

In-Service STEAM Teachers' Perceptions of Using Game-Based Learning in Primary and Secondary Instruction in the Bahamas

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Very few studies on game-based learning (gbl) have been conducted within the Caribbean/West Indies, particularly studies of a mixed-methods nature examining in-service K-12 STEAM teachers' perspectives. This study addresses the aforementioned gap and explores the benefits of employing GBL as a teaching strategy in primary (elementary) and secondary schools within the Bahamas where no research has been conducted in the area of GBL. This study utilizes a mixed-methods approach and is made of a quantitative questionnaire for teachers and interviews with teachers. Thirty-nine teachers completed the quantitative questionnaire and 29 teachers participated in the interview session. Teachers were drawn from the Bahamas' first National Science, Technology, Engineering, the Arts, and Mathematics (STEAM) GBL Mini-Conference. Data findings from the teachers' completed questionnaire and interviews should begin to fill in the research gap as it relates to GBL in the Bahamas and the Caribbean.

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BRIEF REVIEW OF LITERATURE

Researchers, Hartweg et al. (2017), Chung & Tan (2014), and Pinder (2016, 2017) have all conducted and reported on game-based learning (gbl) scenarios in Science, Technology, Engineering, and Math (STEM) disciplines. Specifically, Hartweg et al. (2017) conducted a study entitled “*Peruvian Food Chain Jenga: Learning Ecosystems with an Interactive Model.*” This study, which was conducted with 54 5th grade students from a public charter school in Texas was an experimental/control group design study consisting of a pre-post-test and a “What I Did/What I Learned Response Sheet.” Data from this study showed that both the experimental and control groups of students improved from pre-test to post-test and that there was no statistically significant difference between post-test results of experimental and control groups of students. Additionally, results from the students’ “What I Did/What I Learned Response Sheets” indicated a difference between students who used the “*Peruvian Food Chain Jenga*” (the experimental group) and students who did not (the control group). Moreover, the researchers’ findings suggested that using a model like the “*Peruvian Food Chain Jenga*” as a means of teaching and connecting scientific content with practices related to ecosystems is an effective method of engaging students in discussions about these types of topics.

Chung & Tan (2014) also conducted a study entitled “*The Effects of Educational Games toward Students’ Comprehension of Numerical Operation Concepts.*” This study which consisted of 31 Chinese and Malaysian students was a quantitative study with an experimental research design using a one group pre-post-tests. Students were selected based on their past math exam results.

1st part of study: All 31 students were given a pre-test before the experimental phase (treatment phase) occurred.

2nd part of study: The experimental phase occurred, students were given 1 hour to play 4 math games concerning addition, subtraction, multiplication, and division for 7 days in their school’s computer lab.

3rd part of study: all students were given a post-test after the experimental phase ended.

Results revealed:

- significant relationship between prior knowledge with the choice of game played
- Paired-sample t-test of pre-post tests showed a high possibility at $p = 0.017$ that educational games helped students in acquiring numerical operational concepts.

Pinder (2016, 2017) conducted a mixed-methods study “*Exploring the Effects of Game-Based Learning in Trinidad & Tobago’s Primary Schools: An Examination of In-Service Teachers’ Perspectives (see the attached first research article).*” Pinder found that 50%-60% of teachers interviewed gave favorable responses to the employment of GBL in Trinidad & Tobago’s schools, specific responses were: “*I think GBL can make it easier for primary school students to learn any subject,*” “*GBL is an effective strategy for assessing students’ skills,*” and “*I think GBL will make it easier for school students to excel in any subject.*” Additionally, interview data concurred with survey data that teachers held positive views of the use of game-based learning teaching strategies. This present 2018 research study conducted in the Bahamas is a replication of Pinder’s Trinidad research. Additionally, this study represents the first study of a mixed-methods

nature on game-based learning to come out of the Bahamas and it is also one of a few studies to be conducted on game-based learning within the Caribbean/West Indies region.

RESEARCH QUESTIONS

Three research questions were used in this study, which were:

1. What are your perceptions/views on the use of a game-based learning approach being employed in the traditional teaching of educational concepts, be it in science, math, or other subject?
2. In what ways might game-based learning impact your traditional teaching of educational concepts, be it in science, math, or other subject?
3. In reflecting on your students, in what ways might game-based learning affect those of your students with learning deficiencies or learning challenges?

METHODS

As with the Trinidad study, this replicated study employed a mixed-methods approach consisting of: first, a quantitative questionnaire with 10 Likert-type questions where strongly agreed = 5, agreed = 4, neutral = 3, disagreed = 2, and strongly disagreed = 1 (Karadag, 2015; Pinder, 2008), and second, three interview questions were used as a part of the qualitative section of the study (interview questions were adapted from Pinder, 2016, 2017).

Sample Size

- 50 K-12 educators from private and public schools attended the Bahamas' 1st Science, Technology, Engineering, the Arts, and Mathematics (STEAM) GBL Mini-Conference held on February 3, 2018 in New Providence, Bahamas
- 39 out of 50 teachers or 78% completed the quantitative questionnaire
- 29 out of 50 teachers or 74% completed the three interview questions

Curriculum Focuses of Teachers:

- Bahamas' National K-12 Curriculum in STEAM
- The International Baccalaureate (IB) North American K-12 STEAM Curriculum

Reported Gender on Surveys:

- 4 males
- 19 females
- 16 did not report their gender

Years of Teaching Service Reported:

- 0 to 5 years = 1 teacher
- 5 to 10 years = 8 teachers
- 11 to 19 years = 5 teachers
- 20 years or greater = 12 teachers
- Did not report years of teaching service = 13 teachers

Procedures

First: teachers were trained on the use of game-based learning techniques and tools and were introduced to action based classroom research (assessing the effects of gaming techniques & tools)

Specifically, as the teachers were being trained they were exposed to:

- theories behind game-based learning—cognitive and constructivist theories
- 4 non-digital games or paper based games and 6 digital/computer based games (teachers played these games)

Description of Games, How Games Were Played, and Conceptual Use of Games:

Four Non-Digital/ Paper Based Games (games 1-4):

Game 1: Number and Things Game Board

- Tasks were to identify odd versus even numbers and to identify living versus non-living things

Conceptual Use

- **Math Concepts Measured:**
Identifying counting numbers 1-100
Identifying even versus odd numbers
- **Science Concepts Measured:**
Identifying, labelling, and classifying “living vs. non-living organisms/things”

Game 2: Spin, Select a Number and Question Game

- 12 questions made up this game
- 12 questions were drawn from multiple subjects: Science, Math, Music, English, and Social Studies/Civics
- Two players played the game with each player being given the chance to spin the spinner of the game board to select a number 1-12 on the spinning game board, each selected number was aligned to a specific subject question
- The player who answered most of the questions correctly won the game

Conceptual Use

- This game allowed for the combining/integrating of several subjects into the one game; in this case Science, Math, Music, English, and Social Studies/Civics were all combined/integrated into this one game
- This game was designed for use at the primary/elementary level where integration of multiple subject matter is predominant
- Serve as a tool for: subject(s) review, formative assessment, summative assessment, and for reinforcement of concepts covering several subjects

Game 3: 12 Questions/Random Question Game

- This game was made of 12 questions, which were drawn from the subjects of Music and Technology
- Two players played the game with each player being given the chance to randomly select a question out of an assigned bag, each selected question pertained to either the subject of Music or Technology
- The player who answered the most questions correctly won the game

Conceptual Use

- This game allowed for the combining/integrating of several subjects into one game; in this case Technology and Music were combined/integrated into this one game
- This game was designed for use at the primary/elementary level where integration of multiple subject matter is predominant
- Serve as a tool for: subject(s) review, formative assessment, summative assessment, and for reinforcement of concepts covering one or several subjects

Game 4: Food Chains, Food Webs, Food Pyramids...Hunt Your Food!!!

This is a Hunt game in which teachers took on the roles of various plants and animals and hunted for their food. Once the food was found, teachers linked hands and formed either a food chain or food web. The game could be used to show the effects of loss of members in a food chain, loss of energy/energy distribution, and members could form a human food pyramid as well. The organisms for this game were selected from various aquatic/marine and terrestrial habitats.

Conceptual Use

- This game is considered ideal for grades 5 – college level (first year)
- This game is best intertwined/integrated into lessons or into a unit covering concepts pertaining to food chains/food webs/food pyramids and energy distribution.
- Subject specific—Science, Environmental Science, and Biology
- This game teaches concepts of: food chain, food web, food pyramid, energy distribution, marine/terrestrial habitats, producers, consumers, herbivores, carnivores, and omnivores

Six Digital/Computer Games (games 5-11):

Game 5: Classroom Feud (Modified)

- Digitally modified version of Steve Harvey's Hit Television Game Show "*Family Feud*"

- This game served as a subjects review game, which covered the subjects of: Math, Science, English, Music, & Social Study

Game 6: Digital Math Play Ground—Addition blocks

http://www.mathplayground.com/addition_blocks/index.html

Game 7: Digital Demolition Division

<http://www.arcademics.com/games/demolition/demolition.html>

Game 8: Math Playground: Minus Mission

<http://www.arcademics.com/games/mission/mission.html>

Conceptual Use:

Games 6 to 8 are considered ideal for use at the primary/elementary level and great as a homework assignment as it let the student player see corrections to the questions they missed or answered incorrectly.

Game 9: Digital Learning Arcade: Word Frog

http://www.abcya.com/antonyms_synonyms_homonyms.htm

Conceptual Use:

- This game is considered ideal for upper primary/elementary students
- This game is considered ideal as a homework assigned task and for skills reinforcement as it lets players see corrections to questions they missed or answered incorrectly

Game 10: Digital Letter Activity

<http://www.knowledgeadventure.com/games/letter-activity>

Conceptual Use:

- This game is considered ideal for upper primary/elementary students
- Skills covered by this game: Language Arts—letter writing development,
- Cross-curricular focuses of this game are on: Language Arts– letter writing, punctuations, sentence completion, and grammar; Color Recognition– green, yellow, peach/beige, pink, and purple; and Shape Recognition (minor focus)

Game 11: Kahoot It

<http://www.Create.kahoot.it/discover>

Conceptual Use:

- Game 11 can be used in middle school to graduate level, university level
- It covers many subjects, single subject matter
- It is great as a subject review exercise, pre-assessment or post-assessment exercise, or as a summative or formative assessment tool

Second: teachers were grouped and were allowed to participate as a group/team in an engaging “teacher interactive session” where each of the groups were allowed to choose one of the following

options, either to create their own: “Spin, Select a Number and Question Game,” or to create their own “Random Question Game,” or to create their own “Classroom Feud Game,” or to “think of and discuss a creative game they would like to design for their classroom,” or “to serve as game reviewers, thus critiquing others of their peers’ games and gaming designs.”

Third: After being exposed to various forms of digital and non-digital games and after participating in the “interactive session,” teachers were next given the 10 question quantitative questionnaire and three semi-structured interview questions to complete.

Data Analyses

As with the prior Trinidad study, this research study consisted of: first, a teacher quantitative questionnaire where teachers’ views and perspectives of game-based learning were captured on a rating scale of 1 to 5, where 5=strongly agreed to 1 = strongly disagreed, and second, semi-structured interviews with teachers where teachers’ views were expressed in writing and later the primary researcher coded the written responses in order to generate the “themes” and “categories” that inform this study’s data results.

RESULTS

Quantitative Findings

Survey Results

The first part of this study sought to examine Bahamas’ pre-primary, primary, and secondary school teachers’ views of game-based learning being employed in primary to secondary instruction in Bahamian classrooms. Table 1 (Appendix) shows the percentage score of teachers for each itemized response of the completed quantitative questionnaire. The responses were as follows:

Teachers gave a “strongly agreed” response to:

I believe game-based learning can be highly effective in simplifying concepts for primary and secondary school students (54%)

Teachers gave “agreed” responses in full to:

I think game-based learning can make it easier for primary and secondary school students to learn any subject (math, science, or other subject) (49%)

The use of game-based learning in school classrooms should be increased over time (64%)

I think I can use game-based learning in any phase of the instructional process (54%)

I think game-based learning will make it easier for school students to excel in any subject (math, science, or other subject) (62%)

Game-based learning is an effective strategy for assessing students’ skills (54%)

Teachers gave “disagreed” responses to:

I think developing games in instruction is difficult (56%)

I think game-based learning is time consuming in primary and secondary instruction (46%)

I do not think game-based learning will contribute to the primary and secondary

instructional processes (49%)

Teachers gave a “strongly disagreed” response to:

I think game-based learning is not effective in primary and secondary instruction (51%)

Qualitative Findings

The second part of this study sought to uncover Bahamas teachers’ perspectives/views on the employment of game-based learning within the Bahamian and International Baccalaureate (IB) curriculums. As seen with the quantitative data, the interviewed teachers expressed an overall favorable opinion of the use of games within their classrooms. The Bahamas teachers’ interview and quantitative data findings align with each other and also with Pinder’s (2016, 2017) Trinidad teachers’ interview and quantitative data findings. Overall, 83% of Bahamian teachers interviewed expressed “*positive feelings toward GBL*” being used in the teaching of educational concepts and teachers spoke to games being “*useful tools*” to enhance their teaching process:

[Teacher 1, Midge, 22 years of teaching]

*“ . . . I use games in my lessons to allow students to deepen understanding and therefore I find them an **important tool**.”*

[Teacher 2, Margaret, no teaching years reported]

*“I feel that GBL should be used **as a tool** to link multidisciplines. . . Therefore [,] if it is possible to link all areas while engaging in game play it would be very useful.”*

[Teacher 3, Mary, 25 years of teaching]

*“It is an **amazing tool**. . .”*

[Teacher 4, Francine, 20 years of teaching]

*“A **very useful tool** that can be used to generate interest in a topic and to improve understanding.”*

[Teacher 5, Susan, 15 years of teaching]

*“My students enjoy game-based learning. It is a **useful tool** to enhance my students’ knowledge and understanding.”*

[Teacher 7, Ben, 13 years of teaching]

*“I think it is a **useful addition** to a teacher’s set of [educational] resources.”*

Teachers had an opportunity to give their perspectives on ways GBL might influence their teaching of educational concepts, be it in science, math, or other subjects. Bahamian teachers felt that GBL can lead to the “*enhancement of students’ learning*” by way of improving students’ “*reviewing/recalling of new knowledge*” and “*development of deeper concepts understanding*.”

[Teacher 5, Susan, 15 years of teaching]

*“ . . . it is a useful tool to **enhance learning**. It is good to practice and challenge students to **recall knowledge** and start to lead them to **concepts and deeper understanding**. ”*

[Teacher 12, Tom, no teaching years reported]

*“ . . . **review** of transdisciplinary concepts/ knowledge. . . ”*

[Teacher 27, Margaret, no teaching years reported]

*“**Revision** but needs to be done individually and not as one or two students. . . ”*

In further expressing their favorability of GBL, some teachers felt that the use of games in their lessons could benefit their students with different learning styles and learning challenges:

[Teacher 1, Midge, 22 years of teaching]

*“For [my] students that are **more visual**, putting them in the game setting allows them to gain that deeper understanding.”*

[Teacher 11, Sandra, 3 years of teaching]

*“ . . . game-based learning especially digital[ly] is very appealing to children with **special needs** especially if they can't express themselves verbally.”*

Despite the positive sentiments expressed by most of the teachers about using game-based learning, there were a few negative views also expressed as some teachers felt that the use of games in the classroom could negatively influence the learning processes of students. Negative sentiments about game-based learning being used in the teaching/learning process were expressed by 4 out of 29 teachers or 14% of Bahamian teachers interviewed. Negative view points given by the teachers were: “*GBL is very time consuming,*” “*may inhibit the learning process,*” and “*GBL should not replace traditional teaching or assessments.*”

[Teacher 26, Doe, 23 years of teaching]

*“Games that are speed or timed **may inhibit learners** with processing deficiencies from participating or feeling successful. . . ”*

[Teacher 27, Margaret, 22 years of teaching]

*“**Very time consuming** when it is more important to teach content.”*

[Teacher 28, Dill, 10 years of teaching]

*“I believe that GBL has its place, but **it cannot replace traditional methods**. . . ”*

[Teacher 29, Precious, 6 years of teaching]

*“I do not think that GBL is effective [and] **it should not take the place of regular assessment** (pencil/paper) as it is not always accurate.”*

Both quantitative and qualitative data seem to suggest that GBL is a strategy that teachers in the Bahamas would want to employ or are employing successfully within their classrooms. As with the prior Trinidad study (Pinder 2016, 2017), teachers in this study believed that “*GBL positively impacts the teaching and learning process*” as Bahamian teachers interviewed saw games as “*useful tools,*” which could help students to better “*review and recall concepts.*” Additionally, games were seen as having an appeal to traditional as well as “*visual and special needs learners.*”

DISCUSSION AND CONCLUSION

Data findings from the Bahamian teachers’ completed quantitative questionnaire revealed that the majority of the teachers believed: “*GBL can be highly effective in simplifying concepts for primary and secondary school students,*” “*GBL can make it easier for primary and secondary school students to learn any subject (math, science, or other subject),*” “*Use of GBL in school classrooms should be increased over time,*” “*GBL can be used in any phase of the instructional process,*” “*GBL will make it easier for school students to excel in any subject (math, science, or other subject),*” and “*GBL is an effective strategy for assessing students’ skills.*” These sets of findings align in part with that of Karadag’s (2015) findings with pre-service teachers in Turkey and Pinder’s (2016, 2017) findings with in-service teachers in Trinidad. Similar to Pinder’s (2016, 2017) Trinidad study where 90% of teachers held a positive view point of employing GBL in their classrooms, 83% of Bahamian teachers in this present study held a “*a positive view of using GBL*” in their classrooms and felt that it could be “*useful*” in improving their students’ conceptual understanding, while helping to improve students’ “*reviewing/recalling*” skills. It was also felt that games could appeal to some of their “*visual*” and “*special needs*” students.

Limitation of the Study

As in Pinder (2016, 2017), this study had a few limitations. First, 39 teachers were surveyed for the quantitative part of the study; this may be considered a small sample size. Additionally, a true random sampling of participants did not occur. Thus based on the limitations of this study, findings may not be generalized to a larger population of Bahamian teachers.

Recommendations for Future Research

This study represents the first mixed-methods study on game-based learning to come out of the Bahamas and one of few studies from the Caribbean/West Indies region. Thus, it is recommended that more studies on game-based learning be conducted in the Bahamas and the Caribbean; particularly, studies of a mixed-methods nature. The present research gap would be greatly filled if more researchers fulfilled the “*call*” of conducting more research on game-based learning in the Bahamas and the Caribbean.

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APPENDIX

Table 1

In-service Teachers' Perceptions on the Use of Game-Based Learning in Bahamas' Primary and Secondary Instruction

		SA	A	N	D	SD
1. I believe GBL can be highly effective in simplifying concepts for primary and secondary school students	f	21	15	1	2	0
	%	54	39	3	5	0
2. I think developing games in instruction is difficult	f	1	3	12	22	1
	%	3	8	31	56	3
3. I think GBL is not effective in primary and secondary instruction	f	0	2	3	14	20
	%	0	5	8	36	51
4. I think GBL is time consuming in primary and secondary instruction	f	2	4	10	18	5
	%	5	10	26	46	13
5. I think GBL can make it easier for primary and secondary school students to learn any subject (math, science, or other subject)	f	16	19	4	0	0
	%	41	49	10	0	0
6. The use of GBL in school classrooms should be increased over time	f	5	25	7	2	0
	%	13	64	18	5	0
7. I do not think GBL will contribute to the primary and secondary instructional processes	f	0	4	3	19	13
	%	0	10	8	49	33
8. I think I can use GBL in any phase of the instructional process	f	14	21	1	2	1
	%	36	54	3	5	3
9. I think GBL will make it easier for school students to excel in any subject (math, science, or other subject)	f	5	24	5	5	0
	%	13	62	13	13	0
10. GBL is an effective strategy for assessing students' skills	f	8	21	8	0	2
	%	21	54	21	0	5