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QUALITY EDUCATION: EFFECT OF JIGSAW METHOD ON REVISED BLOOM TAXONOMY IN THE SUBJECT OF MATHEMATICS

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Abstract

The teaching of mathematics is used by several methods; one of them is the cooperative learning jigsaw method to improve the student's higher ordered thinking skills. The study intended to investigate that how the jigsaw method is effective on higher-order thinking skills in the subject of mathematics at the elementary level. The major objectives of the study were; to understand the result of the jigsaw method on students' analysis skills, to examine the effect of the jigsaw method on the assessment of students' abilities, to explore the outcome of the jigsaw method on the creation of students' skills. The hypothesis used that there is no significant difference between the mean score of the experimental group and control group on analyzing, evaluating, and creating skills of the students. The sample of the study consist of 60 elementary school science students of Grade VIII in the subject of mathematics of two groups, 30 in the control group and 30 in the experimental group. The study was experimental and a Pre-test-Posttest control group was used as the study design. Purposive sampling was used for the selection of the samples. Data were analyzed by using SPSS-22, T-test was used to compare student pre-test and post-test. The major results of the study were; the jigsaw method is more effective than the traditional method because the learning effect in a stimulating environment has an eternal influence on the learning process of students. In the classroom, students use the jigsaw method to stimulate their enthusiasm and actively participate in classroom teaching because the jigsaw method creates a positive learning environment in the classroom.

Key words: Jigsaw, understand elementary classroom, analysis classroom.

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Introduction

Mathematics is an actual instrument for the practical education of a person. The students worry that because of this visualization, their achievement in all their favorite subjects will be reduced. Student performance comes from academic performance and is based on normal dimensions, logical intelligence tests, grade tests, and ability tests. This cannot explain the educational outcomes of data collection regarding the importance of alternative contributions to the learning system. Therefore, learning shows changes in individual social performance, rather than fair changes in individual performance. The description is an effective, authentic, and organized link that summarizes a large number of demonstrations of the effort required. With the development of these skills, schools should teach basic skills to solve word problems and conclude that children can also solve problems. The development of problem-solving in the course has been recognized by general research. The problems faced by students and teachers' attention to the evolution of problem-solving skills need to explore all the possibilities related to this scope. (Alagic, 2009).

In 1950, Benjamin Bloom developed a scientific classification for cognitive purposes. It was shaped by Lorin Anderson in the 1990s, and Bloom's revised classification was reopened for scientific classification. Six important areas are engaged in the transformation of things into action word frames. Scientifically classifying different forms of beliefs and goals is a multi-step method, and action words are becoming more and more accurate. Arithmetic educators have shown that by talking about substitutes in mathematics, more scrutiny, evaluation, and creation can help solve problems better. If they openly understand the ideas they are teaching, it is an embarrassing way to review the mathematics answers by using words, diagrams, graphs, and numbers. Having an agent simplifies adding and simplifying some examples related to having more thoughtful abilities, and having frequent agents is about mutual support campaigns. Formulate your search. This is worrying at first, and they often ask questions about the information. However, during exercise, the agent begins to ask better questions to reveal appropriate answers (Anderson, 2001). Advanced thinking is considered as a scaffold for students to think about job questions and their answers. This is different from the typical methods or questions that students try to formulate teacher answers in class (Pickard, 2007).

Agents are called on to use words, pictures, and diagrams to explain mathematical answers. How Tutkun (2012) is fully prepared to describe the old bud area in Bloom's scientific classification. Advanced thinking plays an important role in the ability to put things together. Studies have shown that as students overcome higher levels of thinking, teachers see greater development in students' reading

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performance. Students are inspired by teachers and use techniques to consider tests to improve reading comprehension. This shows that these students will do better bypassing the reading test. An example of excellent thinking is questioning the connection between writing and proficiency. First, there are three types of high-level problems. The teacher can first request a theme for a children's story. This higher-level research helps students understand the obvious theme of the story. Personality enlightenment is an example of a larger problem. This is the time for students to learn the extra reflection card. "For example, how do the characters in the whole story change?" This encourages students to actively think about their motivations (Hill, et al. 2008).

The last problem is that students can still keep in touch while reading follow-up questions about higher thinking. Through reading, students can create three types of links: text to text, text to self, and text to world. If children can link, they will implement higher-order strategies. Finally, writing is a higher level of thinking. Since these two processes are interoperable, embedded reading and writing will help you understand. Writing involves children, increasing their opinions and deepening their understanding. Consequently, after reading if the students write, they must progress more sensitively in the text. (Ball et al., 2008)

Objectives of The Study

1. To understand the result of the jigsaw method on students' analysis skills.
2. To examine the effect of the jigsaw method on the assessment of students' abilities.
3. To explore the outcome of the jigsaw method on the creation of students' skills.

Hypotheses of the Study

Ho1: There is no significant difference between the mean scores of the experimental group and the control group in students' analysis skills.
Ho2: There is no significant difference between the mean scores of the experimental group and the control group in the assessment of students' abilities.
Ho3: There is no significant difference between the mean scores of the experimental group and the control group in the development of students' skills.

Significance of the Study

The study should be very significant of mathematics teachers than they teach on Jigsaw method. This can be useful for preparing lesson plans and adapting to the puzzle method. The study is useful to prepare a math teacher, an instructor for teaching. It is important for figuring out future strategies by planning in math at the elementary level. It will be helpful for curriculum developers to prepare curriculum content using the Jigsaw method. Creating innovative math strategies is helpful.

Delimitation of the Study

1. District Swabi
2. Private Sector School
3. Students of Grade VIII
4. Three Chapters of Mathematics of Grade VIII, Chapter 2 (Real Number), Chapter 9 (Area and Volume), and Chapter 11 (Introduction to Trigonometry).

Review of Literature

What is the jigsaw method?

The jigsaw method is a way of organizing teamwork so that students can work together and trust each other. This educational method is effective for multitasking and instilling a sense of personal responsibility in students. In this simple method of teamwork, each member has something unique to help with the team's final product, as well as any piece of the puzzle to create a finished picture, because no one else at school takes the initiative. Likewise, every student feels they have a closer connection with their peers and a sense of belonging. According to Aronson (2000), the advantage of jigsaw based learning strategy is that the learner performs a challenging and engaging task with interest in their groups of experts, as they know that when performing it in their previous groups, they have this information. Students interact within the group and develop a new idea which they conceive and verbally convey to their partner (Neer, 1987).

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Co-operative learning style–jigsaw strategy

Aronson's (2000) thought is the method that identifies aspects of each student's learning assigned to a team (home). The student finds the next team members who are assigned a similar dimension to a topic, then masters the instrument, returns to their "home" and expert groups share the content with the team members. The participatory learning style of the jigsaw can be helpful as the tool can be broken down into separate components, one person from each group specializing in a different concept and teaching it to members of the new group. Like a jigsaw, each piece (student) is an essential element to complete and fully understand the final product. Each student must have a complete understanding of the concept of everyone being taught (Panitz, 1996).

Jigsaw Teaching Strategy

Elliot Aronson is a pioneer in puzzle training techniques, a group learning method. This method aims to achieve specific goals using community learning content. Aronson (2005) created a series of concise means for implementing jigsaw techniques for teaching. This method is often used because of its adaptability. This course aims to ease tensions between races and improve the academic experience of young students. The ideology of this approach is based on student self-sufficiency. All students are considered excellent and all members of the team have provided extraordinary skills. This method is based on the idea of a puzzle where each student draws a puzzle. Each student submits a designated academic work and completes the jigsaw as the final puzzle image. The puzzle is created by combining different parts. Therefore, it can be inferred that each student plays an important role in cooperating with other students to complete the teacher's task. Students can learn by themselves, but this method inspires them to realize what other students are saying. This method is generally considered to improve educational performance. Students also recognize the significance of taking personal responsibility for their effort (Dhull, 2019).

Cooperative learning

In science education, it is generally believed that collaborative learning methods must be encouraged. Community meetings effectively combine the latest evidence with prior knowledge based on scaffolding exercises, collaborative problem-solving, interpretation, and group work writing, increasing students' confidence, which often supports the effectiveness of collaborative learning methods. It has proven to be useful. According to Geary (2004), the puzzle method creates a collaborative learning environment that promotes student activities, shared content acquisition, and shared interpretation. The student's self-awareness or self-concept is a very important central point, such as the evaluation of academic performance. It is believed that each

student and their opinions are essential to the other group members and that each student in the group is given the facility to contribute and describe their subjects, which improves personal self-awareness and directly affects the predictive collaborative learning group performance.

Mathematics Skills approach

The skills approach emphasizes the memory of basic skills (Passmore, 2007). The premise of this method is that digital intelligence is only the editing of valuable details (rules, facts, formulas, and procedures). In the technical method, the teacher notifies students that, for example, by entering addition, they can start adding from units, ten, hundred, etc. This technique is used to perform some calculations before the children remember them. Since the exercises are carried out on a purely symbolic (abstract) level, without explanation (reason), the skilled method is meaningless (education awakens the child's desire and the true desire to learn and practice mathematics). In the sense provided), it is not a noun. Skill methods require repeated practice but rarely become exploratory because children rarely participate in real-world digital thinking.

Mathematics Conceptual approach

Conferring to Sadia (2010), the conceptual approach focuses on meaningful skill memory. The premise of this method is that mathematics is a network of knowledge and principles. It is believed that children can learn mathematics regardless of whether the process has been taught or proven effective. The purpose of this method is to help teachers learn virtually the information, laws, formulas, and procedures they need. Teachers guide students to understand and master skills. In the conceptual approach, symbolic processes such as additional extensions are presented logically through actual lecturer demonstrations. Children can also use operations to simulate animation lessons. Therefore, education and practice often lack the background, but attempts have been made to promote substantive learning.

Mathematics Problem solving approach

Problem-solving strategies emphasize the application of numerical reasoning (reasoning and problem solving). The premise of this method is that mathematics is essentially the search for ideas, research procedures, or problem-solving models. Children use intuitive reasoning. On the one hand, they are considered to have imperfect intelligence. On the other hand, they can and should consciously establish a mathematical explanation of natural curiosity, which is considered a powerful existence. Mathematics education aims to familiarize beginners with numbers (they may even appear to be realistic and complex problems) when seeking mathematics.

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This allows children to learn and build a more complete knowledge of mathematics, and at the same time cultivate a more realistic way of thinking. As wise contributors to this research, teachers will advance the entire process, but will not set the agenda or manage the research in whole or in part. For example, the system protocol for adding the sum of words follows the development of children's thought processes (Jenkins, 2010).

Mathematics Investigative approach

Farzad (2010) believes that forensic strategies depend on a large amount of memory of skills and improved digital thinking. Mathematics as a logical method is considered a framework of skills and ideas. This is often seen as a method of investigation, similar to a problem-solving method. Teachers mediate, guide, and promote the successful construction of children's understanding through the most frequently organized exercises. Lecturers guide students through research methods, leading to the meaningful creation of programs and concepts and the development of numerical reasoning. Instructors use indirect methods to support students' learning. For example, a teacher might instruct students to re-invent a technique, an algorithm for adding the sum of words. Instructors can help students plan troubleshooting procedures. This can include manipulating or using sketches. Children can then use these symbols to explain situations and improvisational methods and find shortcuts to specific steps.

Performance of Jigsaw Group Work

There are four techniques of doing effective group work (Elliot, 2005):

Planning for students

For groups of students, the organizer sets learning goals for achieving good academic performance and social skills in an informal or formal setting. Informal facilitators and close partners are encouraged to form groups, but different training groups are associated with the unique skills and capabilities of group projects. These talents and skills of planning, organizing, reading, and writing. Concerning effective performance in a group, group responsibilities are usually distributed into 2 to 6 people. The coordinator described the role of each team member in reducing disputes and controlling team members. The obligations of students in the cooperative group range from lecturers to consultants, managers, and assistants. In conflict and control, the group responsibilities of each member are useful, but the coordinator does not need to be registered (Aronson et al., 2000).

Starting for Group Work

The coordinator provided easy communication for the students in the first meeting. Definite research Effective contact is conducive to arousing students' enthusiasm. You must understand the benefits of teamwork. Group members can establish group practices and ideals for group members. Collaborative teachers guide students to work together through work exercises that establish goals, actions to achieve goals, work parts, accountability and responsibilities, individual student responsibilities, and group principles.

Recording group task

Supervision during the group study has been used as a useful technique. This permits the facilitator to understand the progress of the workgroup. Ongoing written notifications or both are verified and observed. Proper observing and support for the observations of students can help you deal with difficult situations. Problem-solving projects require students to work hard and efficiently. The group is monitored by the pamphlet and used for thinking, productive criticism, and problem-solving. Successfully assess and monitor the progress of students.

Review and assessment/ Evaluation

Feedback promotes learning and helps students observe progress by assessing different groups and individuals. Assessment tests, exams, or project results can be used for individual or group study to extent student growth. Therefore, the methods of monitoring and follow-up evaluation are in line with students' reflection, regardless of whether the students' understanding is optimized through the individual learning process or the group learning process. Evaluate individual or group improvement changes to identify students' talents and promote development after the project is completed.

Research Methodology

Research Design

The study was quantitative. The method was true experimental namely, the pretest-posttest control group designs the independent variable, and success is a dependent variable. The jigsaw method was used to preserve research samples through experimental and control techniques.

Population

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The population of the study consists of elementary-level science students studying in a private sector school in district Swabi namely; Quaid-e-Azam Public School Swabi.

Sample and Sampling Procedure

The research sample was taken from Quaid-e-Azam Public School Swabi. With the student list, the researcher uses a simple random sampling method to extract samples. The sample size is 60, taken from Grade 8th in the subject of Mathematics. Both groups (experimental group and control group) at the school adopt the simple random sampling method for sampling and perform pre-test and post-test for inspection.

Table 1. Sample

School Type	Experimental group	Control group	Total
Male	30	30	60

Research Instrument

For testing the students an instrument was designed from the book of mathematics of Khyber Pakhtunkhwa Text Book Board. The instruments were valid for study because the fix marks test was used to assess the control group as well as the experimental group. The test was a total of 100 marks while the achievement test was used to gather the data. The jigsaw method was used and treatment was given.

Validity and Reliability

The validity of the instrument was assured in the field of education. The tool was altered and adapted according to the implications of the professionals. The reliability test was determined by Cronbach's alpha to ensure consistency which was found 0.84.

Data Collection

The researcher used an experimental method to collect data. Two groups were selected from the targeted school for this study. The study intended to use the jigsaw method on higher-order thinking skills (HOTs) in mathematics, therefore, a chapter is provided for the control group as well as the experimental group.

Results

Comparison of mean values of jigsaw method with and traditional method

T-test was used for data analysis. SPSS-22 was used to compare student pre-test and post-test. This section shows descriptive statistics and the Levene test table.

Table 2. Comparison of the traditional method and jigsaw of post-test Mean per MCQs sections

Group statistics						
Particular MCQs		N	Mean	Std. deviation	Std. means error	
Teaching strategies	Traditional method	30	32.5000	11.16568	2.03856	
	Jigsaw method	30	48.3000	20.68174	3.77595	
Levene's test for equality of variances						
	T	DF	Sig. (2-95% confidence interval of the tiled difference			
				Upper	Lower	F
Equal variances Assumed	3.682	58	.001	7.21042	24.38958	4.536
Equal variances not assumed	3.682	44.582	.001	7.15504	24.44496	

The above table explains the mean, standard deviation, standard error, and the mean of the two groups. The mean of the jigsaw method is more than the traditional teaching method. The average difference indicates that both teaching methods are not the same. The average difference of the jigsaw method is 48.3000 and the traditional method is 32.5000. The t-test value occupied by the independent sampling inspection of the traditional method and jigsaw method for two consecutive inspections is significant, indicating that the two groups have a higher level of significance. The average value of the jigsaw method is higher than that of the traditional method. This shows that the jigsaw method is not effective for students before teaching the subject. The jigsaw method has a positive impact on students' academic performance, through it, they present better results at the end of the study. The total number of students is represented by an uppercase letter N. The degrees of freedom are shown in the table above, with DF. The upper and lower values of the confidence interval are considered in the equation of the variance table above. Taking into account the dispersion of the mean in the standard deviation, it shows that the distance between the survey data is not very large. In the study, the standard deviation value is smaller than the arithmetic mean of the control group and the experimental group, which is relatively unknown. The sum of the two averages of most multiple-choice questions categories may not result in a scattering of the averages.

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Table 3. Analysis of control group and experimental group of the post-test mean of Question Answers

Question Answers						
Particular Question Answers		N	Mean	Std. deviation	Std. means error	
Teaching strategies	Traditional method	30	7.1000	3.83586	.70033	
	Jigsaw method	30	9.4667	4.73238	.86401	
Levene's test for equality of variances						
	T	DF	Sig. (2-95% confidence interval of the tiled difference			
				Upper	Lower	F
Equal variances Assumed	2.128	58	.038	4.59296	.14037	.690
Equal variances not assumed	2.128	55.617	.038	4.59500	.13834	

The above table shows that the average value of the jigsaw method is very different from the traditional method. In other words, the results of these two methods are not the same. The average value in this section shows that the average difference between the traditional lecture method and the jigsaw method is not the same. The average difference in this section shows that the jigsaw method is more effective than traditional training methods in answering the questions.

Table 4: Comparison of pre-test and post-test mean of jigsaw teaching method

Particulars	**Pretest**	**Posttest**
Multiple choice question	36.5333	48.3000
Question Answers	4.0667	9.4667
Total	40.6	57.7667

The above shows that the average value of the jigsaw method is very different from the traditional method. In other words, the results of these two methods are not the same. The average value in this section shows that the average difference between the traditional lecture method and the jigsaw method is not the same. The average difference in this section shows that the jigsaw method is more effective than traditional training methods in answering the questions.

Table 5: Comparison of pre-test and post-test mean of the traditional teaching method

Particulars	**Pre-test**	**Post-test**
Multiple choice question	28.1000	32.9667
Question Answers	3.4000	7.1000
Total	31.5	40.0667

The above shows that the average post-test value of the traditional method means that it is higher than the pre-test value. The portion of multiple choice questions where the pre-test means is less than the post-test mean. This means that students who use the jigsaw method to teach these MCQs will not achieve better results. Overall, the pretest average of multiple-choice questions with traditional methods is 28.1000. The average post-test value is 32.9667, which means that the post-test is more effective than the pre-test in the multiple-choice part. The pre-test means the portion of the question and answer is less than the post-test mean. This shows that students who were traditionally taught this question and the answer did not achieve better results. In general, the average value for the traditional pre-test question and answer method is 3.4000. The average post-test value is 7,000, which means that the traditional post-test method is more effective than the pre-test in answering the question.

Interpretations of the researcher's Hypotheses (Testing Hypotheses)

Step 1. Null Hypothesis (H_o) and Alternative Hypothesis (H ı)

H_o = There is no significant difference in mean pre-test and post-test scores between the experimental group and the control group that uses the jigsaw method and traditional methods to teach math in elementary school.

When testing the null hypothesis

H_o: $\mu 1 = \mu 2$

Putting the values: -

H_o: 57.7667 = 40.0667 => values are not equal

This invalidates the null hypothesis. The new hypothesis will be tested. The alternative hypothesis is as follows.

H1: There is a significant difference in the mean pre-test and post-test scores of the experimental group and the control group by jigsaw method and traditional mathematical methods are used for teaching at the school level. Therefore, an alternative hypothesis was generated, which is statistically signified:

H1: $\mu 1 \neq \mu 2$

Therefore, $\mu 1$ = 57.7667 and $\mu 2$ = 40.0667 are not equal, indicating that the alternative hypothesis is accepted and the previous null hypothesis rejected.

Table 6. The mean of both groups

Particular		**N**	**Mean**
Teaching strategies	Jigsaw method	30	57.7667
	Traditional method	30	40.0667

Step 2. Significance level

The significant value is important. The value is between 0-1. The significant value relative to "0" means that there is a significance to support the rejection of the null hypothesis. A value relative to 1 indicates an insignificant result, indicating acceptance of the null hypothesis. The significance level in the simple independent test is zero. It represents a high degree of significance. The numerical values of each

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part of the test paper describe the suggestions in detail and respond to the zero-side expression. This means that test results have a high degree of significance.

Step 3. Calculated t- value and Tabulated value Comparison

The tabulated value is zero. Therefore, the significance value is less than the value of t, which also indicates the rejection of the null hypothesis. In the table above, the value of t is greater than the value of p (significance level) that proving the null hypothesis rejection.

Calculated value T > tabulated value P

Therefore, the calculated value of 2.128 is more than the p-value that also proves the null hypothesis rejection.

Step 4. Decision

Calculated from the previous steps, the null hypothesis is rejected. This means that the result was very important for applying the jigsaw method to math students.

Discussion of the Findings

When attending a class in a traditional environment, students do not pay attention to the lecture, especially at the end of each class. The whole lecture was observed and exchanged by researchers. At first, they were very interested in learning and listened attentively to the teacher's teachings, but after a while, few students started to lose concentration. Some students make noise in class. Farayola (2011) emphasized that the traditional method of learning has a fewer effect on the learning of students than traditional jigsaw methods. In addition, pointed out in their research that traditional research methods can distract students. After some time in the traditional learning environment, students will lose the ability to listen and no longer pay attention to classroom teaching. At the end of the course that asked the question, the student was unable to answer effectively and completely. According to Ariyanti, Lasmawan, & Dantes (2013), the study also explained that the use of traditional jigsaw methods has a positive effect on students' academic performance. The results of this study show that students can discuss the topic of each lesson taught by the teacher with peace of mind, and make notes and summaries necessary for understanding. They explained many important points and asked important questions for the class to answer. The new headteacher encourages and stimulates the students' instincts to try to speak publicly on the subject. At first, some students were hesitant and noticed different ways of learning using the puzzle method. Students are very serious and active in reading and learning. The students' discussions did a good job; they moved from the active group to the core group for better learning and tried to focus on the jigsaw method. A study conducted by Tukur et al., (2018) revealed that the students who learned under the Jigsaw method of cooperative learning had greater mathematics achievement as compared to those taught by the traditional method of teaching. The results also indicate that students in the Jigsaw group had higher participation in the process of learning than students in the comparison group because of the principles

of Jigsaw strategy where students in the treatment group are required to read and learn the learning materials, to move from home groups to expert groups to contribute each other to learn their assigned task and go back to the other teammates what they learned in the expert groups. Motivation helps them improve their cognitive level. Students and their peers are interested in students who are not too concerned about the education and learning process.

Conclusion

Based on the results and interpretations of data it was concluded that;

1. The jigsaw method is very important to students' academic performance because it is most effective for students studying mathematics at the Middle school level in Swabi District.
2. During the teaching process of the experimental group, it was observed that they liked and were satisfied with the newly introduced teaching technology. They are happy to learn through new strategies and are motivated to provide them with a comfortable environment under natural conditions and conditions. This has a positive effect on students' academic performance.
3. By comparing the effect of the jigsaw method and the traditional student performance method, the jigsaw method is more effective than the traditional method, because the learning effect in a stimulating environment has an eternal influence on the learning process of students.
4. In the jigsaw method, student interaction and participation in discussions or collaboration in group activities enthusiastically encourage students to achieve better academic performance. That's because the students were happy to be able to acquire knowledge through a comfortable and peaceful stimulating environment.
5. Students are encouraged to learn by using the jigsaw in the classroom and participate in classroom activation and cognitive improvement. They were encouraged, interested and punctual until the jigsaw learning process is completed.
6. The traditional methods of students are inattentive and get bored when there is a gap in class. The jigsaw method using the traditional method is a more effective method of successful learning than the traditional method because the students are still involved in the interaction with other students and peers in the group.
7. In the classroom, students used the jigsaw method to stimulate their enthusiasm and actively participate in classroom teaching. Because the jigsaw method creates a positive learning environment in the classroom.

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Recommendations

Following are the recommendations of the study based on major findings;

1. Elementary school students can use the jigsaw method to increase their learning horizons.
2. Policymakers, educational planners, and teachers may use a combination of jigsaw methods and traditional elementary school methods to improve students' achievement.
3. School management may need to develop and maintain a strategic plan to effectively use the jigsaw method and develop motivational guidelines, which will have a significant impact on students' academic performance.
4. The survey results also show that students' academic performance has not been properly assessed, so provided there is adequate planning, they can be assessed twice a year.

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