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Comparative study of the effect of two small group discussion teaching methods (Tutorial vs Jigsaw) on academic motivation and achievement of undergraduate dental students – a preliminary study

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Abstract

Background Academic Motivation forces students to work harder to achieve their educational goals and increases their academic achievement. Teaching methodologies are one of the ways to cater learning needs of students and improve academic motivation. However, there is a paucity of literature comparing the two small group discussion methods for their effect on academic motivation and the academic achievement. This study aims to analyze which small group discussion teaching method (between jigsaw and tutorial) is more effective in improving the academic motivation and achievement of undergraduate dental students. .

Methods This experimental study was conducted at Shifa College of Dentistry, randomly sampling the BDS 1st year students into two teaching groups (Jigsaw and Tutorial). Three teaching sessions were conducted within the module to teach the same topics to both groups. Multiple Choice Questions and a shorter version of the Academic Motivation Scale were administered to both groups before and after the intervention, to compare differences in scores. Data was analyzed using SPSS-26.

Results The data of 46 students was included in the study (22 students in the Tutorial Group and 24 in the Jigsaw group). The mean pre-test scores of the academic achievement test for the control (tutorial) group was 16.86 ± 2.997 and for the experimental (jigsaw) group was 16.58 ± 3.296 (p-value=0.765). The mean post-test scores were 17.32 ± 3.859 and 19.50 ± 3.162 for the control and experimental group respectively (p-value=0.041). The control group and the experimental group had mean academic motivation scores of 56.05 ± 15.32 and 59.83 ± 10.09 respectively, before the intervention (p-value=0.324). Post intervention, the two groups had mean academic motivation scores of 57.66 ± 11.87(control group) and 72.17 ± 12.42 (experimental group). There was a statistically significant difference in the mean scores on the academic motivation scale (p value=0.000) between the two groups after intervention.

Conclusion The jigsaw method is more effective in improving academic motivation and achievement of undergraduate dental students.

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Keywords Jigsaw method, Tutorials in medical education, Academic motivation in medical education, Academic achievement in medical education, Active teaching & learning method in undergraduate dentistry

Introduction

Academic motivation proved successful in helping medical students attain their educational goals and was linked to their educational development by adapting deep study strategies and higher study effort [1]. Therefore, by increasing the academic motivation of students, their learning experience and academic achievement can be enhanced [2, 3].

One way to foster motivation and advance learning is through the use of appropriate teaching methodology [4] that besides contributing to productive learning, must foster academic motivation in students [5]. Effective teaching strategies are essential for influencing students'attitudes and knowledge of health information, which in turn affects their ability to use this knowledge in real-world contexts [6]. Teachers must have a comprehensive understanding of the knowledge, individual requirements of their students, and the philosophical underpinnings of dental education to create instructional methods that cater to those needs with a particular focus on fostering motivation [6, 7].

Teacher-centered classrooms are still most popular and widely practiced teaching methodology in medical education around the world [8] and also in most Asian countries [9] as they are feasible to teach more content to a larger group of students in a short time but here students receive knowledge passively and end up memorizing it [10]. Students get limited opportunities to work together as a team and to take ownership of their learning [11]. Medical teachers have expressed growing concern that traditional practices of instructing medical students do not encourage a lifelong learning attitude in students [12].

As education continually evolves, particularly in medical fields, a shift towards active learning methodologies focusing on engaging students in higher-order cognitive tasks has become a cornerstone in medical education reforms [13]. Notably, the active learning methods not only enhance motivation but also contribute to improved attitudes toward learning [7]. Collaborative and cooperative learning are essential components of medical education, as they prepare future healthcare professionals to work effectively in inter-professional teams [14]. It is an effective method that promotes self-directed learning, teamwork, communication skills, and collaborative group work to enhance learning outcomes. In the field of health education, it is very important to be able to comprehend and value the opinions of others [15].

The widely used active teaching methods in medical and dental colleges is small group discussions [16]. Studies have shown that retention in knowledge and increased comprehension of topics via group discussions are related to increased students'satisfaction and motivation to learn [7, 10].

Small group discussions in the format of tutorials have been stated to be effective teaching methods in the basic sciences subjects [17]. Although the literature identifies certain important benefits of tutorials as a teaching method, such as adaptability to facilitate learners of various learning styles [16], reducing students anxiety that they may face in large groups [12] but the limitations, such as deficiencies in structural uniformity, increase in cost, limited resources for teaching in small groups, one student dominating the rest of group discussion [18] and the deficiency of highly trained tutors make it difficult to conduct effective tutorial sessions [17, 19]. The student-to-tutor ratio is not optimal, and some of the tutors do not meet the guidance qualifications [20]. These situations lead the tutorials to devolve into another set of didactic lectures with little student participation and an enormous amount of variability in the way different tutors conduct them [21]. In such tutorial sessions, students attend sessions passively and have a limited opportunity to voice their opinions and improve their learning [22]. Given the observed inefficacy of tutorial sessions in terms of student satisfaction, participation, and resource requirements, there is a need to investigate alternative active learning methods that require fewer resources, such as the Jigsaw method [16].

The Jigsaw method emerges as an encouraging solution, fostering a culture of teamwork and equal participation [19]. Each member's contribution is valued, promoting collaboration and enhancing learning outcomes [23]. The collaborative nature of the Jigsaw Method is especially well-suited to the complexity of health profession education, which frequently necessitates an understanding of complicated and multifaceted issues [19] and relationships among these various health issues [24]. This method emphasizes cooperative learning, where students work in groups to master content and teach each other and to achieve a common goal (11,25–27), as the Social Development Theory of Lev Vygotsky is fundamental to the theoretical underpinnings of the Jigsaw Method [25]. Its unique

structure fosters a deep understanding of the material, critical thinking, and empathy among students [26], increased memory retention and a deeper knowledge of the concepts, which is beneficial to health professionals [11, 27] leading to enhanced academic achievement [24, 26] and encourages them to become lifelong learners [19, 28, 29].

Existing literature also supports the stimulating impact of the Jigsaw method on academic motivation and academic achievement [30]. However, there is a scarcity of available literature comparing the impact of two small-group teaching methods of teaching – Jigsaw and tutorial – on academic motivation and achievement [31]. To the best of our knowledge no study held to compare effect of these two strategies for basic dental sciences at undergraduate level. Exploration in this direction is crucial for informed decision-making and effective pedagogical practices. This study was aimed to evaluate the comparative effect of two small-group teaching methods, the Jigsaw method, and traditional tutorials, as an adjunct teaching tool to lectures, on academic motivation and achievement and help teachers choose the more efficient and effective method to provide a better learning experience for the students.

Methodology

Setting & participants

An experimental study with pre-test and post-test design was conducted at Shifa College of Dentistry for the module of Head & Neck. The sample size was all the students enrolled in BDS 1st year during the year 2023, at Shifa College of Dentistry. Out of the 48 students who enrolled in this study, the data of 46 students was included in the study according to inclusion/exclusion criteria. The inclusion criteria was **s**tudents of first-year BDS who have attended all the study sessions and completed the questionnaire, feedback from, and academic achievement tests. Whereas, the detained students from the last academic session along with those, not willing to participate in the study were excluded.

Ethical approval

The study commenced after obtaining ethical approval from the Institutional Ethics Review Board, Shifa College of Dentistry, Islamabad (Ref# STMU/SCD/Exp/PF323), and the Ethical Review Committee, Aga Khan University, Karachi (ERC# 2023-8744-26574 dated 21.09.23).

The students were assured that their participation was entirely voluntary and informed of their rights as research subjects. For those who agreed to participate, written informed consent was obtained. Those students who did not consent to participate in the study were taught by either method within the group they were allocated but their scores were not included in study data. The scores of the students were recorded for the study only and not included in any other academic record.

Instrument/Tool for data collection

A. Assessment of Academic Motivation:

The survey form used consisted of Biographic Data (e.g.; age and gender) and a pre-validated shorter version of academic motivation scale (SAMS) was administered at the start and end of the study to compare the difference in motivation level scores before and after the intervention.

The shorter version of the academic motivation scale used for this study was developed by Kotera et al., 2023 [32] (r =.61 to.85). The scale consisted of 14 items. It measures academic motivation across three domains of extrinsic motivation, intrinsic motivation, and amotivation. The responses on the scale were recorded at 7-point Likert scale (from 7=Corresponds exactly to 1=Does not correspond at all).

B. A test of Academic Achievement:

The academic achievement criterion in this study was the students' scores on an academic test, comprising 30 Multiple Choice Questions (MCQs) to assess the cognitive domain. The MCQs were developed by two subject specialists (Oral Biology) according to the weightage of the topics in the already available blueprint of the Head & Neck Module. The test was reviewed by the content specialist from Oral Biology and one from the Medical Education Department to ensure the content and face validity of the test. The same test was given as a pre and post-test.

C. End-of-session feedback/evaluation form

This evaluation form was developed by the Department of Medical and Dental Education at Shifa College of Dentistry and is administered at the end of every small group session routinely. The form consists of 7 questions which were responded on 5-point Likert scale (1=Strongly Disagree- 5=Strongly Agree). This form was administered at the end of study.

Sensitization of faculty and students

A workshop was conducted before the commencement of the study to orient the teachers/facilitators of the Oral Biology Department with the concept of jigsaw method and to train them in conducting it effectively.

The students were also explained about the purpose of the study and its benefits by the investigator before the commencement of the study, during the orientation session of the jigsaw method. The investigator also

explained the survey questionnaire and consent form to the students.

Piloting tool

A pilot study was done on 5 students of 2nd year BDS to evaluate the understanding of the students about study tool (Shorter version of the academic motivation scale **(SAMS)**. Pilot was done to assess the feasibility of our study, in terms of clarity and understandability of the items in the Questionnaire and ease & amount of time spend in filling it out. The students gave positive feedback, indicating that they were able to comprehend all the items in the questionnaire.

Data collection procedure

Students were randomly divided into two equal groups using the lottery method, the Control Group (to be taught by tutorial method), and the Experimental Group (to be taught by Jigsaw method).

In the tutorial teaching method, the students are provided with learning objectives and resources for the specific topic three days before the small group session. They study that whole topic independently and later participate in small group discussions about that topic. Where usually facilitator asks the questions and students answer them. Whereas in the jigsaw method of small group discussion, the small group of students are divided into subgroups and assigned a portion of the topic to prepare (in contrast to the whole topic as in the tutorial) which they later discuss/teach their peers in small group discussion. As every member of the subgroup has different content to prepare about that topic, so every student participates in the discussion and learns from one another. Facilitator here just supervises and facilitate the session as needed.

Three topics were identified from the BDS 1st year Oral Biology curriculum to be used in the study for assessing learning in both the intervention and control groups. The topics included the development of the face, Temporomandibular Joint, and Periodontium. The learning objectives, learning material, and resources were prepared in the form of PDF files and PowerPoint slides, which were approved by 2 subject specialists in Oral Biology, containing clear information in bullet point format with textbook references. The learning material and learning objectives of the study session were uploaded in the google classroom after the orientation session and made available to the whole class (both groups studied the same content). The students in both groups were given one week time to read and prepare handouts on the topics allotted to them. Both the groups were provided equal time slot in the timetable to learn the topic via specified small group discussion method.

Before starting the intervention, both groups were administered a pre-test to assess their baseline knowledge and were asked to fill in an academic motivation questionnaire to record scores on SAMS before intervention.

The Control Group was taught by Small Group Discussion -Tutorial Method.

All the students in the group were provided with the learning content and objectives and were asked to come prepared with the topic for discussion in the tutorial session as it's the usual practice at our institute. Each student had to prepare the whole content individually for the tutorial session. They were asked by the facilitator to start discussing the content required to achieve the learning objectives with their group members. The session comprised of students working as one whole group of 25 students. The facilitator asked the questions and directed the group discussion along with explaining the content that students did not discuss due to lack of preparation. The main interaction was between the facilitator and the students. The session continued till all the intended learning objectives were achieved by discussion. Post-test was then administered to assess knowledge, and an academic motivation scale to record motivation scores after intervention.

The Experimental Group was taught by the Small Group Discussion Jigsaw Method.

To achieve learning objectives, the jigsaw technique uses a planned step-by-step linear process [27]. For the jigsaw activity, students of this group were further divided into five "Home/Jigsaw groups" denoted by Alphabets (a, b, c, d & e) comprising five students in each group. Each member of the home/jigsaw group was allocated a specific learning objective/content to prepare for the session. This makes each member an expert (Denoted by 1, 2, 3, 4, and 5) of that portion of content in their respective home/Jigsaw groups [23].

On the day of the learning activity, the students with the same learning material i.e.; members in the expert group (a1, b1, c1, d1 & e1), discussed the main learning points with each other during the initial 20 minutes of class time. One facilitator was present in the room to monitor the process of jigsaw teaching by these subgroups. The facilitator just supervised the whole session and provided guidance and facilitation to the students where needed.

In the second half of the session (40 minutes), students were regrouped into home groups (a, b, c, d & e) such that each home group had one member from every expert group who had prepared a different part of the puzzle (topic/learning content) [33] (Figure 1). Each student taught his peers the part they had prepared, so in this way, the whole group was able to learn the entire

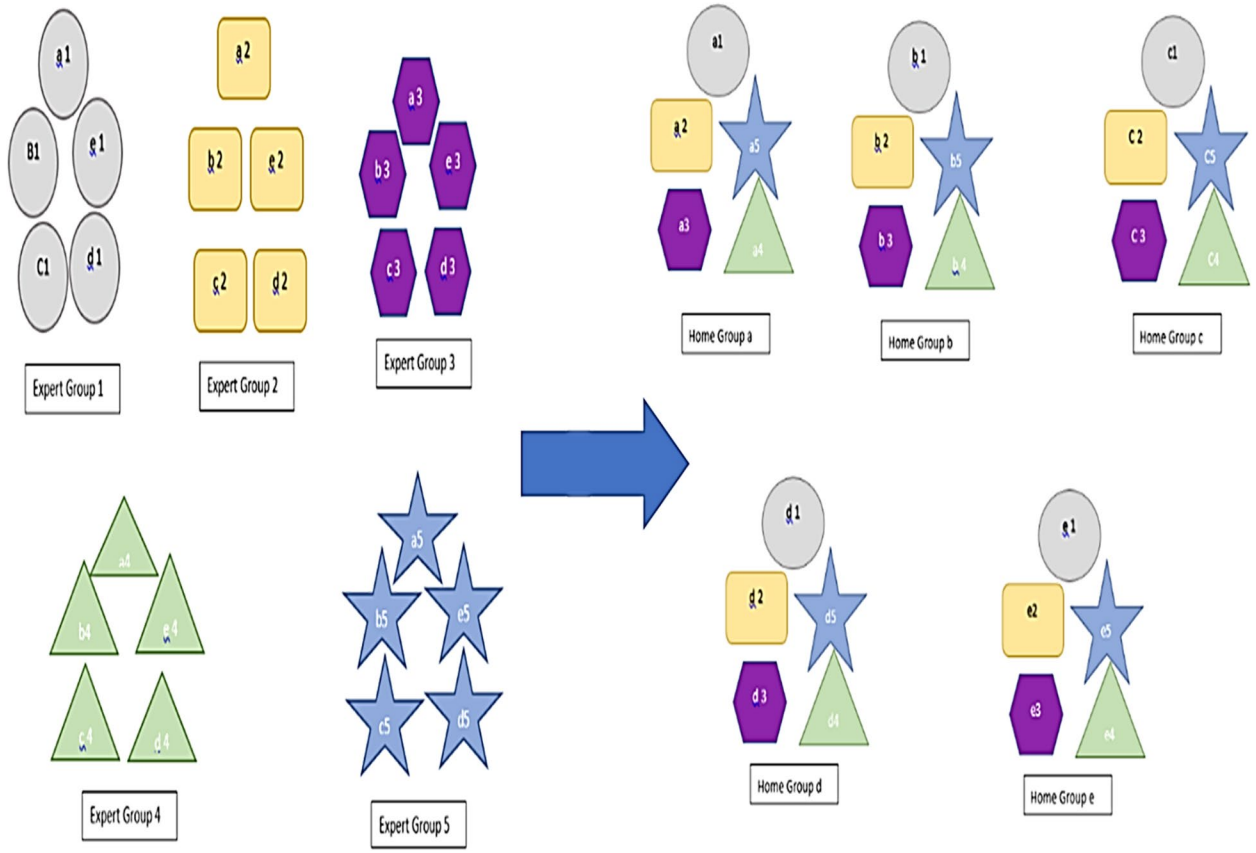


Fig. 1 Expert groups & home groups of jigsaw activity

topic with the help of peers in the group. Later after the completion of this task, all members of the experimental group assembled in one classroom to discuss all the problems that complete the jigsaw puzzle. Post-test was then administered to assess cognitive knowledge followed by filling out an academic motivation scale by the students in the jigsaw group.

A total of 3 study sessions were conducted across the module to teach Control Group via tutorial and Experimental Group via the Jigsaw method. The feedback form was filled out by the students at the end of the session to evaluate their respective teaching methodology sessions (Tutorial method for Control group and Jigsaw method for experimental group).

The crossover of the same topics was done in the next sessions for ethical purposes in order to reduce biasness, by providing an equal opportunity to maximize learning experience to all the students. The data of cross-over was not included in the study.

Data analysis

The Statistical Package for Social Sciences (SPSS) version 26 was used to analyze the data. Categorical data was presented in frequency and percentage, whereas; mean and standard deviation were calculated for continuous data. The Shapiro-Wilk test was applied to check the normal distribution of data, which was found to be normally distributed. The paired sample t-test was used to analyze the difference in the mean scores within the group before and after intervention. This was done for both groups for scores of academic achievement test and academic motivation scale. The independent t-test was applied to compare the difference in mean scores of the academic achievement test and academic motivation scale in both groups, before and after intervention [34]. The confidence interval of 95% with a 0.05 level of significance level. The item 13 and 14 in the academic motivation scale were reverse coded as these were negatively worded items [35].

Results

A total of 48 students consented to participate in this study. According to the exclusion criteria, after eliminating the incomplete responses or absence in any of the 3 study sessions, data from 46 students was

Table 1 Gender distribution in Both Groups (*n*=46)

Gender	Jigsaw Group % (n)	Tutorial Group % (n)	Total
Female	70.84% (17)	90.90% (20)	80.43 %(37)
Male	29.16% (7)	9.09% (2)	19.57% (9)

Table 2 Comparison of Pre-test and Post-test scores Means on Academic Achievement Test within the Groups (paired t-test)

Group (n=46)	Variable	Mean	SD	P-value
Jigsaw (n=24)	Pre-Test Scores	16.58	3.296	0.003*
	Post-Test Scores	19.50	3.162	
Tutorial (n=22)	Pre-Test Scores	16.86	2.997	0.647
	Post-Test Scores	17.32	3.859	

* Significant (p-value = < 0.05)

Table 3 Comparison of Pre-test and Post-test scores Means of Groups on Academic Achievement Test (Independent t-test)

Variable	Group	Mean	SD	P-value
Pre-Test Scores	Tutorial	16.86	2.997	0.765
	Jigsaw	16.58	3.296	
Post-Test Scores	Tutorial	17.32	3.859	0.041*
	Jigsaw	19.50	3.162	

* Significant

included in the study (22 students in the group taught by the Tutorial method and 24 in the Jigsaw group).

Demographics

The gender distribution of participants in the study was found to be 19.57% [9] male and 80.43% [37] female, as shown in Table 1. The mean age of the study participants was found to be 19.52 ± 0.983 years.

Academic achievement

The scores obtained by the students on the MCQ test were analyzed to evaluate the academic achievement of the students in both groups. The mean pre-test score of the Control (Tutorial) group was 16.86 ± 2.997 and the mean pre-test score of the experimental (jigsaw) group was 16.58 ± 3.296. The mean post-test scores of the two groups were 17.32 ± 3.859 and 19.50 ± 3.162 for the control and experimental group respectively.

The paired t-test was applied to determine difference in mean score in a group before and after intervention. The result of analysis revealed a statistically significant difference in the mean scores of pretest and posttest for experimental (Jigsaw) group (Table 2).

Table 4 Comparison of Pre-intervention Means of Groups on Academic Motivation

Variable	Group (n)	Mean ± Standard Deviation	P-value
Academic Motivation scores	Jigsaw [24]	59.83 ± 10.09	0.324
	Tutorial [22]	56.05 ± 15.32	

Table 5 Comparison of Academic Motivation Post-intervention Mean Scores between the Groups

Variable	Group	n	Mean ± Standard Deviation	P-value
Academic Motivation Scores	Jigsaw	24	72.17 ± 12.42	0.000*
	Tutorial	22	57.66 ± 11.87	

* Significant

Independent sample t test was applied to determine the difference in the mean scores in the pretest and posttest of the students of both groups before and after intervention. Results showed a significant statistical difference between the post-test scores of the two groups (after the intervention) (Table 3).

Academic motivation

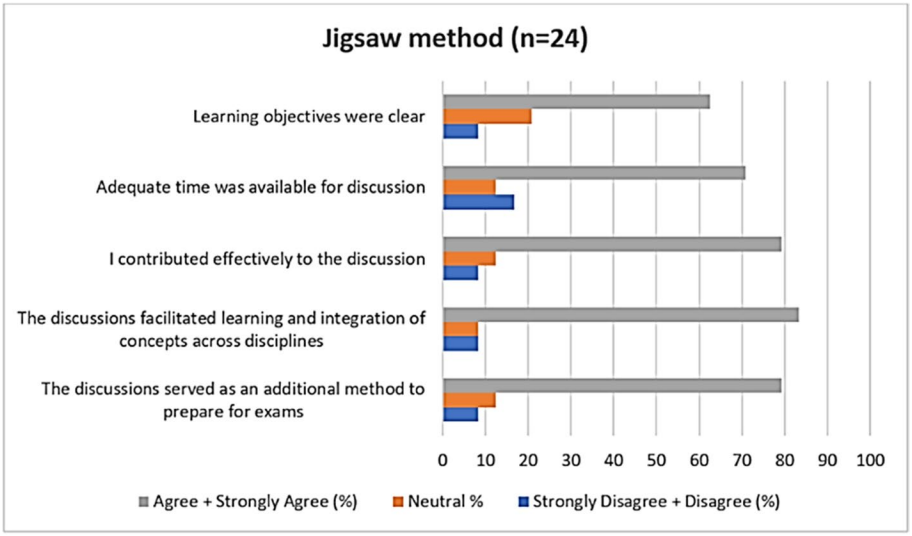
The control (tutorial) group and the experimental (jigsaw) group had mean academic motivation scores of 56.05 ± 15.32 and 59.83 ± 10.09 respectively, before the intervention. After the intervention, the two groups had mean academic motivation scores of 57.66 ± 11.87 and 72.17 ± 12.42. Independent t-test revealed no significant statistical difference between the two groups'ratings on academic motivation before the intervention (Table 4). This demonstrates that the participants of study in both groups contains homogenous characteristics, making them ideal to be included in the study.

However, the difference between the mean post-test scores of the Jigsaw and Tutorial groups was statistically significant, when independent t-test was applied to determine the difference in mean scores between two groups after intervention (Table 5).

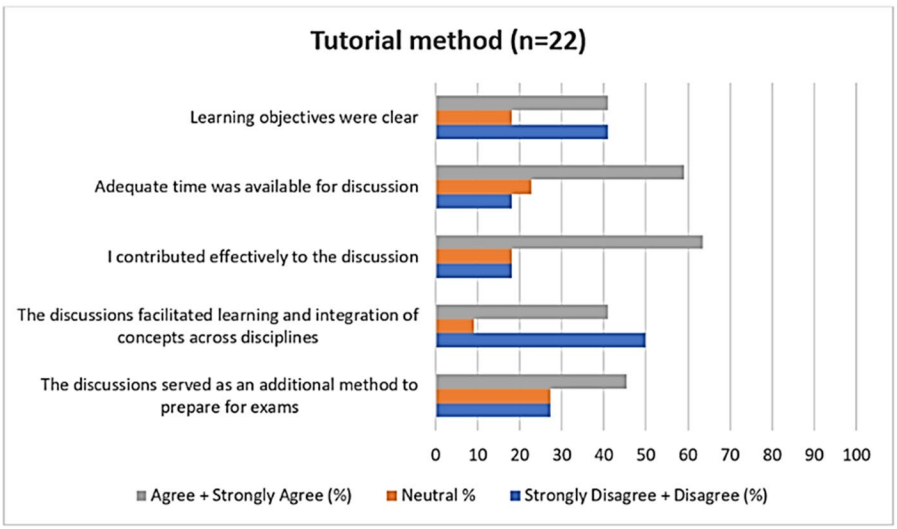
These results show that motivation of the students was influenced positively when taught by the jigsaw method.

Student's feedback of the session

At the end of the study, the participants in both groups were asked to fill out the session evaluation form (consisting of 7 questions with responses on a 5-point Likert scale) about their respective small group teaching



a: Student responses on the feedback questionnaire, regarding jigsaw method



b: Student responses on the feedback questionnaire, regarding tutorial method.

Fig. 2 Student responses on the feedback questionnaire, regarding jigsaw method. Student responses on the feedback questionnaire, regarding tutorial method

methods. The result of responses are plotted below (Fig. 2a & b).

Some responses of students to open-ended questions about Jigsaw teaching, in the result analysis were:

> *"The jigsaw method is more manageable and effective", "Preparation for jigsaw method was less stressful", "More Jigsaw method should be used in SGDs", and "Jigsaw is a new method which only works if other group members study well."*

The majority of students were perceptive about the new method, expressed positive attitude and satisfaction regarding jigsaw technique.

Discussion

This study was conducted to appraise the effect of two small-group discussion teaching methods (jigsaw and tutorials) on the academic achievement and motivation of undergraduate students.

The result of this study has shown a significant difference in the mean post-test scores of the experimental and control groups with the experimental group scoring higher than the control group. Upon comparing the pre-test and post-test scores of each group, it was found that there was a gain in knowledge and learning in both groups. However, statistically significant improvement was observed with the scores of the group taught using the Jigsaw method.

The current findings are similar to the Indian studies [31, 36] where a significant improvement in postest scores was found when undergraduate medical students were taught by jigsaw method. Similar findings were reported by Abobaker [37], where they reported a significant increase in the scores of jigsaw method group as compared to the traditional teaching method after the intervention for undergraduate nursing course. The meta-analysis reported the similar effect of jigsaw teaching method for improving academic achievement in undergraduate students in multiple disciplines such as medicine, public health and nursing education [24] by enhancing academic motivation and knowledge retention [38]. The Jigsaw method holds the students accountable individually and compels them to actively interact with their colleagues [36] thus increasing the knowledge gain, confidence, and motivation of students. On the contrary, Sagsoz et al, [23] and Rehamn et al., [39] did not find a significant difference between the pretest or post-test scores among undergraduate dental students and undergraduate nursing students taught by Jigsaw and lecture-based methods. The cause of the ineffectiveness of the teaching method may be a lack of familiarity of teachers with the innovative method, which can be addressed by providing training sessions to the teacher [38]. The difference between the mean academic motivation scores of the pre-test in both groups was not statistically significant implying that the students in both groups demonstrated homogeneous characteristics and therefore were appropriate for the present study. However, statistical analysis showed improvement in mean scores of both groups after intervention and there was statistically significant difference in post intervention mean score on academic motivation scale between two groups. These results are in congruence with the research conducted by Sanaie et al, [40] who cited improved motivation in the group of undergraduate nursing students exposed to jigsaw teaching, same as concluded by Indian studies [41] and a meta–analysis [24].In the current study, male participants scored slightly higher on the academic motivation scale than female participants. These results are endorsed by the study of Wu et al., [42], but contrary to the study results by Kusukar [1], which suggested an increased level of motivation among female medical students. This difference in result of our study from the Kusurkar's study might be due to the cultural expectation of gender roles in the society where males have the responsibility of managing the family, so they are more career progressive and females anticipate workplace discrimination [42].

In our study, most 75% of the students reported that the jigsaw method has enhanced their knowledge and understanding of the concepts taught. These results agree with other studies [19, 28, 29], which inferred that increased interest and engagement of the undergraduate medical students in the jigsaw method led to their improved motivation and satisfaction.

In this study, students reported the jigsaw method as an effective and less stressful teaching method. The research done by Abobaker [37] for undergraduate nursing students, also endorsed that the jigsaw method inspires students to acquire progressive attitudes and knowledge, lessens the level of stress, and boosts self-confidence and pleasure because of its creative and teamwork-focused method.

Haghighat and colleagues [43], however, could not discover any significant difference between lecture and jigsaw groups concerning nursing students' preference and satisfaction, which could be due to several factors, such as the educational material, the standard of the facilities and tools used for instruction, the questionnaire that was used, and the recipients, which may have had an impact on the study's findings [5].

A large number of participants (70.83%) in the jigsaw group stated that they had adequate time available for discussion and 62.5% of the students in the jigsaw group reported being able to contribute effectively to the discussion. It has been reported that students find the jigsaw method less daunting because they have a set period of time to prepare independently before having a discussion, and rather than preparing the whole topic they can focus and prepare subtopics very well [44].

Most of the participants in this study reported that the Jigsaw sessions stimulated their interest and motivated them to read more about the topic resulting in increased knowledge. This demonstrates how cooperative peer-assisted learning gives students autonomy, lessens their reliance on what their teachers teach them in class, and may even lower student dissatisfaction. Over time, this will help students become self-directed learners at a very early stage [11]. Because of these advantages over other collaborative teaching-learning strategies, the Jigsaw methodology is especially helpful in settings with a restricted number of faculty members and resources because it requires fewer facilitators [41].

In summary, this study identified the improvement in academic achievement and motivation level of the students when taught through jigsaw method. Majority of the students responded positively for teaching by the jigsaw method.

Limitations

This study comprised a small sample size and included only one subject, the results may not be generalizable to the students of other subjects and courses. One limitation of this study is associated with stipulating the results in the theoretical component of basic dental sciences, while it would be more important if dental students' knowledge of clinical science is supplemented to the theoretical component.

This study was a single-blind study as the students knew which methodology they would be using in teaching sessions. The pre-test and post-test were similar so there is a chance of recall bias.

Conclusion

This comparative study offers valuable insights into the impact of Tutorial and Jigsaw methods of teaching on the academic achievement and motivation in undergraduate dental students. The results favor the Jigsaw method, highlighting its effectiveness in fostering motivation and improving academic achievement. These findings provide a foundation for evidence-based decision-making by educators aiming to enhance the learning experience of undergraduate dental students. Our results suggest that Jigsaw teaching being less resource intensive than other novel teaching methods can be used to augment the lectures resulting in a better learning experience and enhanced knowledge and motivation of students.

Future recommendation

This study compares the effect of two small-group learning methodologies on academic motivation and academic achievement, however further studies need to be done to analyze the difference in long-term knowledge retention. This will help to appropriately reveal the significance of the technique. Further research into how intrinsic and extrinsic components of motivation are affected by different teaching methodologies can also be explored.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-025-07244-1.

Supplementary Material 1.

Supplementary Material 2.

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Clinical trial number
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Authors' contributions
A.K.H: Conception of idea, study design, data collection, manuscript writing. S.K.A: Supervisor, concept and study design and review J.R: Co-supervisor, concept and study design, and review manuscript

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Data availability
The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
We obtained approval from the Ethical Review Committee of AKU (2023-8744-26574) and SCD (STMU/SCD/Exp/PF323). Informed consent was obtained from all the participants of the study before the commencement of data collection and the study was conducted according to the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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