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RESEARCH PAPER

Effect of Team-Based Learning on Students' Motivation and Academic Performance in Chemistry at College Level

Faiza Shafqat* [1] **Musarrat Habib**[2]

1. Ph. D. Scholar, Department of Education, The University of Lahore, Lahore, Punjab, Pakistan, baishazoor@gmail.com
2. Assistant Professor, Department of Education, The University of Lahore, Lahore, Punjab, Pakistan, musarrat.javaid@ed.edu.uol.pk

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ABSTRACT

This experimental study was aimed at investigating the effect of team-based learning on the motivation and academic performance of college students studying chemistry course. The objectives of this study were; (i) to investigate the effect of team-based learning on students' motivation in Chemistry class, (ii) to investigate the effect of team-based learning on students' academic performance in Chemistry class, and (iii). to find the relationship between motivation and academic performance of students in Chemistry class. Two instruments were used to collect data: "Chemistry Motivation Questionnaire" (CMQ), and "Chemistry Performance Test" (CPT). The paired sample t-test was used to assess the data. The findings demonstrated a considerable improvement in the students' academic performance and motivation both before and after the intervention, indicating a relationship between these variables. As the motivation of the students increased, their academic performance also increased.

Keywords	Academic Performance, Collaborative Learning, Lecture Method, Students' Motivation, Team-Based Learning (TBL)

Introduction

College and university instructors are putting more and more focus on enhancing student engagement and learning. One teaching strategy that can be used to engage, excite, and motivate students in the learning process is team-based learning. A collaborative learning and teaching technique known as team-based learning (TBL) blends learning in small and large groups by merging several small groups into a big group environment. As an instructional strategy he created for use in academic contexts, such as in medical education, Larry Michaelson, the main player in the development of the TBL method while at the University of Oklahoma in the 1970s, first popularized the phrase and concept. Since then, it has become more and more prevalent in postsecondary and professional education. Team-based learning (TBL) is an effective strategy for teaching chemistry knowledge and skills and reinforcing the knowledge and abilities of students at different levels. The small-group tasks dramatically improve student accountability and teamwork, enabling them to perform to their potential. Group and collaborative tasks have become more common in school settings during the past few decades.

The course's learning objectives are decided by the instructor, who then deliberately arranges the material into modules that address each aim. The modules

are made up of three repeated steps. The pupils are obliged to finish a prior learning assignment that is given to them by the teacher before the learning session (Michaelsen & Sweet, 2008). Ensuring readiness is the focus of the second phase, which contains four aspects. Each student first completes a readiness assessment test (IRAT). In this multiple-choice test, the subjects from the prior learning assignment are assessed. The exam places greater emphasis on factual memory than it does on application. The team then takes the test collectively after each student has finished it separately. The team readiness assurance test is what this is known as (TRAT). Using the immediate feedback assessment technique (IF-AT), the team members work together to refine the responses until each one is accurate. A scratch-off card called the IF-AT has the correct answer for each question. (Nieder et al. 2005; Vasan et al. 2008; Parmelee & Michaelsen 2010, as mentioned in Rania, Rebora & Migliorini, L. 2015). The teams typically perform better than the highest score of any one member. The option to appeal any questions that the students feel are unfair is then given to them in writing. Each issue is taken into account by the instructor. In the final step, the instructor explains any lingering questions regarding the subject (Michaelsen & Sweet, 2008).

In the third step of the procedure, the students collaborate in the same teams to find answers to problems that are based on the material they have already studied. They're called application exercises. The challenges are designed to have the following characteristics: they are the same for each group, they are significant to the learners, the groups must select one option as the best solution (much as in a multiple-choice question), and the results are provided by each group simultaneously. The problems can be solved in a variety of ways, which makes it possible to argue over the best strategy. The teams then debate in favour of their approach over that of the rival teams. The teacher facilitates group conversations. The group assessments are an essential component of TBL. Team members occasionally offer feedback to the other members of the group on the team's performance throughout the course.

Literature Review

Team-based learning is defined as "learning from failures, gaining knowledge and skills, and coming up with new ideas to solve problems in order to improve work method and performance" (Schipper et al, 2013). Team-based learning has been developed and presented as both a teaching strategy and an original educational approach to: 1) Encourage the development of high-performing learning teams so that their unique abilities can be utilised; and 2) Provide teams with the opportunity to participate in relevant learning activities (Michelsen et al, 2002). Two characteristics that are typical of these groups that are advantageous to a learning environment are: Learning teams are able to address problems that even the most gifted individual cannot handle because team members are committed to their work and give it their all (Mohammad-Davoudi & Parpouchia, 2016). Most studies that examined the benefits of TBL found that its effects on students' ability to apply knowledge are generally positive and related to its methodology (Mansoor, Aly, & Javaid, 2019).

When TBL was first created, the goal was to keep the emphasis on applying the concepts gained in the classroom to actual business scenarios. According to empirical studies of TBL, students' test scores, attendance/engagement, retention, attitudes toward group work, contentment with learning experience, and co-regulated learning have all increased (Koles, Stolfi, Borges, Nelson, & Parmelee, 2010). Through preparedness assessment tests, TBL additionally offers opportunities for both individual and team accountability (RATs). Additionally, it promotes a

specific kind of social interaction that raises peer review, assessment, and accountability. TBL also ties reduced social loafing, a concern for most instructors when designing group activities, to increased student accountability. The evaluation of each team member's performance fosters a sense of shared responsibility among the pupils. Although it is typical for students to be reluctant to assess and evaluate their peers at first, TBL research has shown that these barriers may be overcome when instructors discuss peer evaluation with students and work with them to make the process relevant for them (Cestone, et al., 2008; Hye-Jung & Cheolil, 2012; Wat son, BarNir, & Pavur, 2010).

TBL enhances academic performance and boosts attendance regardless of the student body. However, the advantages are more pronounced in groups of students who are repeating a course as opposed to those who are enrolling for the first time. Additionally, TBL encourages ongoing, self-directed learning, improves the learning environment in the classroom, and encourages collaboration, group projects, and interactions among many students. Additionally, every student grows much more aware of their capacity for learning and rate of knowledge expansion. According to Ruder, Maier, and Simkins (2021), the framework design and the TBL approach's highly organized components cooperate to encourage pre-class preparation and in-class involvement. Based on the aforementioned evidence, the TBL technique is said to be a great fit for this field because it helps students acquire higher-order learning and analytical skills.

Michaelsen & Sweet (2008) defined team-based learning (TBL) as giving the students the chance to apply conceptual knowledge through a series of activities that incorporate individual effort, group work, and quick feedback. It places a major emphasis on the learner and exposes students to the kind of obstacles that will occur during their learning process. Additionally, it encourages the growth of expertise in teamwork, collaboration, and peer review. It has a good track record of boosting academic accomplishments, and more and more data is pointing to its academic utility.

Motivating oneself to study is among the most crucial elements of team-based learning. Learning should be primarily seen as an ongoing flow that is started by an interest or motivational flame and never ends. Motivation is the process of fostering and upholding purpose-driven behavior (Najmi, 2009). According to Christenson, Reschly, & Wylie, (2012) students' participation in their education can be viewed as their action, and their goal as their motivation. Theoretically, motivation influences students' motivation directly, and motivation influences students' performance and learning directly (Jones, 2015). Furthermore, fostering children's intrinsic motivation can make them more eager to learn science, math, and other topics in the future. As a result, it is critical to understand how students in the current study are motivated to learn as well as how different motivational elements relate to the desired learning processes and outcomes. According to Taimoory, knight & Hori, (2021) if the classroom environment did not encourage academic desire in the students, merely arranging them in groups would not result in the development of those abilities.

Challenges of Team-based Learning

Poorly executed group work can be challenging for both students and teachers (Bravo, 2019; Davies, 2009), particularly in terms of participant motivation. "Social loafing" and "free riding," which refer to individuals of a group who do not participate in or contribute to group efforts, are examples of motivational issues. Some highly motivated team members successfully encourage their less motivated teammates to

join in and contribute to team tasks by planning and coordinating activities as stated by Andrews & Rapp, (2014). The highly competent student, however, refuses to rely on or accept information from those person or persons when paired with team members who are thought to be less capable. Managing the social aspects of small group learning can be challenging (Curseu et al., 2019). Asserting their will on the group or dominating talks are just a few of the ways that students with dominating personalities may behave. Students who have been purposefully excluded from groups or treated disrespectfully for their efforts by other students may withdraw or feel humiliated as a result.

Hypotheses of the Study

In this experimental research, the following null hypotheses were tested:

$H_0$1: There is no significant effect of Team-Based Learning technique on students' motivation in chemistry class.

$H_0$2: There is no significant effect of Team-Based Learning technique on students' academic performance in chemistry class.

$H_0$3: There is a significant relationship between students' motivation and academic performance in Chemistry class.

Material and Methods

The positivist research paradigm was followed in this quantitative and experimental study. Following the positivist research paradigm, the deductive technique was used in this study to measure the effect of team based learning on the motivation and academic performance of chemistry students in district, Lahore.

Research Design

This study was experimental in nature, and quasi-experimental one group pretest-posttest design was implemented to collect students' data. Team based learning was the independent variable while student's motivation and academic performance were the dependent variables.

Population

The population of this study was all the male students studying Chemistry in public colleges at intermediate level in district, Lahore, being enrolled in the session 2021-2022.

Sample

For present study, an intact group of 25 students (boys) studying Chemistry class at the intermediate level in a semi-autonomous college in district Lahore was selected through convenience sampling. The age range of the sample was between 16 to 20 years old. As the students in this research study were already intact and could not be separated nor adjusted, therefore, the entire group was used to represent the large population of students studying in this subject.

Research Instruments

For this study purpose, two instruments were used; the first instrument was the "Chemistry Motivation Questionnaire" (CMQ), the adapted form of the Science

Motivation Questionnaire (SMQ) developed by Glynn & Koballa (2006) to measure students' motivation to learn Chemistry, and the second instrument was the "Chemistry Performance Test" (CPT) to determine the effect of the intervention strategy on students.

Instrument-1: Chemistry Motivation Questionnaire (CMQ)

The 30-item Science Motivation Questionnaire (SMQ) is a 5-point Likert type scale ranging from 1 (never) to 5 (always). For this study, the Science Motivation Questionnaire (SMQ) was substituted with the word "Chemistry," making it a Chemistry Motivation Questionnaire (CMQ). It was administered before and after the intervention of this experiment to measure the motivation of students for Chemistry learning and keeping in view the lack of proficiency in English language of Pakistani public college students, this questionnaire was translated into Urdu language which is the native language of this country.

Instrument-2: Chemistry Performance Test (CPT)

The Chemistry Performance Tests (CPT) was designed by the researcher herself to measure the academic performance of students. The pre-test consisted of 20 multiple-choice objective questions, with four options and one correct option from the units taught. Likewise, the posttest consisted of 20 multiple-choice objective questions, each with four options and one correct option. All of these tests (pretests & posttests) were constructed using table of specification and unit wise SLOs covering the six levels of Bloom's taxonomy of educational objectives.

Pilot Study

Pilot study was done on a sample of 70 students from a semi-autonomous girls' college in district Lahore to ensure the validity and reliability of these instruments and seeking expert opinions from the expert teachers and researchers. The researcher also conducted item analysis, item discrimination, difficulty levels and uniformity before conducting these tests in the experimental settings. The construct validity of the motivation questionnaire was measured through factor analysis.

Intervention

This experiment lasted for 04 weeks to study the effect of team based learning on students' motivation and academic performance of college students in chemistry subject. The students had to go through a three-step cycle: pre-class preparation, readiness assurance process (RAP), and application-focused exercises. They had to prepare the material before the class and when the class began, they had to take Individual Readiness Assurance Test of 10 multiple choice questions. Then the students were divided into 5 permanent heterogeneous groups with alphabets (A-E). After forming the groups, each group had to take the same test as that of IRAT called the Team Readiness Assurance Test (TRAT). The students' responses were found through scratch cards. After announcing the results of both IRATs and TRATs, the students were asked to write appeals on the templates provided if they had any objection about the scores. Then a short mini-lecture was delivered by the teacher bringing classroom discussion on the difficult topics. Students' prior knowledge was also assessed in the form of pretest. After implementing the activities of this technique, posttest was administered to see the performance of students in the units taught.

Data Collection

To measure the motivation of students in chemistry course, Chemistry Motivation Questionnaire (CMQ) was conducted once in the initial phase before conducting the intervention and then again after conducting the intervention. And the academic performance was measured through pretest and posttest for the units taught.

Data Analysis

In this study, to find the effect of team-based learning on students' motivation and academic performance, paired sample t-test was used. Moreover, to find the strength and direction of association that exists between the two variables; motivation and academic performance of students, Pearson product-moment correlation coefficient was used.

Ethical Considerations

Before the intervention, proper permission was taken from the administration of the college to conduct the intervention for a specific period of time. The research participants were free to choose to participate without any pressure or coercion. They were allowed to withdraw from or leave the study at any point without feeling an obligation to continue. The participants were provided with relevant information about the study, its duration, and the risks and benefits of taking part in it. The students' personal data was protected as long as for the purpose of this study. The results of this research study were also communicated transparently and honestly to avoid misconduct wherever possible.

Results and Discussion

H01: There is no significant effect of team-based learning on students' motivation in Chemistry class.

Table 1
Paired Sample T-test for mean difference of the students' motivation scores

		Paired Differences					t	df	Sig. (2-tailed)	Cohen's d
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper				
Pair 1	Motivation Before - Motivation After	-11.88000	6.11910	1.22382	-14.40584	-9.35416	-9.707	24	.000	1.86

A paired sample t-test was conducted to find the effect of team-based learning on motivation of students. The results showed a significant increase in the motivation of students Before (M = 116.80, SD = 6.17) to After (M = 128.68, SD = 6.60), t (24) = -9.70. The mean increase in the motivation scores was 11.88 with a 95 % confidence interval ranging from -14.40 to -9.35. The p- value of the mean differences was p = .000 (2-tailed) smaller than p < .05. The value of Cohen's d was 1.86 (> 0.80) which indicated a large effect size. Thus the null hypothesis was rejected because there was a statistically significant difference in the motivation scores of students before and after the treatment.

H02: There is no significant effect of Team-Based Learning technique on students' academic performance in chemistry class.

Table 2
Paired Sample T-test for mean difference of the students' academic performance

	Paired Differences								
				95% Confidence Interval of the Difference					
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)	Cohen's d
Pair 1 TBL Pretest - TBL Posttest	-10.72000	2.17025	.43405	-11.61584	-9.82416	-24.698	24	.000	7.45

A paired sample t-test was conducted to find the effect of team-based learning on academic performance of students taught through team based learning technique. The results showed a significant increase in the performance of students Before (M = 7.72, SD = 1.54) to After (M = 18.44, SD = 1.47), t (24) = -24.69. The mean increase in the performance scores was 10.72 with a 95 % confidence interval ranging from -11.61584 to -9.82416. The p- value of the mean differences was p = .000 (2-tailed) smaller than p < .05. The value of Cohen's d was 7.45 (> 0.80) which indicated a large effect size. Thus, the null hypothesis was rejected because there was a significant effect of team based learning technique on students' academic performance in Chemistry class.

H03: There is a significant relationship between students' motivation and academic performance in Chemistry class.

Table 3
Correlations

		TBL	Motivation
TBL	Pearson Correlation	1	.599**
	Sig. (2-tailed)		.002
	N	25	25
Motivation	Pearson Correlation	.599**	1
	Sig. (2-tailed)	.002	
	N	25	25
**. Correlation is significant at the 0.01 level (2-tailed).			

A Pearson product-moment correlation coefficient was computed to assess the linear relationship between students' motivation and academic performance in Chemistry class. There was a strong, positive and significant correlation between the two variables, r = .59, n = 25, p < .01 indicting that the students' academic performance was associated with their motivation in this subject.

Findings

The findings of this study showed that the mean scores of the motivation of students taught through team-based learning were significantly higher (Mean Difference = 11.88, p < .05) than the mean scores of students before the start of the experiment and the mean scores of the academic performance of students taught through team-based learning technique were significantly higher (Mean Difference = 10.72, p < .05) than the mean scores of students before the start of the activity.

Moreover, the results from Pearson correlation revealed a strong, positive and significant relationship between the two variables ($r = .59$, $n = 25$, $p < .01$) indicting that the students' academic performance was associated with their motivation in Chemistry subject.

Discussion

Over 30 years have passed since the TBL technique was created. TBL spread slowly at first, like many innovations, mostly within the business school sector and at the University of Oklahoma, where many of its early proponents were faculty members. However, as educators from other disciplines started to promote TBL and its possible applicability to the changes that many educational contexts were going through in the late 1990s, it started to become more widely accepted. A growing body of scholarly work has emerged as a result of the increased use of TBL. Present study was intended to determine the effect of team-based learning on motivation and academic performance of students studying Chemistry in grade XII. The motivation of the students studying Chemistry course in grade XII was measured through CMQ before and after the intervention. And the performance scores were measured through pretest and posttest. The data obtained was analyzed through paired sample t-test. The results from the analysis showed a positive effect of team-based learning on students' motivation and their performance in chemistry subject. It was also found that students' academic performance is linked to their motivation in chemistry subject.

According to the research, TBL has been very effective at improving students' final grades and significantly raising the motivation and learning performances of low-achieving students (Beaudin et al. 2017; Dolmans et al. 2015); increasing students' engagement and retention (Jeno et al. 2017) and influencing critical thinking, teamwork, and gender diversity (Artz, Jacobs, and Boessen 2016). Liu and Beaujean (2017) did a meta-analysis of TBL, and Sisk (2011) conducted a systematic review research. They all came to the same conclusion that TBL generally resulted in satisfied, more active, and better-graded students than regular individual exams.

TBL exercises are generally regarded as being more challenging, useful, and enjoyable than traditional lectures by most students, who cited them as factors in their improved academic achievement. Student's academic growth may also be a result of the TBL methods, which encourage peer interaction, help students address problems with their peers, boost confidence, and facilitate learning. Aside from that, classroom conversations help students feel less anxious and become more conscious of how they are learning. This method ensures that everyone has access to educational opportunities, transforms competitiveness into friendship, strengthens collaboration and partnerships, and encourages critical thinking and creativity in a class setting.

Sadly, the quality of education is falling in emerging nations like Pakistan. Pakistani students have a lot of difficulty finishing annual test papers, which has a detrimental impact on how well they perform on science exams. Sultana and Zaki (2015) claim that because interactive teaching methods cannot currently be used in our educational system's classrooms, students are forced to memorize information rather than cultivate critical thinking skills. The current teaching strategies need to be changed since traditional or standard classroom learning activities have failed to generate thoughtful and reflective learners. Pakistan's educational system needs to be upgraded by introducing new teaching techniques in order to overcome these problems (Raza, Qazi, & Umer, 2019).

There haven't been many studies on this topic in Pakistan. Such studies are essential to educating educators and students about the importance of motivating factors in teaching and learning. According to prior studies, student motivation is crucial to the teaching and learning of the topic of chemistry. As a result, it would seem that chemistry education needs to be enhanced if a nation is to advance in science and technology.

Conclusion

The results of this study showed that team-based learning produces results that are more substantial in comparison to the lecture method. When a teacher employs this technique as a teaching approach, the students' academic performance improves enhancing their social and communication skills. Both high achievers and low achievers are proven to benefit from team based strategies used in classrooms increasing their motivation and interest in the subject.

Limitations of the Study

The study's weakness was that it was not feasible to separate the participants into two TBL and lecture groups and administer the same curriculum to each of them. Therefore, it is advised that future research compares these two approaches in a peer group with comparable educational challenges in order to better regulate the environment and provide a more accurate comparison. Overall, this study offers additional proof of the value and significance of students' motivation in learning, which can support the adoption of this approach in a variety of academic disciplines.

Implications and Future Research

This study offers preliminary proof that using TBL may be a helpful instructional strategy for many adolescent students who are at the stage of college and career preparedness. Future studies on the impacts of TBL may also give teachers crucial knowledge about the key components of the instruction. This new research would give a better indication of the impacts of TBL as well as additional information about who and under what circumstances TBL can be beneficial. It would also examine various grade levels and content areas. In Pakistan's educational system, the idea of team-based learning is a very recent development. It is recommended that the pre-service training programs for new teachers' Chemistry curricula incorporate this instructional program. Reasonable weight should be given to these strategies in teaching practice or presentations to gauge a future teacher's readiness to tackle the challenges of teaching modern chemistry, and the public sector should hire professionally trained master trainers to train educational administrators and master trainers to promote modern teaching techniques in actual classroom settings.

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