results indicate that teachers with HEA tend to have a greater extent in the utilization of GBA in class. Mathematics teachers with different educational attainment are more likely to have teaching techniques learned from the courses they have taken. Specifically, the psychology of teaching and learning where teachers learned how to get the interest of students in learning.

Correlated to this, teachers' seminars/training attended is indirectly correlated with how they utilized game-based in terms of motivation. This implies that teachers who are exposed to more seminars and training showed to have considered lesser use of GBA in terms of motivation. Knowledge from seminars/training helps teachers to be more effective and efficient inside the classroom. The fewer seminars they have attended, the more they tend to rely on or use game-based activities.

3.2 Engagement. As reflected in the Table 11 that the computed chi-square value of 6.364 scored a p-value of 0.1736 and 5.453 yielded a p-value of 0.0655 which is greater than 0.05 level of significance indicates that the null hypothesis of no significance is accepted for age and seminars and training attended.

Table 11
Relationship of the Extent of Utilization of GBA in terms of Engagement to their profile variables

Variables	Chi-square values	p-values	Decision	VI
Age	6.364	0.1736	Failed to Reject	Not significant
Sex	5.404	0.0201	Reject	Significant
Highest Educational Attainment	8.515	0.0142	Reject	Significant
Teaching Experiences	10.835	0.0285	Reject	Significant
Seminars and Training Attended	5.453	0.0655	Failed to Reject	Not significant

Thus, there is no significant association between the teachers' extent of utilizing GBA in terms of engagement and age and seminars and training attended respectively. These outcomes indicate that the age of the teachers, how young and old, and seminars and training attended does not matter on how they will engage the students in learning through using game-based activities. The computed chi-square value of 5.404 yielded a p-value of 0.0201 for sex, 8.515 yielded a p-value of 0.0142 for highest educational attainment, and 10.835 yielded a p-value of 0.0285 for teaching experiences are less than 0.05 level of significance. These indicate that the null hypothesis of no significance is rejected, respectively. Therefore, there is a significant association between teachers' extent of utilizing GBA in terms of engagement and sex, HEA, and TE. Then results show that sex, HEA, and TE have an indirect relationship with the extent of utilizing GBA in terms of engagement. Teachers who are male tends to engage male students in the discussion, moreover, female teachers can let the students be engaged. This is because students exhibit moderately stable tendencies to engage in same-sex interactions. Math teachers with higher educational attainment will gain more learnings regarding engagement techniques in teaching. Teachers have seen from their experiences, through observation how they will engage the students in the class discussion. The higher number of teaching experience of the teachers, the more likely they will also gain techniques on how to engage students in the learning

3.3 Performance. As displayed in Table 12, the computed chi-square value of 2.107 yielded a p-value of 0.3487 and 5.336 yielded a p-value of 0.2546 which are greater than 0.05 level of significance implies that the null hypothesis of no significance is failed to be rejected for sex and seminars/training attended. Thus, there is no significant association between the teachers' extent of utilizing GBA in terms of performance and sex and seminars/training attended respectively. This finding indicates that the sex of the teachers, whether male or female does not affect the way they utilized the game-based activities in terms of performance of the students.

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Table 12
Relationship of the Extent of Utilization of GBA in terms of Performance to their profile variables

Variables	Chi-square values	p - values	Decision	VI
Age	15.593	0.0486	Reject	Significant
Sex	2.107	0.3487	Failed to Reject	Not significant
Highest Educational Attainment	12.990	0.0113	Reject	Significant
Teaching Experiences	22.338	0.0043	Reject	Significant
Seminars and Training Attended	5.336	0.2546	Failed to Reject	Not significant

Also, it can be inferred that the seminars/training attended by the teachers has no association with the performance of the students in utilizing game-based activities.

Meanwhile, the computed chi-square value of 15.593 yielded a p-value of 0.0486 for age, and 12.990 yielded a p-value of 0.0113 for the highest educational attainment and 22.338 yielded a p-value of 0.0043 for teaching experiences are lessnthann0.05nlevelnof significance. These indicate that the null hypothesis of no significance is accepted, respectively. Therefore, there is a significant association between teachers' extent of utilizing GBA in terms of performance and age, HEA, and TE.

These results indicate that age, highest educational attainment, and teaching experiences have an association with how game-based activities are utilized for performance. This means that older math teachers tend to use game-based activities to a lesser extent. Young teachers are more inclined to use game-based activities to measure performance when they prepare lessons. Also, teachers who attained higher education are capable of uplifting students' performance to a higher extent. Moreover, teachers who are new to the teaching profession especially 21st-century teachers can implement games in the lessons since they are aware of the new trends in education, unlike the old teacher who experienced the traditional way of teaching.

3.4 Application. As depicted in Table 13, the computed chi-square value of 7.806 yielded a p-value of 0.4527, 4.227 yielded a p-value of 0.1208, 3.233 yielded a p-value of 0.5196, 6.229 yielded a p-value of 0.6216 and 4.457 yielded a p-value of 0.3476 which are greater than 0.05 level of significance indicates that the null hypothesis of no significance is failed to be rejected. Therefore, there is no significant association between the teachers' extent of utilizing GBA in terms of application and age, sex, HEA, TE, and seminars/training attended respectively.

Table 13
Relationship of the Extent of Utilization of GBA inntermsnofnApplicationnto their profile variables

Variables	Chi-square values	p - values	Decision	VI
Age	7.806	0.4527	Failed to Reject	Not significant
Sex	4.227	0.1208	Failed to Reject	Not significant
Highest Educational Attainment	3.233	0.5196	Failed to Reject	Not significant
Teaching Experiences	6.229	0.6216	Failed to Reject	Not significant
Seminars and Training Attended	4.457	0.3476	Failed to Reject	Not significant

Notwithstanding, these findings reveal that age does not matter and the sex of the teachers, whether male or female has nothing to do with how the way they utilized the GBA in terms of application. Similarly, it indicates that the level of education achieved by the Math teachers has no association with the application of students' learning through games. Likewise, the number of years of experience of the teachers and seminars/training attended is not associated with utilizing GBA in terms of application.

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CONCLUSIONS

In light of the foregoing findings, the following conclusions are drawn.

1. Majority of Mathematics teachers are young female with 5 years and below teaching experience, have attended seminars/training on pedagogical approach and Baccalaureate Degree holders.
2. Game-based activities were utilized by Mathematics teachers in motivation, engagement, performance, and application.
3. There is no significant association between the teachers' extent of utilizing GBA in terms of motivation and age, sex, and TE, between teachers' extent of utilizing GBA in terms of motivation and the HEA and seminars/training attended, between the teachers' extent of utilizing GBA in terms of engagement and age and seminars and training attended , between the teachers' extent of utilizing GBA in terms of application and age, sex, HEA, TE, and seminars/training attended and between the teachers' extent of utilizing GBA in terms of performance and sex and seminars/training attended. On the other hand, there is a significant association between teachers' extent of utilizing GBA in terms of performance and age, HEA, and TE, and between teachers' extent of utilizing GBA in terms of engagement and sex, HEA, and TE.

RECOMMENDATIONS

Based on the findings and conclusions drawn from the collected data, the researchers recommend the following:

1. The prepared game-based activities may be reviewed by Grade 9 Mathematics teachers as their reference and applied these games in teaching lessons in their class.
2. Teachers are encouraged to update their professional growth and development through studying and attending seminars/training about the strategies that they will use in teaching which are aligned in the new trends of education.
3. Similar studies may be conducted that will cover other Grade levels such as 7, 8, 10, 11, and 12.

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