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Transformative Pedagogy: Investigating the Impact of Online Jigsaw Model on Motivation and Academic Achievement in High School Mathematics

Rizka Aliya Mitayani[1], Naufal Ishartono [1,2*]

[1]Department of Mathematics Education, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia
[2]Department of Curriculum and Instructional Technology, University of Malaya, Kuala Lumpur, Malaysia
*ni160@ums.ac.id

Abstrak

Banyak penelitian sebelumnya yang meneliti penerapan Jigsaw dalam meningkatkan kualitas proses belajar-mengajar matematika secara daring. Namun belum ditemukan penelitian yang menerapkan model Jigsaw dalam meningkatkan kualitas pembelajaran matematika daring, terutama dalam hal peningkatan motivasi dan hasil belajar. Untuk mengisi kesenjangan penelitian ini, tujuan penelitian ini adalah untuk mendeskripsikan proses penerapan model Jigsaw dalam pembelajaran daring dan untuk melihat signifikansi peningkatan motivasi siswa selama proses pembelajaran. Metode penelitian tindakan kelas diterapkan dalam penelitian ini dengan melibatkan 36 siswa dari sebuah sekolah menengah atas di Provinsi Jawa Tengah, Indonesia. Hasil penelitian ini menunjukkan bahwa penerapan Jigsaw dapat dilakukan secara daring melalui beberapa langkah yang dijelaskan dalam penelitian ini. Selain itu, temuan menunjukkan bahwa ada peningkatan yang signifikan dalam motivasi dan hasil belajar. Hasil penelitian ini diharapkan dapat menjadi referensi bagi guru bagaimana menerapkan model Jigsaw secara daring.
Kata kunci: Jigsaw, Pembelajaran Daring, Motivasi Belajar, Hasil Belajar.

Abstract

Several earlier research investigated the use of Jigsaw to improve the quality of the online mathematics teaching-learning process. However, few studies have used the Jigsaw approach to improve the quality of online mathematics education, particularly in terms of motivation and learning results. To address this research gap, the goal is to outline the process of integrating the Jigsaw model in online learning and to demonstrate the importance of enhancing student motivation during the learning process. This study used the classroom action research approach, which involved 36 students from a high school in Central Java Province, Indonesia. The results of this investigation indicate that the application of Jigsaw can be done online using numerous procedures indicated in this study. Furthermore, the results indicate a considerable improvement in motivation and learning outcomes. The findings of this study are expected to serve as a reference for teachers on how to implement the Jigsaw model online.
Keywords: Jigsaw, Online Learning, Learning Motivation, Learning Outcomes

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INTRODUCTION

Mathematics is the study of abstract objects (Kneebone, 2001). Therefore, to learn it, a student must optimize their abstraction skills (Mitchelmore & White, 2004). However, not all students have good abstract thinking skills (Irawati et al., 2021). Therefore, it is very much found in previous research related to the challenges in teaching mathematics—which has abstract objects—to students due to their lack of abstraction skills (Hazzan & Kramer, 2016). However, this condition has become more challenging for mathematics teachers, especially after the emergence of the Covid 19 pandemic in early 2020 where teachers were required to be able to teach mathematics online (Khanal et al., 2022). In Indonesia, for example, many teachers find it difficult when it comes to teaching mathematics online (Kusumadewi et al., 2021). Their difficulties are not only in operating online learning applications, but also how to explain mathematical concepts online by utilizing existing online mathematics learning media. Based on these cases, several previous studies have shown the impact of teachers' unskillness in teaching mathematics online, some of the impacts include low motivation and achievement of students' mathematics learning (Panjaitan et al., 2023; Sujadi et al., 2022).

In theory, learning motivation is a complex and dynamic process that directs and sustains learning activity (Su & Chen, 2018). It can be intrinsic, originating within the individual, or extrinsic, influenced by outside factors. Motivation levels have a significant impact on learning outcomes, with higher motivation resulting in greater achievement (Lukassen et al., 2014). Motivation is particularly important in education because it drives learners to achieve their goals and is a key component of effective teaching (Wardani et al., 2020). On a case-by-case basis, cases of decreased student motivation in learning mathematics due to their low involvement during the learning process, including in the online mathematics learning process (Cole et al., 2019). One of the reasons is the inability of teachers to manage online mathematics learning, especially in choosing the right learning model and being able to increase student involvement actively during the online mathematics learning process (Hartnett, 2015; Xie & Ke, 2011). Based on the author's experience while training in-service mathematics teachers for the past five years in Indonesia through the teacher training program (PPG), it was found that the students they taught online felt unmotivated. After being examined by the author, this is due to the paradigm of teachers who treat the same online learning process and offline learning which should be different.

Conceptually, online learning is different from offline learning. The fundamental difference between the two learning modes is the obstacles faced during their implementation. In online learning, the obstacles faced are limited space, time, cost, and access that both students and teachers have (Ishartono, et al., 2022). Thus, online learning must be carried out effectively and efficiently where, in a limited time, teachers can improve student understanding as best as possible by harnessing all online learning media existing at the moment (Ishartono et al., 2024).

These obstacles are not found in offline mode learning so that concerns about the ineffectiveness of the mathematics learning process are almost non-existent. Therefore, to achieve effective and efficient online learning, especially in the context of increasing students' mathematics learning motivation and achievement, a learning model is needed that can actively involve students during the online mathematics learning process where one of them is the Jigsaw learning model.

The Jigsaw learning model is a cooperative learning approach that involves dividing students into expert groups, where they gain knowledge about a specific topic, and home groups, where they share their expertise with their peers (Istiqomah et al., 2021). This model has been discovered to be effective in various contexts, including online learning (Istiqomah et al., 2021), the use of audiovisual media (Sulfemi et al., 2020), and computer science labs (Soh, 2006). The Jigsaw model's key components are the home group, expert group, and evaluation process (Sari, 2017). This model consists of several steps, namely dividing the group into several groups. Each group then discusses the topic shared by the teacher and appoints one of the group members to represent the group as an expert. Next, each group member goes to an expert from another group to pay attention to the explanation from the expert in the other group until all groups are visited. Finished with visits in all groups, then group members return to the home group and discuss the results with experts in the home group (Bacsal et al., 2022).

Some previous research has tried to implement the Jigsaw model in the mathematics learning process. Amin et al., (2020) and Istiqomah et al., (2021) both found positive effects of the Jigsaw model on students' learning outcomes and motivation, with Istiqomah specifically noting significant differences in online learning. Bacsal et al. (2022) researched how to apply the jigsaw model in the mathematics learning process in the Philippines and found that this model was able to help teachers improve student learning achievement during the mathematics learning process. However, from some of these studies, no research results have been found that concentrate on applying the Jigsaw model in the online mathematics learning process and focus on its impact on student motivation and achievement in learning mathematics. This is important to research because the results of this study can be a reference for researchers and practitioners in the field of mathematics education on how to increase the effectiveness and efficiency of online mathematics learning. Therefore, this study aims to improve student motivation and learning outcomes in online mathematics learning through the Jigsaw learning model.

METHOD

This qualitative research uses the Classroom Action Research (CAR) model, which aims to apply the Jigsaw learning model to the online mathematics learning process in terms of learning motivation and achievement. This research was carried out at SMA Negeri 2 Wonogiri—in the 2022/2023 school year—as one of the Central Java province, Indonesia, schools that has fulfilling online learning facilities. In addition, based on the results of observations and interviews of researchers and teachers at the school, it was found that student motivation and learning outcomes were low during the teachers' online learning process. Next, the subjects of this study were 36 students from one class randomly selected from existing parallel courses. The students have agreed to voluntarily participate in this research process, which means this study is ethically acceptable. The design of the study will follow the syntax of Classroom Action Research, which consists of two cycles (minimum). Then each cycle will consist of four steps: Planning, Implementation, Observing, and Reflecting (see Figure 1).

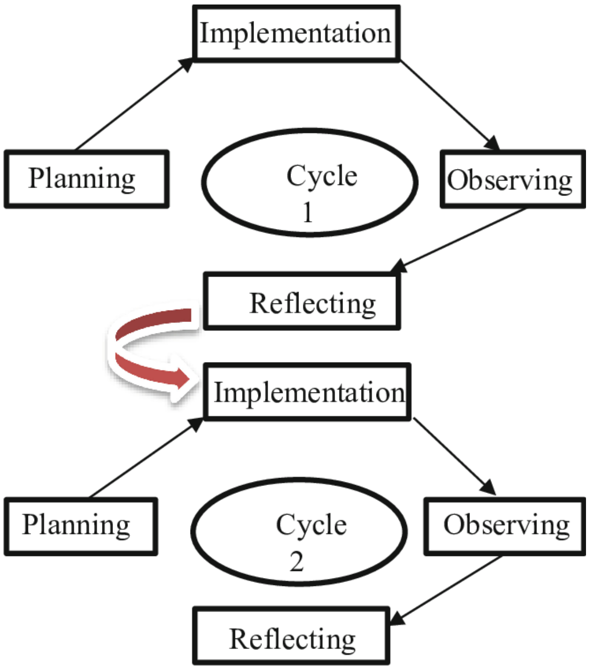

Figure 1. Adopted syntax of CAR by Swondo & Haya (2022)

The first stage was stiffened by planning, determining the design, and developing a step-based lesson plan on the Jigsaw model adapted to the online mathematics learning mode. In addition, the authors also design and developed instruments to measure the students' learning motivation the indicators can be seen in Table 1 that was adopted from and learning achievements (see Table 1 for the indicators). The results of the development are then tested for validation both internally and externally. Internally, the author involved 2 experts from one of the private universities in Central Java, Indonesia, to test the lesson plan along with both learning motivation measurement instruments and learning achievements. The validation results were analyzed using Aiken's coefficient value and found that both the lesson plan and the instruments developed were categorized as valid (Aiken, 1985). Afterwards, the external validation process was done by engaging three teachers to check readability of the lesson plan, and they found no part to be revised. While the learning motivation instrument—questionnaire—was given to three students to check the instrument's readability as well, they saw that there is no confusing part of the instrument.

Table 1. Indicators and Research Aspects of Learning Motivation

Aspect	Indicator Questions	Positive	Negative
Desire and desire to succeed	Students have the passion and desire to succeed in solving problems	1,2	
Encouragement and need in learning	Students have the encouragement and need to learn	3	4
Hopes and aspirations for the future	Students have hopes and aspirations that must be achieved in the future		5,6
Rewards in learning	Students give awards for the learning achievements they have achieved	7,8	
Interesting activities in learning	Students do activities to facilitate learning	9	10
A conducive learning situation allows students to learn well	Students have a conducive learning situation so that students can learn well		11,12

Table 2. Indicators and research aspects of learning outcomes

Material	Basic Competencies	Achievement Indicator Competence	Learning Outcome Indicators
Transformation	3.5 finish problem related to matrix transformation geometry (translation, reflection, dilatation, and rotation)	3,5 use procedure for finish problems related to the use of metrics in transformation	Cognitive domain

The second stage was implementation where the authors begin the stage by coordinating with the school's mathematics teachers regarding the implementation of the lesson plan that the teacher would do. Afterward, the teacher taught the online class according to the lesson plan while the authors observed the implementation of the lesson plan. Beforehand, the author gave the students a pretest to gain the data for further statistical analysis to assess students' learning motivation and achievements.

The third stage was observing, when the author observed the implementation of the lesson plan used by the mathematics teacher. The result of the implementation will be evaluated quantitatively based on the students' learning motivation and achievement aspects. Once the observation was done, the authors assess the learning process by spreading out the questionnaire and gave a test as a posttest where the result of those data-gaining process will be statistically evaluated.

The last step is reflection where the authors decide based on the evaluation of data analysis from the instrument for assessing students' learning motivation and achievements. The result of this analysis is to be a reference for the author for the need of cycle to make the result better. The cycle aimed to revise the lesson plan so that better result could be gained.

RESULT

In cycle I, students are still not confident, have not mastered the presentation material, and are awkward when opening and closing presentations. Therefore, researchers continued research in cycle II. Researchers carry out reflection and provide appropriate solutions for the subsequent actions. In cycle II, students showed improvement; they already looked confident, had mastered the assigned material, and could open and close presentations properly. During the lesson, the researcher made observations. Observations are made during the learning process. Observations were made to determine the increase in students' interest in learning mathematics about transformation material through the online Jigsaw learning method in cycle I and cycle II. Researchers can evaluate students' interest in learning based on the results of these observations. The weaknesses found in cycle I were corrected in cycle II by recording the results of observations made. After conducting research, the number of subjects was 36 students of the class before and after applying the learning methods jigsaw online in Table 3.

Table 3 Research Results Data

Descriptives		**Statistics**
Pre-score motivation questionnaire scores	Average	33.1111
	Median	33,0000
	Std. deviation	5.27949
	Range	23.00
Cycle 1 motivation question score	Average	37.4167
	Median	37.5000
	Std. deviation	4. 22493
	Range	16.00

Descriptives		**Statistics**
Cycle 2 motivation question score	Average	41. 6667
	Median	42,0000
	Std. deviation	3.33809
	Range	13.00
Pre-assessment of learning outcomes	Average	52,7778
	Median	50,0000
	Std. deviation	17.17325
	Range	70.00
Cycle 1 Value of learning outcomes	Average	72. 4055
	Median	75, 0000
	Std. deviation	11.36253
	Range	50.00
Cycle 2 Value of learning outcomes	Average	83.7500
	Median	80,000
	Std. deviation	10.44544
	Range	35.00

Table 4. Normality Test

	Kolmogorov-Smirnov			**Shapiro-wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
PretestPretest learning outcome	.171	36	.010	.952	36	.117

There is an increase in the average and standard deviation at each cycle. After the researcher got the research results above, the researcher analyzed the results of learning mathematics using the online Jigsaw method, which can be concluded according to the results of the SPSS analysis in Table 4. All data on the test are good. Based on the output of pair one and pair 2 in Table 5, the two H0 accepted because both pairs have a sig value of 0.000 <0.05, and in pair 1, the t-value = 8.778 > t-table= 2.022691 while pair two obtained value Kolmogorov-Smirnov and Shapiro-Wilk test >0.05. So, it can be concluded that the research data is normally distributed. Because the research data is normally distributed, we can continue the homogeneity test to determine whether this data can be analyzed using a parametric or non-parametric test.

The t-value count= 9.759 > t-table= 2.022691. It can be concluded that there is a difference in the average or influence between learning outcomes before using the online Jigsaw method and After using the online Jigsaw method by looking at the 2-tailed significance level = 0.000 <0.05 and the difference in average or influence between learning motivation before using the method Jigsaw online and after using the online Jigsaw method due to the significance level of 2-tailed = 0.000 < 0.05. So, in this case, it can be concluded that the online jigsaw learning method can significantly increase learning motivation and student learning scores/ outcomes in mathematics conducted during online learning (online class).

Table 5. Test Pired Sample T-Test

	Mean	Std. Deviation	Std. Error	95% Confidence Interval of Difference		t-value	df	Sig. (2-tailed)
				Lower	Upper			
Pair 1 Pre-motivation questionnaire scores	- 8.56	5.84	. 97	- 10.53	- 6.57	-	35	. 000
Pair 2 Pre-study results test scores	- 30.97	19.04	3.17	- 37.41	- 24.52	-	35	. 000

DISCUSSION

After the researcher has carried out research and processed the data, it can be seen in the discussion that the learning method applied to Jigsaw Online can significantly increase student motivation and learning outcomes. This significant increase can be seen from the value of the student learning motivation questionnaire and the value of learning outcomes. Several previous studies examined the Jigsaw learning method. States that the average learning motivation of students in the control class is 29.03, and in the experimental class, it is 29.59. They both have high average motivation, but in experimental class using the online Jigsaw method, the average is higher than the average control class. The value of t-count> t-table in the experimental class, namely 2.158 > 2.00, then H0 accepted, which means that in the experimental class the value of student learning outcomes after using the Jigsaw method increase compared to before using Jigsaw method. The results of observations of learning motivation increased in cycle one from 75% to 84.75% in cycle two and an increase in students who achieved completeness from 77.8% to 88.9% with an average value for cycle 1 of 82.5 and cycle 82.61. It can be seen from previous research that learning the Jigsaw method online and offline can significantly increase student motivation and learning achievement.

Although online learning is no longer the main choice for education practitioners, especially in mathematics education, online learning is still the main alternative if offline learning is challenging to implement. In addition, many experts in the field of education predict about the educational process in the future where the physical learning process is no longer the main choice. For instance, a study by UNESCO titled “The futures of education for participation in 2050: educating for managing uncertainty and ambiguity" discusses the need for education to help learners manage the ambiguity and uncertainty that will accompany the many changes yet to come (Haste & Chopra, 2020). The study contends that developing the capacities to manage ambiguity and change are critical to enabling membership and participation in societies in the future. (Haste & Chopra, 2020). As for the future of online education, it is a rapidly growing field with significant potential. Some experts believe that the "online genie" is out of the bottle and won't go back in (Doughty, 2021). They argue that simply broadcasting pre-recorded lectures is no longer an option for forward-thinking universities (Doughty, 2021). Instead, they suggest that universities should leverage technologies like artificial intelligence and develop personalized learning experiences (Doughty, 2021). However, while online education is becoming more popular, this does not imply that all education will be entirely online in the future. The future of education is expected to be a combination of online and traditional face-to-face learning, also known as hybrid or blended learning. This method combines the flexibility and accessibility of online learning with the advantages of in-person instruction, like social interaction and hands-on experience. In another words, the future of education is likely to involve a mix of learning modalities, tailored to the needs of individual learners and the changing demands of our society. Therefore, this study will benefit all mathematics teachers regarding how to conduct online mathematics teaching-learning.

Throughout those findings and their benefits, some parts of this study can be more elaborated and explored. For example, the number of students involved in this study can be multiplied to provide more comprehensive research results. In addition, the Jigsaw learning model can still be combined and integrated with other technologies that are empirically able to have a positive impact on online learning such as a study conducted by Ishartono, et al. (2022), who integrate online learning with GeoGebra. Thus, further research can examine more deeply related to the application of the Jigsaw learning model in the online mathematics learning process by expanding the scope of research subjects, and integrating with other learning media.

CONCLUSION

Based on the research results presented by researchers, the online jigsaw learning method can significantly increase motivation and mathematics learning outcomes. The researchers suggest that the online jigsaw method can teach innovation in online situations so students do not feel bored and can be more active. For further research, we can examine the online jigsaw method more deeply so that you can get more comprehensive information related to the online jigsaw method, which will be helpful for innovating online learning in a fun way.

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