Journal of Teacher Education and Lifelong Learning (TELL)

Volume: 5 Issue: 2 Year: 2023 | Research Article | ISSN: 2687-5713

The Effect of Game Integrated Flipped Classroom Applications on Primary School Students' Mathematics Beliefs and Motivation

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Article Info

Article History
Received: 26/08/2023
Accepted: 12/10/2023
Published: 26/10/2023

Keywords:
Game integrated flipped classroom application,
Mathematics classes,
Third grade students

ABSTRACT

The aim of this study is to examine the effect of the game-integrated flipped classroom application on the mathematics beliefs and motivations of primary school 3rd grade students. In the study, a quasi-experimental design with pretest-posttest group was used. For this purpose, two 3rd graders, one experimental and one control group, were determined by random sampling method from public primary schools in Aydın province Efeler district. As data collection tools, "Primary School Mathematics Motivation Scale" and "Mathematics Beliefs Scale" were used. Since the data obtained from the scales did not show normal distribution, Wilcoxon signed-rank test was used for intragroup comparisons and Mann-Whitney U test was used for intergroup comparisons. From the obtained results, it was concluded that there was a significant difference in favor of the experimental group in the comparison of the post-test scores of the experimental group and control group students. This shows that the game-integrated flipped classroom application has a positive effect on students' motivation and mathematics belief levels. Considering the positive effect on students' motivation and belief levels, the game-integrated flipped learning approach can be applied to other mathematics subjects as well.

Citation: Genç, G. & Aydın, Z. E. (2023). The effect of game integrated flipped classroom applications on primary school students' mathematics beliefs and motivation. *Journal of Teacher Education and Lifelong Learning*, *5*(2), 524-537.

INTRODUCTION

With the rapid advancement in technology, information has become accessible anytime and anywhere. Especially during the pandemic period, the resources of technology have become more used. During this period, the continuation of education outside the classroom has also been ensured in educational processes. Educational videos and games, in particular, have been prepared to access information on the internet. Jonathan Bergman and Aaron Sams (2012), recognizing developments in technology and its applicability in the classroom, have proposed the “Flipped Classroom Model, which saves students and teachers time in the classroom through the use of technology. The main purpose of this model is to save face-to-face time in the classroom and increase the quality of it by enabling students to learn actively at their own pace (Ekici, 2021). At the same time, in this model, the process of teaching during the lesson will be reversed and the lessons will be recorded in advance and shared with the students so that they can watch them before the lesson and activities such as educational games, digital games, group work, class/group discussions can be carried out during the lesson (Ök, 2019). Flipped classrooms provide opportunities for practice-based, retention-based learning and relearning (Bolat, 2016). Sergis et al. (2018) stated that the flipped classroom caused a significant increase in students' cognitive learning.

Concretization of abstract concepts by students and making them meaningful is essential in the education and training process. Mathematics in particular is a subject with abstract concepts, and therefore, it is essential to implement innovative teaching methods and techniques into the courses to facilitate students' understanding and organization of concepts. The rapid advancement of technology in particular has brought the integration of technology into teaching to light. More recently, mathematics scholars (e.g., Ford, 2015; Ichinose & Clinkenbeard, 2016; McBride, 2015) have suggested that the flipped learning model holds the potential to improve mathematics instruction (Lo et al., 2017). In the flipped classroom model, the teacher serves as a facilitator, guiding students towards autonomous learning (Bergmann & Sams, 2012). The implementation of flipped classroom practices in mathematics education has been shown to increase students' motivation (Bhagat et al., 2016), enable self-paced learning (Ogden & Shambaugh, 2016), enhance academic achievement (Özler, 2020), and evoke positive perceptions (Acar, 2022). However, despite its advantages, flipped learning can also be seen as a disadvantage as students are disconnected from the pre-class learning process (Durmaz & Alkış Küçükaydın, 2021). To address this issue, it is suggested to incorporate gamification into the model (Lo & Hew, 2017).

In the flipped classroom model, learning theoretical knowledge outside the classroom and performing active learning activities in the classroom are at the forefront (Alsancak Sırakaya, 2017). Teachers may differ when planning teaching, and considering the development of primary school students, games can help teachers as an effective technique in planning. In particular, educational games can be learning aids used as reinforces to support traditional learning (Tsai et al., 2012). Manzano-León et al. (2021) there have been a growing number of attempts to combine games and game integration with flipped learning. The introduction of game elements and mechanics into education, the realization of the learning experience in the context of the game, strengthening students' motivation to learn, actively participating in the learning process, and contributing to an entertaining experience for the things to be learned make students more focused on their learning (Choi & Choi, 2021; Kim et al., 2018; Choi, 2016). The most important feature of environments supported by games is that they provide a learning environment where students are enthusiastically and willingly active (Yıldız et al., 2017). In this way, children test new ideas and concepts and apply problem solving and reasoning skills (Akman, 2002).

In the primary school period, we can use technology and games intertwined to ensure that students actively participate and make better sense of concepts. Children in this period can make information more meaningful through games. The topic of length measurement, which has an important place in the primary school mathematics curriculum, has a critical importance in the acquisition of basic concepts related to measurement (Tan-Şişman & Aksu, 2012). Length measurement can be expressed as the baseline of the concept of measurement in terms of being the first feature that students learn, and it forms the basis for other measurement areas such as area measurement, perimeter measurement, etc. (Van de Walle et al., 2019). Since students have difficulties in understanding and associating the concepts of length measurement, they draw conclusions by using the formulas they have learned by heart (Tan-Şişman & Aksu, 2009). In this sense, mathematics courses supported by technology and games can contribute to students' learning. It can be said that students will be more active especially in primary school mathematics courses and permanent learning can be supported with technology supported teaching processes.

Game-integrated flipped learning is a learning method that emerged by integrating digital and educational games within the flipped learning model. In this method, students are taught in a way to plan their own learning outside the school with mini videos prepared, and when they come to the classroom, the things they have learned from the mini videos is reinforced by digital and educational games planned by the teacher. In this sense, it supports students to make their knowledge more permanent. Demirel (1999) described educational games as activities that are used to reinforce the place of information in the memory with the necessary repetitions in a certain environment such as a classroom in order to enable learning (cited in Çangır, 2008).

Research has shown that integrating digital games into instructional content can support student motivation, engagement, and sustained attention (Barab et al., 2007; Gee, 2007; Squire & Jan, 2007; Ketelhut & Schifter, 2011; Sánchez & Olivares, 2011; Chang et al., 2012; Hung et al., 2014). Looking at the literature, it has been concluded that the use of flipped learning in teaching has a positive effect on students (Strayer, 2007; Howell, 2013; Çukurbaşı, 2016; Tao et al., 2016; Ekmekçi, 2017; Gökdaş & Gürsoy, 2018; Yorgancı, 2020). Regarding the use of flipped learning integrated with games during teaching, the study of Li, Hou, Li and Kuo (2022) stands out. Therefore, this study aims to reveal the effect of mathematics courses supported by flipped classroom applications integrated with games on students' mathematics beliefs and motivation levels. The problem of the research is: What is the effect of flipped classroom applications integrated with games on the mathematics motivation and belief levels of 3rd grade primary school students?

METHOD

Research Design

This research, in which the effect of mathematics courses supported by game-integrated flipped classroom applications on students' mathematics beliefs and motivation levels was investigated, was an experimental study and consists of a quasi-experimental design with pretest-posttest control group. It was used to reveal the effect of experimental procedures on dependent variables and enabled the data obtained as a result of the research to be interpreted by making cause and effect associations (Creswell, 2016). Accordingly, the quasi-experimental design plan with pretest-posttest control group in the study is shown in the table below.

Table 1. *Design for the research process*

Groups	Pre-Test	Process	Post-Test
Experimental Group	Mathematics Beliefs Scale (MBS) Primary School Mathematics Motivation Scale (PSMMS)	Game integrated flipped classroom practices	Mathematics Beliefs Scale (MBS) Primary School Mathematics Motivation Scale (PSMMS)

Control Group	Mathematics Beliefs Scale (MBS) Primary School Mathematics Motivation Scale (PSMMS)	Practices for the existing curriculum	Mathematics Beliefs Scale (MBS) Primary School Mathematics Motivation Scale (PSMMS)

The independent variable of the study consisted of game-integrated flipped classroom practices while the dependent variable consisted of students' beliefs and motivation levels about the mathematics course.

Research Sample

The study group consisted of students studying at the 3rd grade level in primary schools in the Efeler district of Aydın Province in the 2022-2023 academic year. Simple random sampling method, one of the random sampling methods, was used in the study. Büyüköztürk et al. (2018) stated that all units in the universe have an equal and independent chance to be selected as a sample for simple random sampling. In this sense, an experimental and a control group were randomly selected from 3rd grade students studying at a state primary school in Aydın province Efeler district. Efforts were made to ensure that the selected groups were close to each other for the experimental study. The experimental group consisted of 15 students and control group consisted of 14 students. Within this sense, when comparing, coordination was tried to be ensured in terms of variables such as gender, achievement, and socioeconomic level. To compare students in terms of success, evaluations were made based on common exams on a school basis. Two third-grade classes whose exam success levels were close to the same level formed the experimental and control groups. For this, classes that were close to each other in terms of success were determined in a school located at the middle socio-economic level.

The distribution of the students in the study group according to gender variable is given in Figure 1.

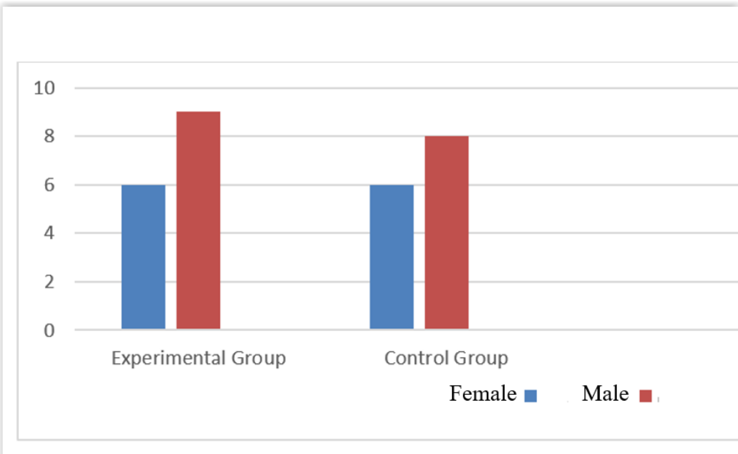

Figure 1. *Gender Distribution of the Students in the Study Group*

As seen in Figure 1, there were 6 female students in both groups. While there were 9 male students in the experimental group, there were 8 male students in the control group.

Data Collection Tools and Processes

In the study, the 5-point Likert-type scale "Mathematics Beliefs Scale (MBS)" developed by Aksu, Demir, and Sümer (2002) was used to determine the effect of the mathematics course supported by game-integrated flipped classroom practices on students' beliefs about the course. There were 20 items in the scale and the items measured the sub-dimensions of learning mathematics (Cronbach's alpha value .75), using mathematics (Cronbach's alpha value .71) and the nature of mathematics (Cronbach's alpha value .66). The

Cronbach's alpha value for the whole scale was .75. In this study, the reliability coefficient for the whole scale was calculated as .75 and for the sub-dimensions as .70, .71 and .71 respectively.

The Primary School Mathematics Motivation Scale (PSMMS), a 3-point Likert scale developed by Ersoy and Öksüz (2015), was used to determine its effect on motivation. There were 33 items in the scale. The scale was intended to determine the degree of motivation towards mathematics by scoring I agree (3), somewhat agree (2), disagree (1). Conducting a reliability test before the study, the reliability coefficient of the scale was found to be .87.

Research Implementation Process

The process regarding the implementation of the research was as following:

After obtaining the necessary permissions to start the research, videos were prepared for the game integrated flipped classroom practice as required by the lesson plan units and outcomes. In addition, questions were prepared on the web 2.0 tool (Wordwall) that could be used for evaluation. The researchers interviewed two classroom teachers in the videos prepared for teaching the subject of length measurement within the scope of the primary school 3rd grade mathematics teaching program. Information was shared about the teaching process and what to do to help students understand the subject regarding length measurement. Support was received from a faculty member who is an expert in instructional technologies in transferring the subject to video and creating the video.

Wordwall questions were created within the framework of the opinions of mathematics field experts and measurement and evaluation field experts. These videos and questions were shared with different classroom teachers and some corrections on important points in the subject expression and question levels were completed in line with their opinions.

Educational games prepared by Aykaç and Köğce (2021) were used in the classroom. These games were about the relationship between meters and centimeters, as well as kilometers and meters, and the writing of values given in meters as centimeters, that is, converting length measurement units. Three educational games were selected by taking the opinions of the mathematics expert and the classroom teacher. These educational games were played by the researchers with material support during one and a half class hours.

The lesson plan for the game-integrated flipped classroom practices planned by the researchers for the experimental group was implemented by the researchers for 2 weeks as required by the unit and learning outcomes.

In determining this period, the course hours foreseen for teaching the subject of length measurement in the curriculum were taken into consideration. Additionally, Palmer (2005) considered the fact that students' motivation was motivated by even a reward that could be given to them during the course; As Sezgin Memnun and Akkaya (2010) stated in their study of mathematics beliefs, considering that the course content is closely related to beliefs, a two-week period was deemed sufficient. For the study, a game that would attract students' attention was integrated into the education and training process, and flipped learning was applied. During this process, the control group carried out their lessons within the lesson plan of the existing teaching plan. To prevent the videos from being seen by the students in the control group, the researcher created a separate Google classroom and WhatsApp system for the videos. Educational games were played by the experimental group students and the classroom teachers in the classroom. The lessons in both groups were taught by the class teachers of those classes.

At the end of the implementation, mathematics belief and post-tests were applied to the study group.

Table 2. *Illustration of the Research Implementation*

Research Implementation		
Grade Level	Third Grade	
Learning Domain	Measuring	
Sub Learning Domain	Measuring Length	
Resources Required	Mini videos, ruler, measuring tape, cards for educational games	
	Before Class	**During Class**
Activities	Note taking, watching lecture videos	Within the scope of the educational games "1 meter is 100 centimeters", "Convert the unit of length measurement while turning", and "I know kilometers and meters", and digital games prepared through Wordwall were used.
Methods of Evaluation	Answering the questions in the videos before coming to the classroom.	Class discussions about the videos, playing digital games and educational games.

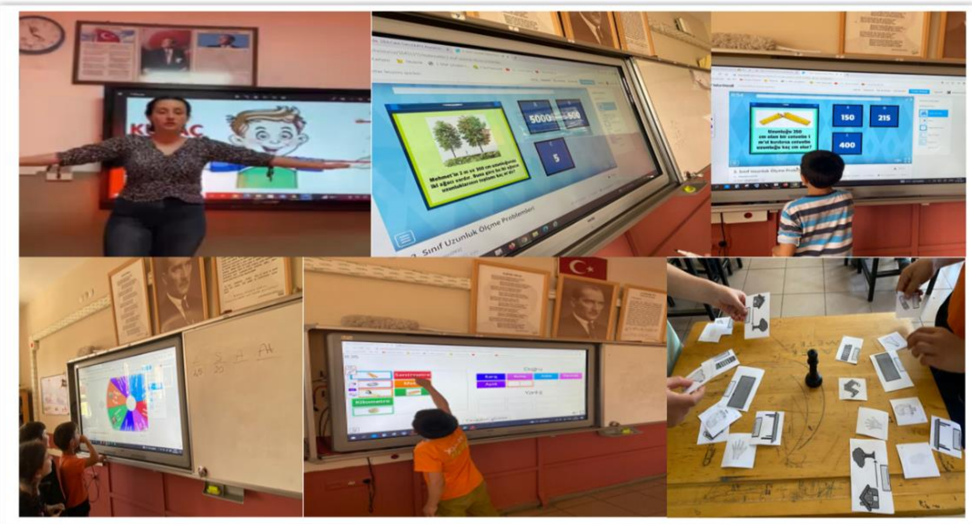

Figure 2. *Practices images*

In the practices, digital games prepared by the researchers were used. Interviews were held with the mathematics field expert, classroom teacher and an assessmeny and evaluation expert regarding the suitability of the content of the games. In addition, the educational games prepared by Aykaç and Köğce (2021) were used with permission.

Data Analysis

The data obtained in the study were analyzed with SPSS 27.0 package program. In the study, Mann-Whitney U test was used for inter-group comparisons and Wilcoxon signed-ranks test was used for intra-group comparisons to compare the data obtained with the mathematics motivation and belief scale in the experimental group where the teaching was carried out with the game-integrated flipped learning practice and in the control group where teaching was carried out with the current program.

To determine the effect of game-integrated flipped learning, statistical analyzes were conducted to determine the equivalence of students in both the experimental and control groups in terms of their mathematics beliefs and motivations. First, normality analysis was performed to test whether the data obtained in the study had a normal distribution and it is shown in the table below.

Table 3. *Normality Analysis Results*

Groups	Tests	Scales		Shapiro-Wilk		
				Statistics	Sd	p
Experimental	Pre	Mathematics Beliefs Scale	Learning Mathematics	0,771	0,862	0,00
			Using Mathematics	0,654	1.280	0 .00
			The Nature of Mathematics	0,898	0,961	0,04
		Motivation Scale	Motivation	0,742	6,01	0 .00
	Post	Mathematics Beliefs Scale	Learning Mathematics	0,931	4,93	0,02
			Using Mathematics	0,955	2,48	0,04
			The Nature of Mathematics	0,898	1,44	0,04
		Motivation Scale	Motivation	0,874	7,92	0,03
Control	Pre	Mathematics Beliefs Scale	Learning Mathematics	0,545	0,611	0,00
			Using Mathematics	0,681	0,938	0,00
			The Nature of Mathematics	0,919	1,05	0,01
		Motivation Scale	Motivation	0,867	5,66	0,01
	Post	Mathematics Beliefs Scale	Learning Mathematics	0,877	2,21	0,04
			Using Mathematics	0,835	1,45	0,01
			The Nature of Mathematics	0,843	1,27	0,01
		Motivation Scale	Motivation	0,881	3,90	0,04

As seen in Table 3, when the data collected from the scales of the students in the groups were analyzed with the Shapiro-Wilk test, it was seen that the significance values were less than 0.05 and the normality of the data was not ensured (p<.05). At the same time, it was seen that the number of groups included in the research was less than 30.

In order to test whether the mathematics beliefs and motivation pre-test results of the students in the study group were equivalent to each other, Mann-Whitney U test, was performed. The values obtained as a result of the analysis are shown in Table.

Table 4. *Pretest results of the study group*

	Scales	Group	N	Rank Mean	Rank Mean	U	p
Mathematics Beliefs Scale	Learning Mathematics	Experimental	15	17.37	260.50	69.50	.73
		Control	14	12.46	174.50		
	Using Mathematics	Experimental	15	15.07	226.00	104.00	.95
		Control	14	14.93	209.00		
	The Nature of Mathematics	Experimental	15	16.33	245.00	85.00	.35
		Control	14	13.57	190.00		
Motivation Scale	Motivation	Experimental	15	16.30	244.50	85.50	.38
		Control	14	13.61	190.50		
Mathematics Beliefs Scale	Learning Mathematics	Experimental	15	17.37	260.50	69.50	.73
		Control	14	12.46	174.50		
	Using Mathematics	Experimental	15	15.07	226.00	104.00	.95
		Control	14	14.93	209.00		
	The Nature of Mathematics	Experimental	15	16.33	245.00	85.00	.35
		Control	14	13.57	190.00		
Motivation Scale	Motivation	Experimental	15	16.30	244.50	85.50	.38
		Control	14	13.61	190.50		

In Table 4, the significance values of the three dimensions of the mathematics belief scale, namely "learning mathematics", "using mathematics" and ""the nature of mathematics", and motivation scale were greater than .05. According to the pre-test results of the two groups, there was no statistically significant difference in the sub-dimensions of the Mathematics Belief and Motivation Scale. The pre-test results of both groups showed that the groups consisted of equivalent groups (*p*>.05).

FINDINGS

In the study, Wilcoxon Signed Ranks test was used to compare the mathematics belief and motivation pre-test and post-test scores of the experimental group students. The results obtained as a result of the analysis are given in the table below.

Table 5. *Analysis Results of Experimental Group Students' Mathematics Motivation and Belief Pre-post Tests*

	Scales	Group	End measurement-start measurement	N	Rank Mean	Rank Total	z	p
Mathematics Beliefs Scale	Learning Mathematics	Experimental	Negative Ranks	2	1.50	3.00	-3.244	.001
			Positive Ranks	13	9.00	117.00		
			Non-difference	0				
	Using Mathematics	Experimental	Negative Ranks	0	.00	.00	-3.417	.000
			Positive Ranks	15	8.00	120.00		
			Non-difference	0				
	Nature of Mathematics	Experimental	Negative Ranks	0	.00	.00	-3.420	.000
			Positive Ranks	15	8.00	120.00		
			Non-difference	0				
Motivation Scale	Motivation	Experimental	Negative Ranks	0	.00	.00	-3.408	.000
			Positive Ranks	15	8.00	120.00		
			Non-difference	0				

The results of the analysis in table 5 show that there was a statistically significant difference between the mathematics motivation levels of the students in the experimental group before and after the application (z=-3.408, p<.05). At the same time, in the results of the Wilcoxon Signed Ranks test there was a statistically significant difference between the mathematics belief sub-dimensions (learning mathematics, using mathematics and the nature of mathematics) of the experimental group students before and after the application (learning mathematics z=-3.244, p<.05; using mathematics z=-3.417, p<.05; nature of mathematics z=-3.420, p<.05) and after the implementation, a statistically significant difference was observed between the mathematics belief levels before and after the implementation. According to these results, the fact that the scores were in favor of the positive ranks (after the implementation) showed that the game-integrated flipped learning classroom practices had a significant effect on mathematics belief and motivation levels.

Within the scope of the current curriculum, Wilcoxon Signed Ranks test was applied to determine whether there was a significant difference between the scale mean scores of the students in the control group before and after the lesson. The results obtained from the analysis are given in the table below.

Table 6. *Analysis results of mathematics motivation and belief pre-post-tests of control group students*

	Scales	Group	End measurement-start measurement	N	Rank Mean	Rank Total	z	p
Mathematics Beliefs Scale	Learning Mathematics	Control	Negative Ranks	0	.00	.00	-2.379	.017
			Positive Ranks	7	4.00	28.00		
			Non-difference	7				
	Using Mathematics	Control	Negative Ranks	0	.00	.00	-1.633	.102
			Positive Ranks	3	2.00	6.00		
			Non-difference	11				
	The Nature of Mathematics	Control	Negative Ranks	1	2.00	2.00	-1.518	.129
			Positive Ranks	4	3.25	13.00		
			Non-difference	9				
Motivation Scale	Motivation	Control	Negative Ranks	1	3.50	3.50	-1.084	.279
			Positive Ranks	4	2.88	11.50		
			Non-difference	9				

In Table 6, according to the results of analysis, there was no statistically significant difference between the mathematics motivation levels of the students in the control group before and after the application (z=-1.084, p>.05). As a result of the analysis, no statistically significant difference was found between the sub-dimensions of the mathematics belief levels (learning mathematics, using mathematics and the nature of mathematics) of the control group students before and after the lesson (using mathematics z=-1.633, p>.05; the nature of mathematics z=-1.518, p>.05). Only within the scope of the learning mathematics dimension, a statistically significant difference was observed in terms of the processing of the courses in the current curriculum (learning mathematics z=-2.379, p<.05). In the sub-dimension of learning mathematics, positive ranks also appear to be different. Although the difference in the use of mathematics and the nature of mathematics sub-dimension and the positive ranks of the motivation scale was very small, it was not considered as significant. In this case, it can be said that the topics learned affected students' learning beliefs. However, it was seen that the lessons taught within the scope of the current curriculum did not have a significant effect on the mathematics motivation, using mathematics and nature of mathematics levels of the control group students.

Mann-Whitney U test was conducted to determine whether there was a significant difference between the pretest-posttest means scores of mathematics beliefs and motivation of the students in the experimental group in which game-integrated flipped classroom practices were taught and the control group in which the courses were taught within the scope of the current curriculum. The results are given in the table 7 below.

Table 7. *Analysis results of mathematics motivation and belief post-tests of experimental and control group* students

	Scales	Group	N	Rank Mean	Rank Total	U	p
Math emati	Learning Mathematics	Experimental	15	20.00	300.00	30.00	0.01

		Control	14	9.64	135.00		
	Using Mathematics	Experimental	15	22.00	330.00	.00	0,00
		Control	14	7.50	105.00		
	The Nature of Mathematics	Experimental	15	22.00	330.00	.00	0,00
		Control	14	7.50	105.00		
Motivation Scale	Motivation	Experimental	15	21.43	321.50	8.50	0,00
		Control	14	8.11	113.50		

In table 7, a statistically significant difference was observed between the motivation levels after the implementation (*U*=8.50, *p*<.05). This result shows that game-integrated flipped classroom practices had a significant effect on students. There was a significant difference in favor of post-test scores within the scope of mathematics belief scale sub-dimensions. Mathematics belief scale sub-dimensions, a statistically significant difference was observed in the mathematics learning sub-dimension (*U*=30.00, *p*<.05), using mathematics sub-dimension (*U*=0.00, *p*<.05) and the nature of mathematics sub-dimension (*U*=0.00, *p*<.05). This result showed that game-integrated flipped classroom practices had a significant effect on students' mathematics belief levels.

DISCUSSION, CONCLUSION, RECOMMENDATIONS

In this study, classroom applications were carried out by integrating games into the flipped learning approach. With these applications, the effects of the activities carried out within the scope of the current curriculum on the mathematics belief and motivation levels of primary school third grade students were investigated. It was concluded that there was a significant difference in favor of the experimental group between the mathematics course motivation levels of the experimental group students who were taught with game-integrated flipped classroom practices and the control group students who were taught within the scope of the current curriculum. This situation created a positive effect on students' motivation for the lesson with game-integrated flipped classroom practices. Primary school 3rd grade students received distance education for a while during the pandemic process. In this case, it can be said that the students were familiar with the internet distance education process. In this way, the flipped learning model could also be a suitable method for these students. The literature shows that the flipped classroom implementation increased students' motivation (Çukurbaşı, 2016; Strayer, 2007; Ekmekçi, 2017; Pawelczak, 2017; Yorgancı, 2020). However, Gökdaş and Gürsoy (2018) concluded that the flipped classroom model did not make any difference in students' motivation.

A significant difference was observed between the post-test scores of the experimental and control group students in the mathematics belief scale the nature of mathematics, mathematics belief and using mathematics sub-dimensions, indicating that game-integrated flipped classroom practices had a significant effect on students' mathematics belief levels. This can be said to have a positive effect especially on students' learning and using mathematics. Howell (2013) concluded that the Flipped Classroom Model facilitates students' learning by increasing student responsibility. Li, Hou, Li, and Kuo (2022) showed that the mini-game-based flipped classroom model had significantly higher scores than the control group in terms of learning performance and acceptance. In recent years, as a result of the rapid integration of technology in the education and training process, flipped learning studies can be planned in which software is more integrated in mathematics courses.

In this study, the motivation and belief levels of the game-integrated flipped classroom practices and the lessons taught within the current curriculum were compared. However, Ahmet (2017), in his study on a third-grade level English course, revealed that the Flipped Classroom Model prepared with educational games gave more successful results than the normal Flipped Classroom Model (cited in Özler, 2020). With this result, comparisons can be made between the game-integrated flipped classroom and the lessons taught with flipped learning.

Within the scope of this study, students' mathematics motivation and belief levels were evaluated. Yorgancı (2020) investigated the effectiveness of the flipped learning model in mathematics courses on associate degree students and concluded that there was an increase in students' mathematics achievement and motivation. The increased use of online education, especially during the pandemic period, has increased students' internet access and use. Considering this, the flipped learning model can be used in different subjects in the fields of learning numbers, geometry, data and measurement in the mathematics course, and students can be compared in terms of success, attitude, and anxiety.

This study is a quantitative study. However, within this scope, studies on mixed research method can be conducted by supporting qualitative studies in which students' opinions are taken and student documents are analyzed. Primary school students like to play games depending on their age and for this reason, flipped learning classroom applications in which different games (verbal games, mechanical games, intelligence games, etc.) are integrated and qualitative studies in which student opinions are taken can be planned.

This study was supported by the game-integrated flipped learning application. Educational games were used in the classroom and the Web 2.0 tool was used for evaluation. With the rapid increase of the internet and softwares, flipped classroom applications with digital game integration can be used, where digital games (applied individually or in groups) are used more frequently. After these applications, students' problem solving processes and skills can be evaluated.

By incorporating technology into the teaching process, teachers can also gain information about different methods, techniques and applications. In this sense, in the study conducted by Dere and Akkaya (2022), they concluded that social studies teachers used EBA, Zoom and some Web 2.0 tools as educational technologies during the distance education period. In line with this result, seminars can be organized for classroom teachers, especially on Web 2.0 tools and flipped learning. Flipped teacher training can also be organized for teachers. In the study conducted by Yaylak (2021), it was concluded that prospective teachers received quick feedback on the tasks given in the lessons conducted with Google Classroom, and errors were observed.

REFERENCES

Acar, Z. (2022). *Pandemi dönemi uzaktan eğitim sürecinde ters yüz öğrenme modeli ile matematik öğretimi*, (Unpublished master’s thesis), Tokat Gaziosmanpaşa University.

Ahmed, A. A. A. (2017). *An Adaptive Educational Model for Flipped Classroom*, (Unpublished master’s thesis), Atılım Üniversitesi.

Akman, B. (2002). Okulöncesi dönemde matematik. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 23*(23), 244-248.

Aksu, M., Demir, C. E., & Sümer, Z. H. (2002). Öğrencilerin matematik hakkındaki inançları: Betimsel bir çalışma. *Eğitim ve Bilim*, 27(123), 72-77.

Alsancak Sırakaya, D. (2017). Student views on gamified flipped classroom model. *Ondokuz Mayis University Journal of Faculty of Education, 36*(1), 114-132. https://doi.org/10.7822/omuefd.327393

Aykaç, M. & Köğce, D. (2021). *Eğitsel oyunlar ile matematik öğretimi*. Pegem.

Barab, S. A., Sadler, T. D., Heiselt, C., Hickey, D., & Zuiker, S. (2007). Relating narrative, inquiry, and inscriptions: Supporting consequential play. *Journal of Science Education and Technology*, 16(1), 59–82. https://doi.org/10.1007/s10956-006-9033-3

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. ISTE.

Bhagat, K. K., Wu, L. Y., & Chang, C. Y. (2016). Development and validation of the perception of students towards online learning (POSTOL). *Educational Technology & Society*, 19 (1), 350–359. https://www.jstor.org/stable/jeductechsoci.19.1.350

Bolat, Y. (2016). The flipped classes and education information network (EIN). *Journal of Human Sceiences, 13*(2), 3373-3388. https://doi.org/10.14687/jhs.v13i2.3952

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2018). *Bilimsel araştırma yöntemleri [Scientific research methods]*. Pegem.

Chang, K. E., Wu, L. J., Weng, S. E., & Sung, Y.T. (2012). Embedding game-based problem-solving phase into problemposing system for mathematics learning. *Computers & Education*, 58(2), 775–786. https://doi.org/10.1016/j.compedu.2011.10.002

Choi JF. (2016). Gamification in Smart Learning Design to Enhance Speaking Skills for EFL Young Learners. *Journal of Korea Game Society*, 16(3), 7-16. http://dx.doi.org/10.7583/JKGS.16.3.7.

Choi J. F. & Choi, J. (2021). Development of gamıficatıon model for flipped learning, *International Journal of Crisis & Safety*, 6(2) 68-79. https://doi.org/10.22471/crisis.2021.6.2.68.

Creswell, J. (2016). *Research in Education: Design, Conduct and Evaluation of Quantitative and Qualitative Research.* Athens.

Çangır, M. (2008). *İlköğretim din kültürü ve ahlak bilgisi derslerinde eğitsel oyun yönteminin uygulanma durumu (Tuzla örneği).* (Unpublished master’s thesis), Yeditepe University.

Çukurbaşı, B. (2016). *Ters yüz edilmiş sınıf modeli ve lego-logo uygulamaları ile desteklenmiş probleme dayalı öğretim uygulamalarının lise öğrencilerinin başarı ve motivasyonlarına etkisi.* (Unpublished doctoral thesis). Sakarya University.

Dere, İ. & Akkaya, A. C. (2022). Distance social studies courses in the pandemic period with the experiences of teachers, *Çukurova Üniversitesi Eğitim Fakültesi Dergisi*, 51(2), 1172-1206. https://doi.org/10.14812/cufej.1035594

Durmaz, B., & Alkış Küçükaydın, M. (2021). *Matematik eğitiminde oyun entegreli ters yüz sınıf uygulaması*, (Ed. Taştepe, M. & Can Aksoy, M.). *Oyun ve Matematik Eğitimi*, Nobel.

Ekici, M. (2021). A systematic review of the use of gamification in flipped learning. *Education and Information Technologies*, *26*, 3327-3346. https://doi.org/10.1007/s10639-020-10394-y

Ekmekçi, E. (2017). The flipped writing classroom in Turkish EFL context: A comparative study on a new model. *Turkish Online Journal of Distance Education*, *18*(2), 151-167.

Ersoy, E. & Öksüz, C. (2015). Primary school mathematics motivation scale, *European Scientific Journal June 2015 edition*, 11(16),1857 – 7881.

Ford, P. (2015). Flipping a math content course for pre-service elementary school teachers. *PRIMUS*, 25(4), 369-380. https://doi.org/10.1080/10511970.2014.981902

Gee, J. P. (2007). *What video games have to teach us about learning and literacy*. Palgrave MacMillan.

Gökdaş, I. & Gürsoy, S. (2018). İlkokullarda dönüştürülmüş sınıf modelinin matematik dersindeki akademik başarı ve motivasyona etkisi. *Akdeniz Eğitim Araştırmaları Dergisi, 12*(26), 159-174. https://doi.org/10.29329/mjer.2018.172.9

Howell, D. (2013). *Effects of an inverted ınstructional delivery model on achievement of ninth-grade physical science honors students*. (Unpublished doctoral thesis, Gardner-Webb University), Erişim adresi:https://digitalcommons.gardnerwebb.edu/cgi/viewcontent.cgi?article=1034&context=education_etd

Hung, C.-Y., Kuo, F.-O., Sun, J. C.-Y., & Yu, P.-T. (2014). An interactive game approach for improving students’ learning performance in multi-touch game-based learning. *IEEE Transactions on Learning Technologies*, 7(1), 31–37. https://doi.org/10.1109/Tlt.2013.2294806

Ichinose, C. & Clinkenbeard, J. (2016). Flipping college algebra: effects on student engagement and achievement, *Learning Assistance Review*, 21(1), 115-129

Ketelhut, D. J., & Schifter, C. C. (2011). Teachers and game-based learning: Improving understanding of how to increase efficacy of adoption. *Computers & Education*, 56(2), 539–546. https://doi.org/10.1016/j.compedu.2010.10.002

Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in Learning and Education*. Springer.

Li, C. T., Hou, H. T., Li, M. C., & Kuo, C. C. (2022). Comparison of mini-game-based flipped classroom and video-based flipped classroom: An analysis of learning performance. Flow and concentration on discussion. *The Asia-Pacific Education Researcher*, 31(3), 321–332. https://doi.org/10.1007/s40299-021-00573-x

Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Research and Practice in Technology Enhanced Learning*, 12(1), 1-22. https://doi.org/ 10.1186/s41039-016-0044-2.

Manzano-León, A., Camacho-Lazarraga, P., Guerrero, M. A., Guerrero-Puerta, L., Aguilar-Parra, J. M., Trigueros, R. & Alias, A. (2021). Between Level Up and Game Over: A Systematic Literature Review of Gamification in Education, *Sustainability*, 13(2247), 1-14. https://doi.org/10.3390/su13042247

McBride, C. (2015). Flipping advice for beginners: What I learned flipping undergraduate mathematics and statistics classes. *PRIMUS*, 25(8), 694–712. http://dx.doi.org/10.1080/10511970.2015.1031300

Ogden, L. & Shambaugh, N. (2016). *The Continuous and Systematic Study of the College Algebra Flipped Classroom*. In J. Keengwe & G. Onchwari (Eds.), *Handbook of Research on Active Learning and the Flipped Model Classroom in the Digital Age (41-71).* Information Science Reference

Ök, S. (2019). *Ters yüz öğrenme ortamlarında öğrencilerin akademik başarılarının ve öz-düzenleyici öğrenme becerilerinin araştırılması* (Unpublished master’s thesis). Balıkesir University.

Özler, A. (2020). *Tersyüz sınıf modeli ile desteklenmiş tam öğrenme yaklaşımının matematik dersindeki akademik başarıya ve öz düzenleme becerilerine etkisi*, (Unpublished master’s thesis), Aydın Adnan Menderes University.

Palmer, D. (2005). A motivational view of constructivist-ınformed teaching. *International Journal of Science Education*. 27(15), 1853-1881. http://dx.doi.org/10.1080/09500690500339654

Pawelczak, D. (2017, June). Comparison of traditional lecture and flipped classroom for teaching programming. In Proceedings of the 3rd International Conference on Higher Education Advances (pp. 391-398). Editorial Universitat Politècnica de València.

Sa´nchez, J., & Olivares, R. (2011). Problem solving and collaboration using mobile serious games. *Computers and Education*, 57(3), 1943–1952. https://doi.org/10.1016/j.compedu.2011.04.012

Sergis, S., Sampson, D. G. & Pelliccione, L. (2018). Investigating the impact of flipped classroom on students’ learning experiences: A self-determination theory approach. *Computers in Human Behavior*, *78*, 368-378. https://doi.org/10.1016/j.chb.2017.08.011

Sezgin Memnun D. ve Akaya R. (2010). İlköğretim yedinci sınıf öğrencilerinin matematik dersi hakkındaki düşünceleri. *Kuramsal Eğitimbilim*, 3(2), 100-117. http://dergipark.gov.tr/download/article-file/304143

Squire, K., & Jan, M. (2007). Mad city mystery: Developing scientific argumentation skills with a place-based augmented reality game on handheld computers. *Journal of Science Education and Technology*, 16(1), 5–29. https://doi.org/10.1007/s10956-006-9037-z

Strayer, J. (2007). *The effects of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system*. (Unpublished doctoral thesis) The Ohio State University. https://etd.ohiolink.edu/!etd.send_file?accession=osu1189523914&disposition=inline

Tan-Şişman, G. & Aksu, M. (2009). Yedinci sınıf öğrencilerinin alan ve çevre konularındaki başarıları. *İlköğretim Online, 8*(1), 243-253. https://dergipark.org.tr/tr/pub/ilkonline/issue/8599/107065

Tan-Şişman, G. & Aksu, M. (2012). The length measurement in the Turkish mathematics curriculum: Its potential to contribute to students’ learning. *International Journal of Science and Mathematics Education*, *10*, 363-385. https://doi.org/10.1007/s10763-011-9304-1

Tao, S. Y., Huang, Y. H. & Tsai, M. J. (2016). Applying the flipped classroom with game-based learning in elementary school students' english learning, 2016 International Conference on Educational Innovation through Technology https://doi.org/1109/EITT.2016.19

Tsai, F.-H., Yu, K.-C., & Hsiao, H.-S. (2012). Exploring the Factors Influencing Learning Effectiveness in Digital Game-based Learning. *Educational Technology & Society*, 15 (3), 240–250.

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2012). *İlkokul ve ortaokul matematiği* (S. Durmuş, Trans.). Nobel Akademik Yayıncılık.

Yaylak, E. (2021). Google classroom ile ters yüz edilmiş (flipped) öğretmen eğitimi. *Journal of Innovative Research in Teacher Education*, *2*(1), 1-24. doi: 10.29329/jirte.2021.342.1

Yıldız, E., Şimşek, Ü. & Ağdaş, H. (2017). Eğitsel oyun entegre edilmiş işbirlikli öğrenme modelinin öğrencilerin fen öğretimi motivasyonları ve sosyal becerileri üzerine etkisi. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 18*(2), 37-54. https://dergipark.org.tr/en/pub/kefad/issue/59416/853275

Yorgancı, S. (2020). A flipped learning approach to improving students' learning performance in mathematics courses. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi (EFMED)*, 14 (1), 348-371. https://doi.org/10.17522/balikesirnef.657197