Role of JIGSAW method of teaching in improving clinical diagnosis among final year dental students

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Abstract

The Jigsaw method is an active learning strategy designed to enhance collaborative learning and critical thinking. This study aims to evaluate the effectiveness of the Jigsaw method in improving the clinical diagnostic skills of final-year dental students. A quasi-experimental study was conducted at AIMST Dental Center, where students were divided into control and experimental groups. The experimental group underwent Jigsaw-based learning sessions, while the control group received traditional lecture-based instruction. The assessment of diagnostic skills was conducted before and after the intervention using standardized clinical cases. The results indicated a significant improvement in the diagnostic accuracy of the experimental group compared to the control group. The findings suggest that the Jigsaw method fosters deeper understanding and critical thinking, making it a valuable pedagogical tool in dental education.

Keywords: Jigsaw method, active learning, clinical diagnosis, dental education, collaborative learning

Introduction:

Clinical diagnosis is essential for dental students transitioning into professional practice, ensuring quality patient care and professional growth. Traditional teaching methods, such as lectures and textbook study, often fail to engage students or prepare them for real-world challenges (1). Effective medical education fosters competency, motivation, and critical thinking through well-structured instructional strategies, shifting from passive to active learning (2).

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Lecture-based teaching remains widely used due to its efficiency in covering large volumes of content. However, its one-way communication limits student engagement and deep learning. To enhance learning outcomes, educators must adopt contemporary teaching strategies that encourage collaboration and critical thinking (3). The shift from teacher-centered to student-centered learning has led to the integration of cooperative approaches, such as small-group discussions and interactive learning models like the Jigsaw technique (4).

The Jigsaw method, developed by Elliot Aronson, promotes teamwork and knowledge-sharing, fostering deeper understanding and problem-solving skills (5). This approach divides students into small groups where each member becomes an expert in a specific topic and then teaches their peers, creating an interdependent learning environment (6). The method encourages accountability, active participation, and mutual learning, ultimately improving comprehension and retention.

Despite its benefits, many educators hesitate to implement Jigsaw due to time constraints and unfamiliarity with the technique. Research suggests that when teachers understand the method's advantages, they are more likely to integrate it into their curriculum (7). Studies show that students engaged in Jigsaw-based learning outperform those in traditional settings, demonstrating improved academic performance and problem-solving abilities (8,9).

The effectiveness of the Jigsaw method has been validated in various disciplines, including medical and dental education. Research by Doymuş et al. (2007) highlighted its superiority over traditional methods in a chemistry laboratory setting, reinforcing its potential across different subjects (10). Given these findings, this study aims to evaluate the impact of the Jigsaw method on dental education, specifically its role in enhancing clinical diagnostic skills and critical thinking among students.

Materials and Methods

Sample Size Calculation

The sample size was determined using G*Power 3.1.9.4 based on previous study data. Assuming a mean difference of 2.39 between the conventional group (8.44 ± 2.33) and the Jigsaw group (11.03 ± 2.07), with an alpha error probability (α) of 0.05 and a power (1-β) of 0.99, the required

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sample size per group was 28 (total = 56). To account for potential dropouts, the final sample size was increased to 64 students (32 per group).

(S, A., V, S., & Sakthivadivel, V. (2021). Role of JIGSAW method of teaching in improving clinical diagnosis among final year medical students – A prospective observational study. Asian Journal of Medical Sciences.)

Study Design and Participants

This quasi experimental study was conducted at AIMST Dental Center over four months (May–August 2024). A total of 64 final-year dental students participated, divided into:

Control Group: Traditional lecture-based teaching.

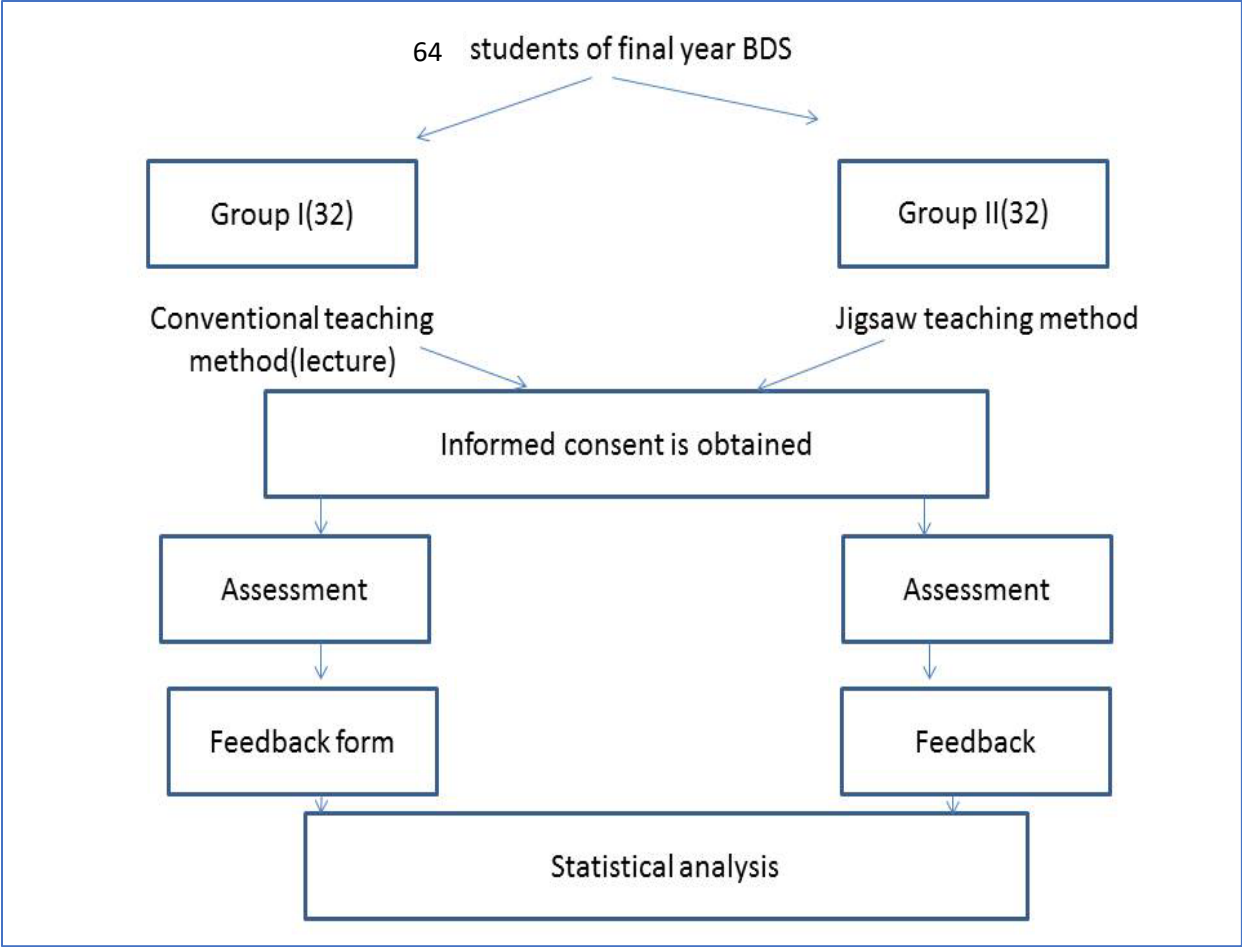Experimental Group: Jigsaw-based learning sessions.

Inclusion Criteria: Final-year students who provided informed consent and completed prerequisite courses.Exclusion Criteria: Students absent during the study or previously trained in the Jigsaw Technique.

Sampling and Grouping

A simple random sampling technique was used. Students were assigned to either the Jigsaw or lecture group.

Study Workflow

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Data Collection and Analysis

Data were collected through pre/post-tests, feedback forms, and observational checklists. Statistical analysis was performed using IBM SPSS 27. A paired t-test was used for score comparisons, while Chi-square and Fisher's exact tests analyzed categorical data. A p-value < 0.05 was considered statistically significant.
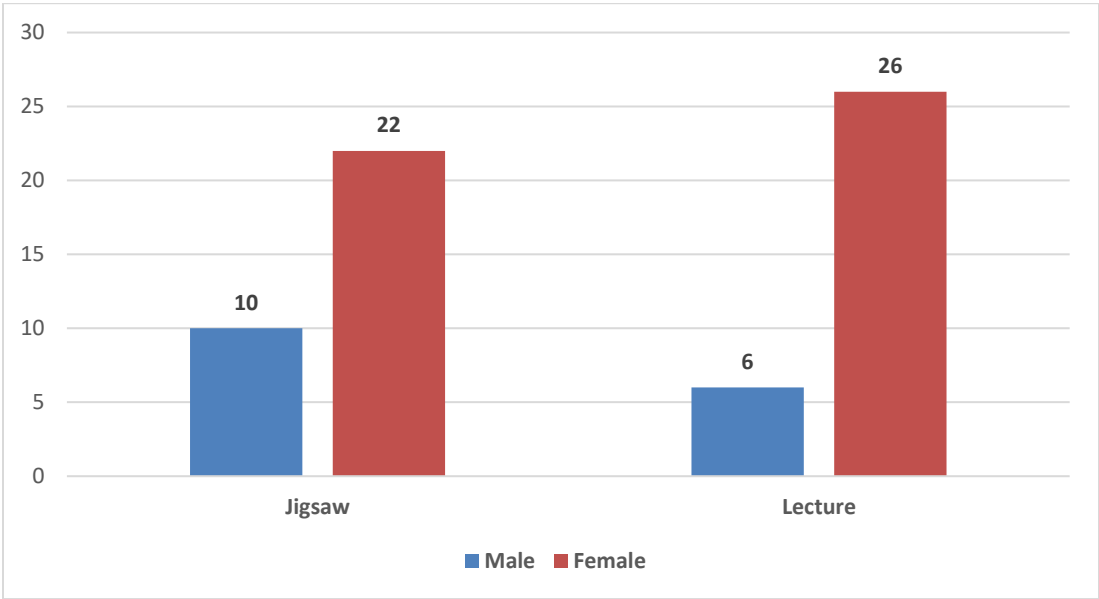
Results:

RESULTS

Table 1: Gender-wise distribution for Jigsaw and Lecture groups

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Gender	Groups		Test values	P-value
	Jigsaw	Lecture		
Male	10 (31.3%)	6 (18.8%)	1.33	0.38(NS)
Female	22 (68.8%)	26 (81.3%)		
Total	32	32		

Fischer's test: (NS) Non-significant as p >0.05; *Significant- p <0.05

Interpretation: The proportion of males who completed the Jigsaw test (31.3%) is slightly higher than those who attended the Lecture (18.8%). However, the p-value of 0.38 indicates that this difference is not statistically significant (NS) (Figure 1).

Figure 1: Gender-wise distribution for Jigsaw and Lecture groups

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Table 2: Comparison of Questioner scores of Jigsaw and Lecture groups

Groups	N	Mean ± Standard Deviation	Standard Error	Mean Difference ± Std. Deviation	95% Confidence Interval of the Difference		t	p-value
					Lower	Upper		
Lecture	32	6.84 ± 1.48	0.26	-0.47 ± 1.26				0.045*
Jigsaw	32	7.31 ± 0.99	0.17		-0.93	-0.01	-2.09	

Paired-t test: * Significant- p <0.05

The Jigsaw group performed better than the Lecture group, with a statistically significant mean difference (p-value = 0.045*). The mean difference between the groups was -0.47, with a 95% confidence interval ranging from -0.93 to -0.01 (Figure 2).
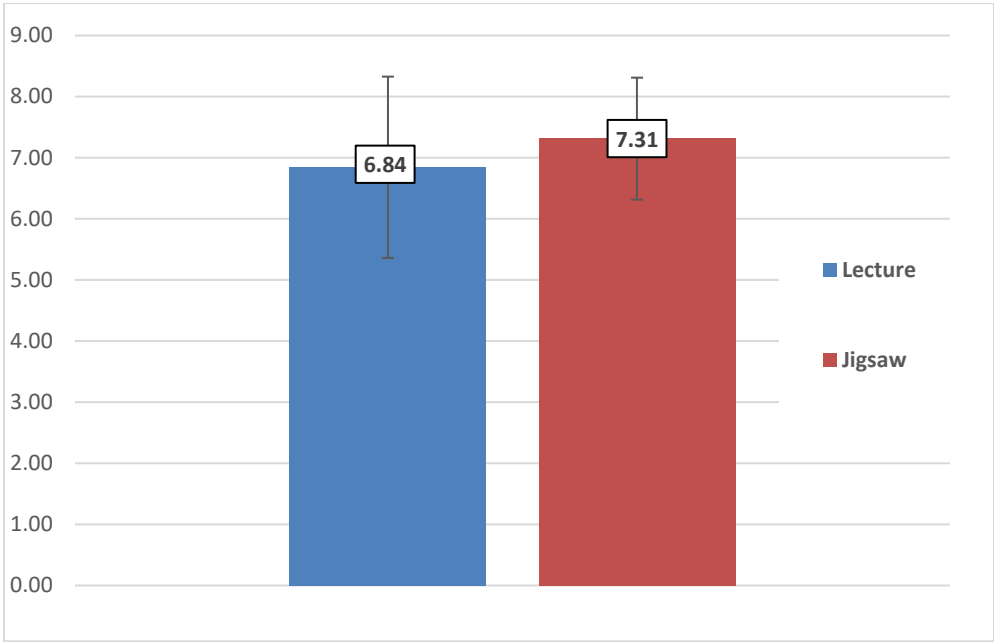
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Figure 2: Comparison of Questioner scores of Jigsaw and Lecture groups

GROUP WISE RESPONSES FOR FEEDBACK FORM QUESTIONS (Table 3-12)

Table 3: Group-wise responses for the feedback question "This new method generated interest in learning this topic"

Question	Response	GROUP		Test Value	P - Value
		JIGSAW	**LECTURE**		
This new method generated	**Strongly agree**	17 (53.1%)	0 (0.0%)	45.5	<0.001**
	Agree	9 (28.1%)	0 (0.0%)		
	Neutral	3 (9.4%)	7 (21.9%)		
	Disagree	1 (3.1%)	18 (56.3%)		

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interest in learning this topic	**Strongly disagree**	2 (6.3%)	7 (21.9%)		

Chi-square test: (NS) Non-significant as p >0.05; *Significant p <0.05

Interpretation: The responses to the feedback question "This new method generated interest in learning this topic" show a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (53.1%) compared to the Lecture group (0.0%). The chi-square test result is highly significant with a p-value less than 0.001**, indicating a strong preference for the Jigsaw method in generating interest in the topic(Figure 3).
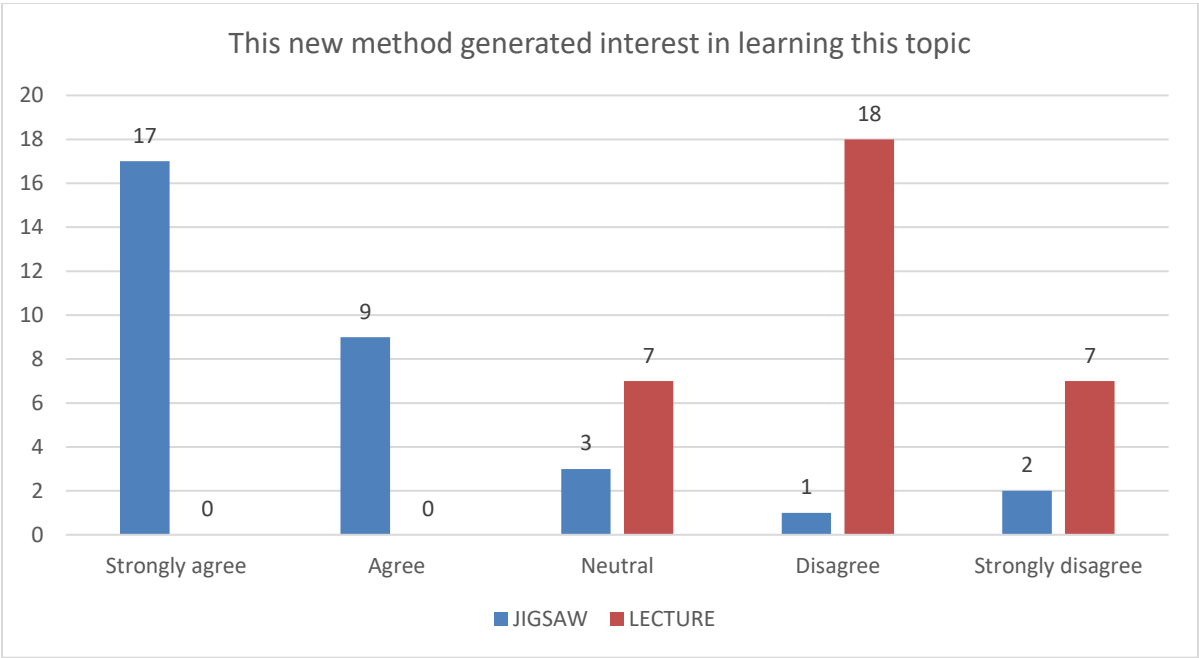
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Figure 3: Group-wise responses to the feedback question "This new method generated interest in learning this topic".

Table 4: Group-wise responses for feedback question "This method enabled in-depth understanding of the desired topic"

Question	Response	GROUP		Test Value	P - Value
		JIGSAW	**LECTURE**		
This method	**Strongly agree**	15 (46.9%)	0 (0.0%)	51.1	<0.001**
	Agree	13 (40.6%)	0 (0.0%)		
	Neutral	2 (6.3%)	5 (15.6%)		

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enabled in depth understanding of the desired topic	**Disagree**	1 (3.1%)	22 (68.8%)		
	Strongly disagree	1 (3.1%)	5 (15.6%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method enabled in-depth understanding of the desired topic" reveal a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (46.9%) and agreed (40.6%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as much more effective for enabling an in-depth understanding of the topicc(Figure 4).
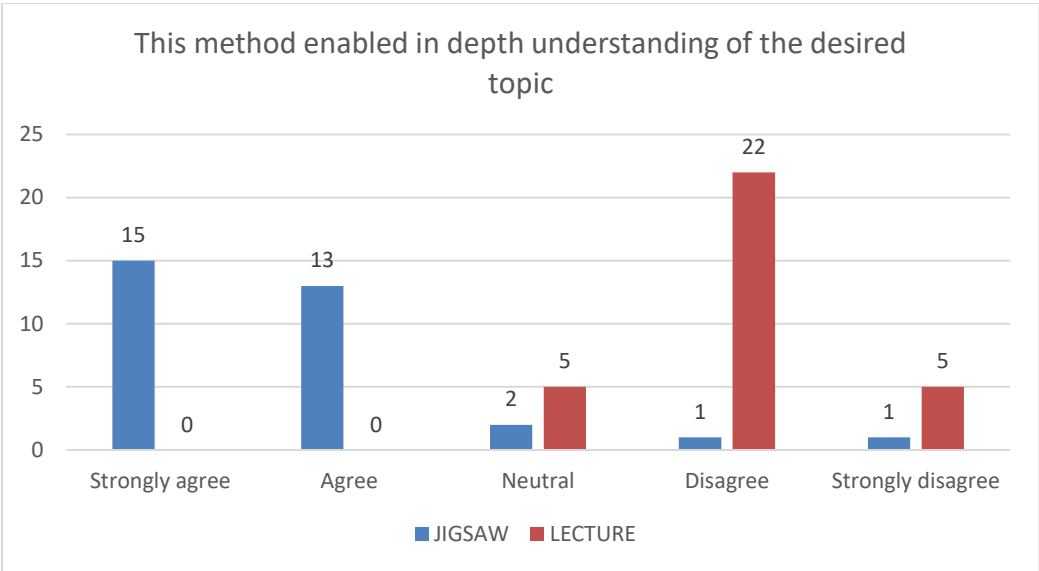
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Figure 4: Group-wise responses to the feedback question "This method enabled in-depth understanding of the desired topic".

Table 5: Group-wise responses to the feedback question "This method enhanced my referral habits"

Question	Response	GROUP		Test Value	P - Value
		JIGSAW	**LECTURE**		
This method enhanced my referral habits	**Strongly agree**	16 (50.0%)	0 (0.0%)	45.01	<0.001**
	Agree	10 (31.3%)	0 (0.0%)		
	Neutral	3 (9.4%)	10 (31.3%)		
	Disagree	3 (9.4%)	13 (40.6%)		

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	Strongly disagree	0 (0.0%)	9 (28.1%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method enhanced my referral habits" show a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (50.0%) and agreed (31.3%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly more effective in enhancing referral habits (Figure 5).
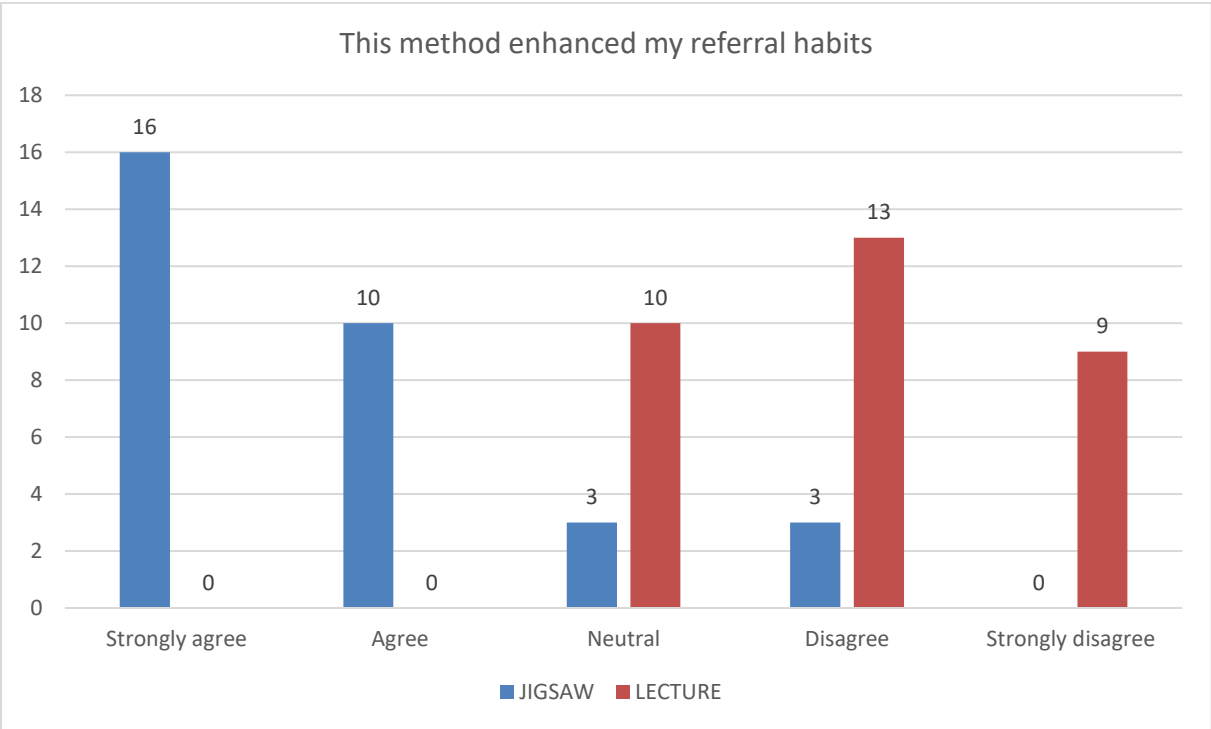
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Figure 5: Group-wise responses to the feedback question "This method enhanced my referral habits".

Table 6: Group-wise responses to the feedback question "This method helped me to improve my communication skills"

Question	Response	GROUP		Test Value	P - Value
		JIGSAW	LECTURE		
This method helped me to improve my communication skills	Strongly agree	15 (46.9%)	0 (0.0%)	53.3	<0.001**
	Agree	14 (43.8%)	0 (0.0%)		
	Neutral	1 (3.1%)	7 (21.9%)		
	Disagree	2 (6.3%)	16 (50.0%)		
	Strongly disagree	0 (0.0%)	9 (28.1%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method helped me to improve my communication skills" demonstrate a significant difference between the Jigsaw and Lecture

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groups. The Jigsaw group had a higher proportion of participants who strongly agreed (46.9%) and agreed (43.8%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly more effective in improving communication skills (Figure 6).
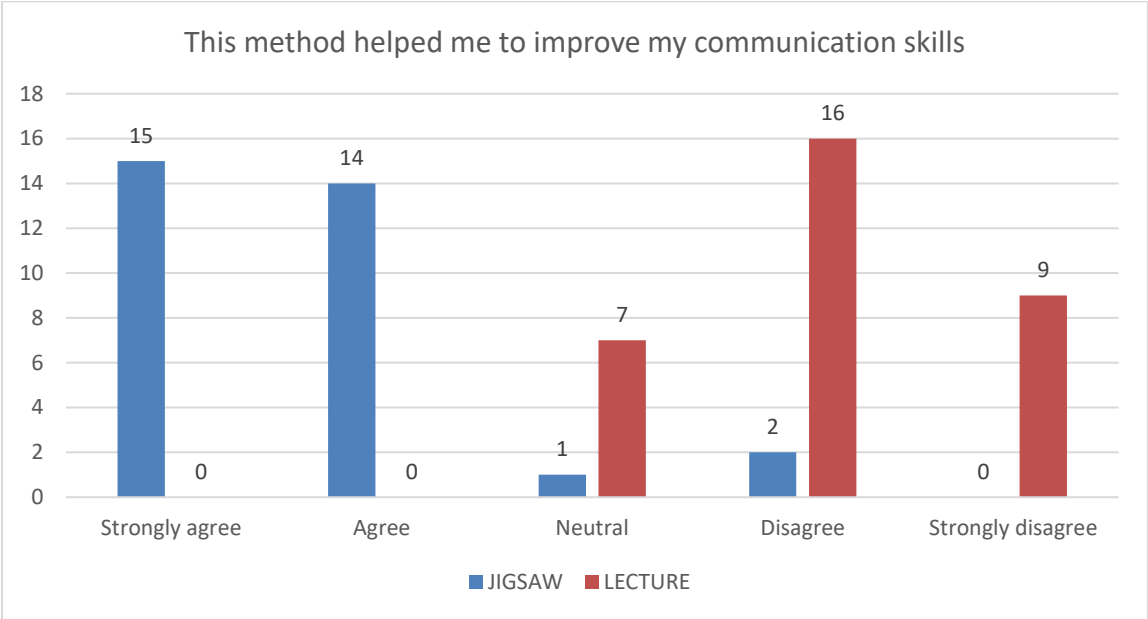

Figure 6: Group-wise responses to the feedback question "This method helped me to improve my communication skills".

Table 7: Group-wise responses to the feedback question "This method creates opportunities for team members to share their information"

Question	Response	GROUP	Test value	p-value

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		JIGSAW	LECTURE		
This method creates opportunities for team members to share their information	**Strongly agree**	18 (56.3%)	0 (0.0%)	50.89	<0.001**
	Agree	10 (31.3%)	0 (0.0%)		
	Neutral	2 (6.3%)	5 (15.6%)		
	Disagree	1 (6.3%)	18 (56.3%)		
	Strongly disagree	1 (3.1%)	9 (28.1%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method creates opportunities for team members to share their information" show a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (56.3%) and agreed (31.3%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly more effective in creating opportunities for team members to share information (Figure 7).
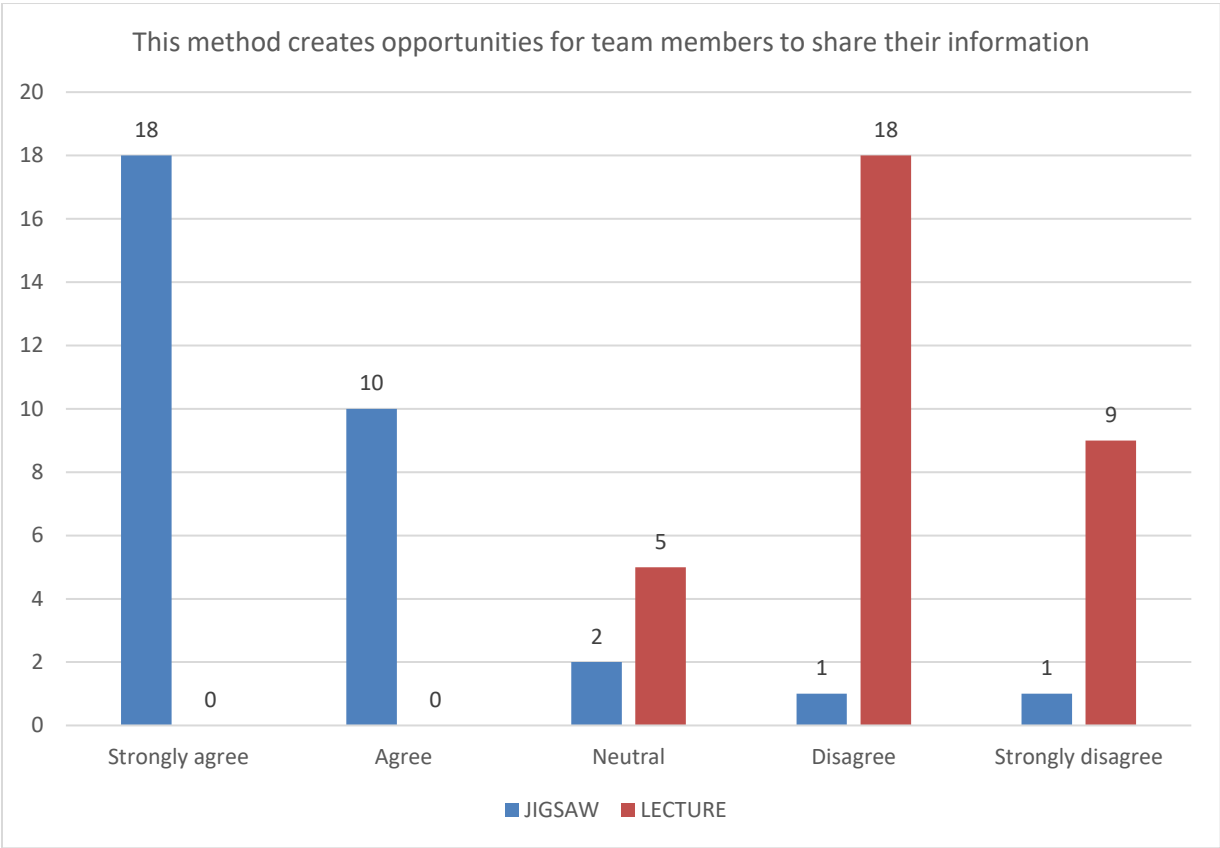
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Figure 7: Group-wise responses to the feedback question "This method creates opportunities for team members to share their information".

Table 8: Group-wise responses for the feedback question "This method can be applied to other concepts for other subjects in the future"

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Question	Response	GROUP		Test Value	p-value
		JIGSAW	**LECTURE**		
This method can be applied to other concepts for other subjects in future	**Strongly agree**	16 (50.0%)	0 (0.0%)	53.6	<0.001**
	Agree	13 (40.6%)	0 (0.0%)		
	Neutral	2 (6.3%)	10 (31.3%)		
	Disagree	1 (3.1%)	14 (43.8%)		
	Strongly disagree	0 (0.0%)	8 (25.0%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method can be applied for other concepts for other subjects in the future" reveal a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (50.0%) and agreed (40.6%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly more applicable for future use in other concepts and subjects (Figure 8).
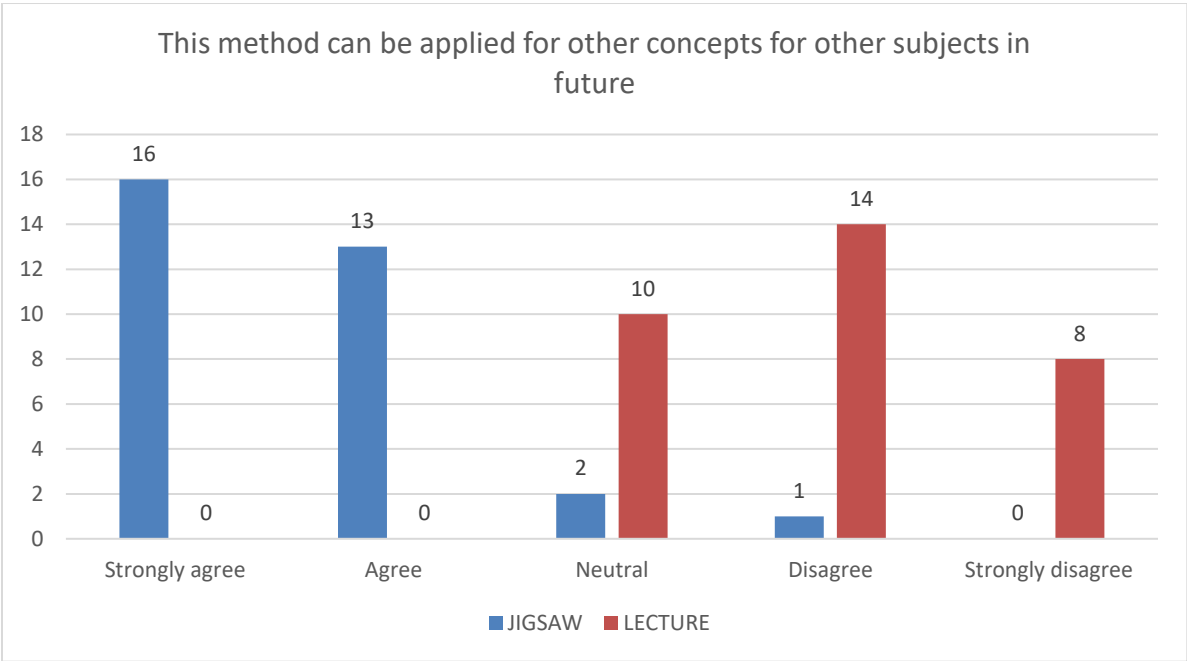
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Figure 8: Group-wise responses to the feedback question "This method can be applied to other concepts for other subjects in the future".

Table 9: Group-wise responses for feedback question "This method improves my analytical ability"

Question	Response	GROUP		Test Value	p-value
		JIGSAW	**LECTURE**		
This method improves my	**Strongly agree**	15 (46.9%)	0 (0.0%)	51.83	<0.001**
	Agree	13 (40.6%)	0 (0.0%)		
	Neutral	3 (9.4%)	7 (21.9%)		

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analytical ability	**Disagree**	1 (3.1%)	16 (50.0%)		
	Strongly disagree	0 (0.0%)	9 (28.1%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method improves my analytical ability" indicate a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (46.9%) and agreed (40.6%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, suggesting that the Jigsaw method was perceived as significantly more effective in improving analytical ability (Figure 9).
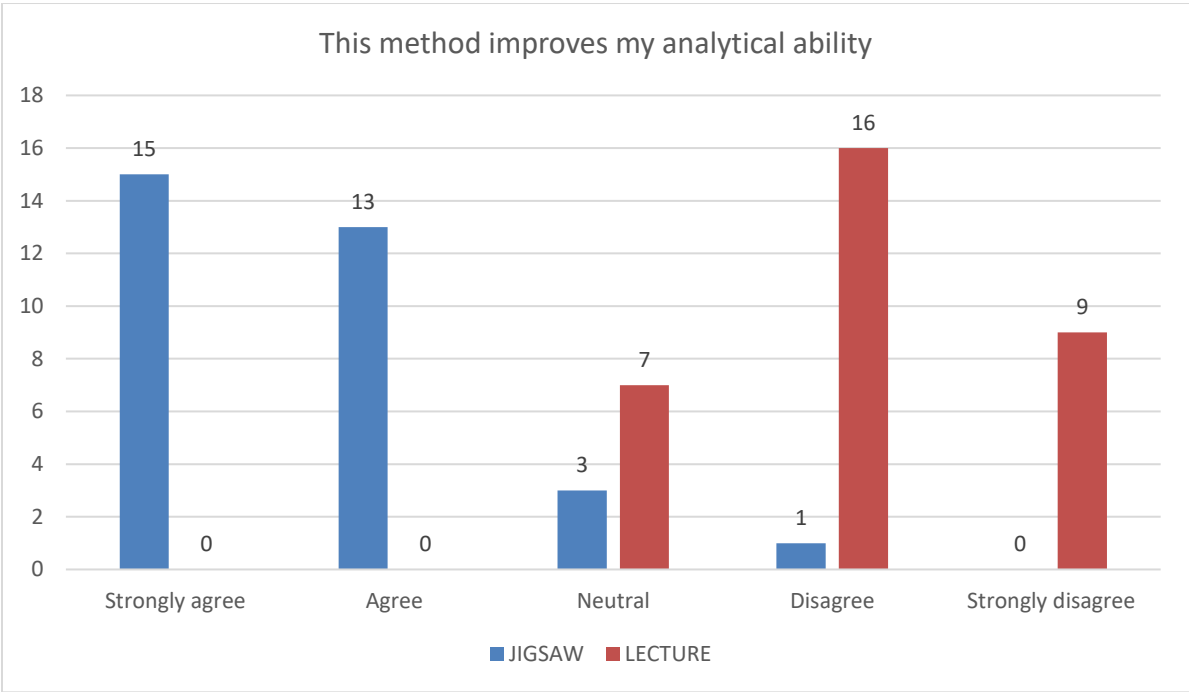
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Figure 9: Group-wise responses to the feedback question "This method improves my analytical ability".

Table 10: Group-wise responses for feedback question "This method is an effective way of learning"

Question	Response	GROUP		Test Value	p-value
		JIGSAW	**LECTURE**		
This method	**Strongly agree**	15 (46.9%)	0 (0.0%)	54.44	<0.001**
	Agree	13 (40.6%)	0 (0.0%)		

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is an effective way of learning	Neutral	3 (9.4%)	3 (9.4%)		
	Disagree	0 (0.0%)	21 (65.6%)		
	Strongly disagree	1 (3.1%)	8 (25.0%)		

Chi-square test: **Highly Significant p <0.01

Interpretation: The responses to the feedback question "This method is an effective way of learning" show a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (46.9%) and agreed (40.6%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly more effective for learning compared to the Lecture method (Figure 10).
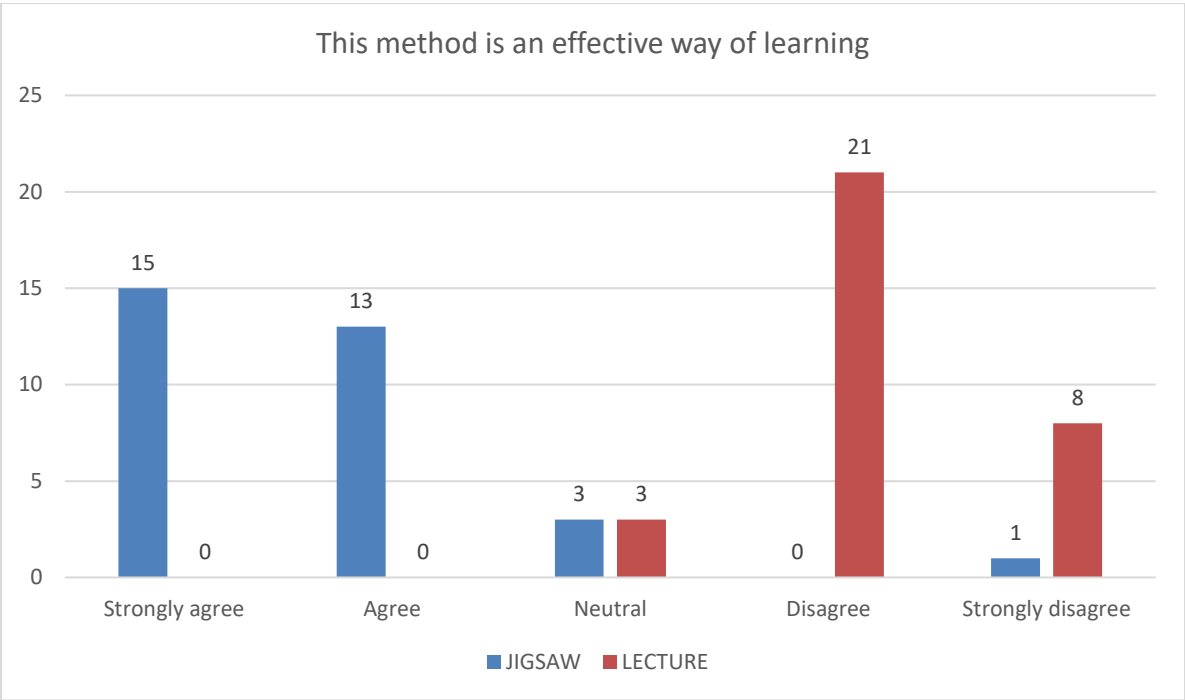
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Figure 10: Group-wise responses to the feedback question "This method improves my analytical ability".

Table 11: Group-wise responses for feedback question "I could easily adapt to this technique"

Question	Response	GROUP		Test Value	P - Value
		JIGSAW	**LECTURE**		
	Strongly agree	14 (43.8%)	0 (0.0%)	48.05	<0.001**
	Agree	13 (40.6%)	0 (0.0%)		

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I could easily adapt to this technique	Neutral	3 (9.4%)	8 (25.0%)		
	Disagree	1 (3.1%)	18 (56.3%)		
	Strongly disagree	1 (3.1%)	6 (18.8%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "I could easily adapt to this technique" show a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (43.8%) and agreed (40.6%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly easier to adapt to compared to the Lecture method(Figure 11).
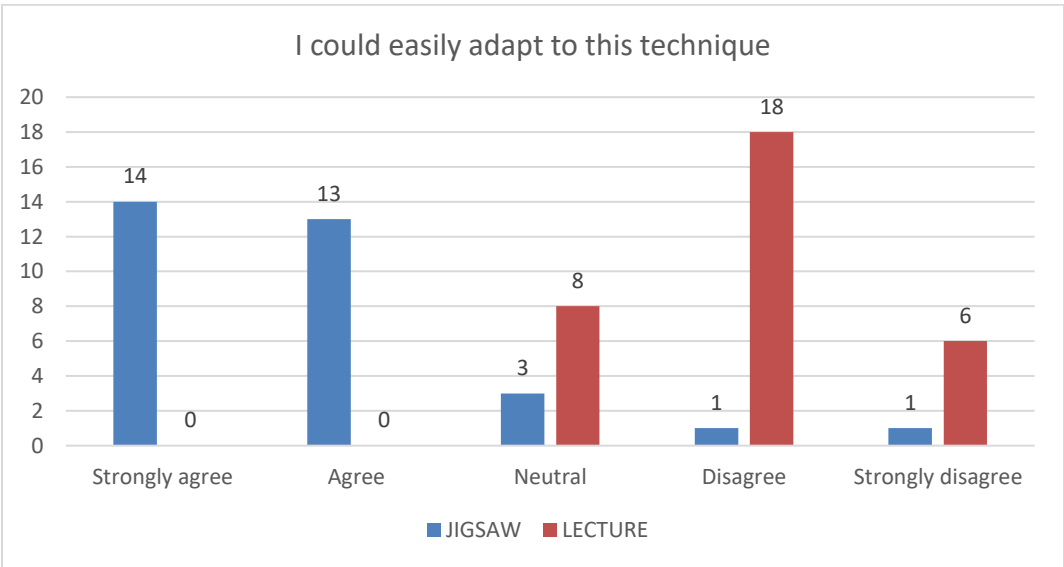
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Figure 11: Group-wise responses to the feedback question "This method improves my analytical ability".

Table 12: Group-wise responses to the feedback question "This method improves teaching skills in the participants"

Question	Response	GROUP		Test Value	p-value
		JIGSAW	**LECTURE**		
This method improves teaching skills of the participants	**Strongly agree**	14 (43.8%)	0 (0.0%)	49.07	<0.001**
	Agree	13 (40.6%)	0 (0.0%)		
	Neutral	4 (12.5%)	10 (31.3%)		
	Disagree	0 (0.0%)	15 (46.9%)		
	Strongly disagree	1 (3.1%)	7 (21.9%)		

Chi-square test: **Highly Significant- p <0.01

Interpretation: The responses to the feedback question "This method improves teaching skills in the participants" reveal a significant difference between the Jigsaw and Lecture groups. The Jigsaw group had a higher proportion of participants who strongly agreed (43.8%) and agreed

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(40.6%) compared to the Lecture group, which had no participants who strongly agreed or agreed. The chi-square test result is highly significant with a p-value less than 0.001**, indicating that the Jigsaw method was perceived as significantly more effective in improving teaching skills compared to the Lecture method (Figure 12).
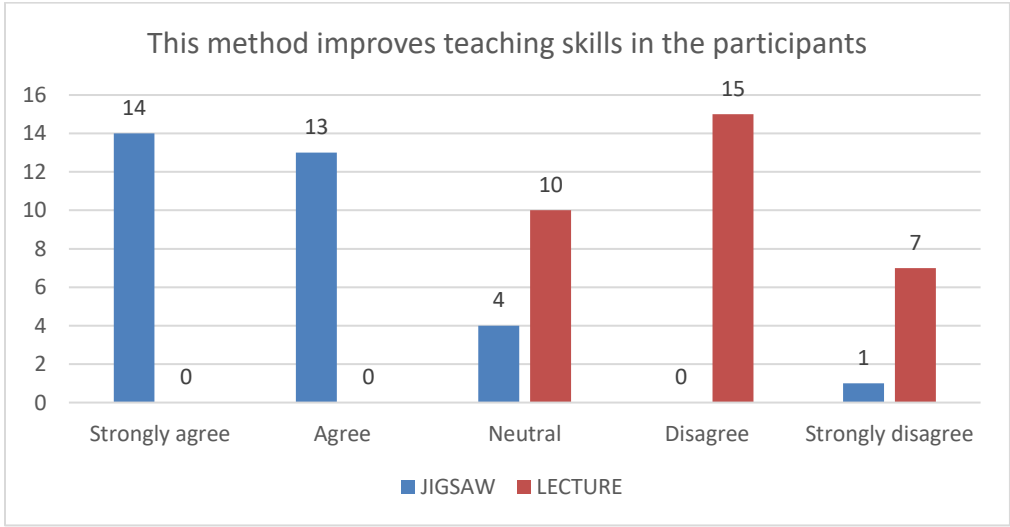
Figure 12: Group-wise responses to the feedback question "This method improves my analytical ability".

Discussion:

Clinical Diagnosis Performance

The Jigsaw group had significantly higher post-test scores than the Lecture group (p = 0.045).

Mean difference: -0.47 (95% CI: -0.93 to -0.01), confirming improved learning outcomes.

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Student Feedback and Learning Outcomes

Engagement & Interest: 53.1% strongly agreed that the Jigsaw method increased engagement (p < 0.001).

Understanding & Critical Thinking: 87.5% reported enhanced comprehension compared to none in the Lecture group (p < 0.001).

Communication & Teamwork: 90.7% found Jigsaw beneficial for communication and teamwork (p < 0.001).

Referral Habits & Professional Growth: 81.3% reported improved referral habits (p < 0.001).

Analytical Skills: 87.5% found Jigsaw effective in developing problem-solving skills (p < 0.001).

Adaptability & Teaching Skills: Over 80% found the method adaptable and effective in improving teaching abilities (p < 0.001).

Overall Learning Effectiveness: 87.5% strongly agreed Jigsaw was more effective than lectures (p < 0.001).

Several studies have investigated the impact of the Jigsaw method on various educational outcomes, providing a broader context for interpreting the findings of this study.

The findings from Nusrath et al., (2019) reinforce the positive outcomes observed in this study regarding the Jigsaw method (11). The study highlights significant improvements in students' academic performance and communication skills through cooperative learning. The preference for Jigsaw cooperative learning among a majority of participants supports its effectiveness as a teaching strategy. Nusrath et al., (2020) found a statistically significant improvement in students' post-test scores compared to pre-test scores after using the Jigsaw Cooperative Learning (JCL) method (p < 0.001). Students rated JCL highly for enhancing communication skills (mean 4.59) and positively for the overall learning experience (mean 4.14 out of 5), though it was rated lower for in-depth topic coverage (mean 3.56). The majority (83%) preferred JCL over traditional methods, citing key advantages such as improved communication skills, better understanding of topics, overcoming shyness, and efficient topic coverage. Some disadvantages noted were that JCL is time-consuming and challenging for slow learners. The authors conclude that JCL can enhance understanding of concepts, improve communication and analytical skills, and make learning more enjoyable for medical students.

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Similarly, a study by Sagsoz et al., (2015) investigated the impact of the Jigsaw learning method versus traditional lecture-based teaching on dental students' academic performance. The study included fifty third-year dental students, divided into two groups: one using the Jigsaw method and the other following lecture-based learning. Both groups were pre-tested on their knowledge of "adhesion and bonding agents in dentistry," and then taught using their respective methods for three weeks before being post-tested. A retention test followed three weeks later. The Jigsaw group had higher mean post-test scores and significantly better retention test scores compared to the lecture-based group. This suggests that the Jigsaw method enhances long-term knowledge retention better than traditional lectures. Additionally, the failure rate decreased more in the Jigsaw group from pretest to post-test, indicating that this method may be more effective in reducing failure rates (12).

Moreover, the study by Dnyanesh et al., (2022) explores the effectiveness of the jigsaw technique as an innovative teaching strategy in anatomy. The primary objectives were to motivate students for self-directed learning and enhance their communication skills, with a specific focus on cooperative education. Feedback from the students indicated that the jigsaw sessions were more engaging than traditional lectures, and a surprise MCQ test revealed that the study group outperformed the control group (13). This method, originally designed by Elliot Aronson, emphasizes positive interdependence, team formation, accountability, social skills, and structured learning (14). The results demonstrated that the jigsaw technique significantly improved understanding and retention of anatomical concepts, making it a valuable addition to traditional teaching methods. Faculty members observed that students were more enthusiastic, confident, and engaged in their learning. The study concludes that incorporating interactive and cooperative learning methods like the jigsaw technique can enhance educational outcomes by fostering deeper understanding, better communication, and critical thinking skills among students (13)

The findings from Chopra et al., (2023) support the positive impact of the Jigsaw method observed in this study. Both studies emphasize the Jigsaw method's role in enhancing communication skills, as evidenced by 81% of students in the referenced study and the high levels of agreement in this study (15). Additionally, the Chopra et al., (2023) study highlights that 75% of students felt the Jigsaw method helped them overcome shyness and hesitation, which aligns with the adaptability findings in this study. Faculty feedback further corroborates the benefits of the Jigsaw method, similar to the positive outcomes reported by participants in this study regarding improved teaching skills and analytical abilities

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Conclusion:

The Jigsaw method significantly improves **clinical diagnostic skills** in final-year dental students. Integrating this approach into the curriculum can enhance **critical thinking, teamwork, and diagnostic reasoning**, leading to better patient care outcomes.

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