Int. J. Nonlinear Anal. Appl. In Press, 1–9
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2024.34668.5186

Comparison of two implementation strategies of the flipped learning method in academic mathematics

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(Communicated by Sirous Moradi)

Abstract

Implementing the flipped learning method in Iran's higher education with the perspective of localization brings challenges, it seems to depend on classroom participation. In this regard, the purpose of the present study is to investigate the effect of gender and personality in group work and to compare the mathematical performance of two different strategies of this new approach. The statistical population of this descriptive-analytical research included four classes of general mathematics II, and all of them took the DISC personality test. In two classes, the students were grouped by their results, and the others were grouped according to personal choice. So, students' introversion and extroversion, as well as neutral, introverted, extroverted, more introverted, or more extroverted groups, were also determined and recorded. The conducted investigations showed that the flipped learning method with the voluntary grouping strategy was more effective than the other for just females, introverts, and extroverts; the population of males showed similar performance in both strategies; the neutral and more introvert groups in the voluntary grouping, and the introvert and more introvert groups based on the DISC Test had the same result. Eventually, the superiority of students' mathematical performance was proved in the voluntary grouping compared to grouping by DISC test.

Keywords: DISC Personality Test, Gender, Personality, Mathematical Performance, Voluntary Grouping
2020 MSC: 97A40

1 Introduction

Humans are social beings and interact with each other to meet their needs [6]. According to Maslow's motivational theory, if the teacher has sufficient knowledge and insight regarding biological, security and emotional needs, the need to respect and the need to provide a space for progress, creativity, innovation and perfection; the learning process will be strengthened. According to Alderfer's theory, as a manager, the teacher should pay attention to his high-level needs and encourage him to participate in class activities to increase student performance [19]. Since the education system receives a significant part of the government's annual budget and is influential in the social, political, cultural and economic aspects of the society, it should be taken into account. The use of effective teaching techniques is a vital element in a quality education system [11]. Learning means a relatively stable change in people's attitudes, behaviour and performance. Teaching and learning are different subjects; Because every teaching method does not always lead

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Received: July 2024 *Accepted:* September 2024

to learning [1]. Considering the speed and different levels of students' learning and the development of information technology, the teacher should use the appropriate teaching method [3]. The development of students' thinking and performance has been significantly influenced by new educational approaches that have emerged in recent decades and are more effective and efficient than conventional methods, while they are based on the findings of psychology and new educational sciences [1]. The reverse learning method is a new educational approach in which there is no mention of the usual order of learning and classroom teaching is replaced by homework. In this method, the course materials can be reviewed and studied by students at home in different ways; As a result of practice, questioning, discussion and other activities are done in the classroom[4]. In the flipped learning approach, students are grouped to facilitate constructive interactions. This can be done in different ways; Such as: homogeneous, heterogeneous, voluntary, random, grouping based on similar abilities, age grouping and any other creative strategy.

2 Theoretical foundations and research background

In the late 1990s, Eric Mazur and several other educators independently pursued active teaching methods with the goal of student-centred learning. Baker also created an educational strategy focusing on class time to master knowledge and present lecture content as homework. In this way, the places of lectures and assignments were changed and students participated in class activities; with this work, a better understanding of the material was provided. Some of the important elements for engaging students in learning and encouraging educational change included the introduction of computers and the growth of the Internet in the 1980s and 1990s.

In the early 2000s, two high school chemistry teachers in the United States, Aaron Sams and Jonathan Bergman, recorded their lectures and uploaded them to YouTube, asking students to watch the videos before entering the classroom. The purpose of this work was to create an opportunity to make up for the backlog of students absent from class; However, thanks to these posted videos, the flipped learning model quickly caught the attention of educators and academics. It can be concluded from the research that the interest in this educational method is still increasing [7]. According to a study [13], none of the appropriate methods are superior in comparison to each other regardless of the conditions, objectives, audience and cost. In using an educational approach, several variables are important; These items include: objectives, topics, training time, audience status, training level, training program and training infrastructure. The teacher must have critical and integrated thinking, responsibility, sensitivity, knowledge, practical experience in the subject and self-control to choose the best method. An effective teaching approach encourages learners and helps them challenge their assumptions. Using such a method to improve educational standards and enable effective teaching is undoubtedly associated with challenges and requirements [20]. When the teacher appropriately uses an active educational approach with any subject and content, student satisfaction is the criterion for determining the quality of his teaching [22]. A study [12] showed that the flipped teaching method helps student learning in three main ways: more time in class for work or practice, integration of new information with previous beliefs and immediate feedback. Students' lack of familiarity with the reverse learning approach and the teacher's significant initial effort have been two of the most commonly reported challenges. According to the research of university mathematics level [21], the flipped learning method has a moderate effect on learning speed; Therefore, it is expected to be used at the university level as a basis for policies to improve the quality of mathematics learning. The results of a study [16] indicate the improvement of student participation, the creation of a positive attitude towards learning, control of the learning speed, independence in managing the time needed for studying and the relative improvement of performance. Students work in groups to solve problems. In fact, there are challenges such as the need for regular participation of the student in the educational process, handling questions while completing assignments, doubts about the effectiveness of the method on challenging academic subjects, time constraints and the necessary expertise in classroom management.

The reverse teaching approach improves the learning and academic progress of students in high school mathematics courses, but it has not been seen in some studies. It can be said that the subject that is taught and how to deal with it are not without influence in reaching the result. The attitude towards mathematics, both from the teacher's side and from the families' side, with the mutual influence of various variables such as feelings, beliefs, individual and emotional factors, people's performance towards mathematics, previous successes, type of teaching, class characteristics, evaluation method and doubts at the beginning The way is formed [**?**]. According to research [5], the use of the flipped learning method usually improves the student's knowledge and attitude towards It improves the subject and strengthens aspects such as teamwork, self-regulation of learning, autonomy and academic performance. Most of the students prefer the flipped learning method to the traditional teaching approach. This new method causes appropriate reactions; Such as: satisfying learning experiences, engaging group discussions, motivation, understanding of the subject and willingness to return to class participation [15]. Based on the perception of student-teachers in a research work [2], using the flipped learning method can improve efficiency, personalization of learning and technical skills of students. Flipped Learning Method helps low-performing students to increase their learning effectiveness [18].

This method improves learning by reducing cognitive load and increasing accuracy, engagement with content, attitude, motivation, lesson satisfaction and self-efficacy. Students' lack of familiarity and adaptation with this method, which increases the workload of professors and creates learning problems through educational videos, has been one of the most important obstacles to the implementation of this approach [23]. Group work-based learning is one of the vital components in the flipped classroom and increases student academic achievement compared to the traditional classroom structure [9]. In this way, learning happens for a larger number of students, and mathematics is taught in a real-life way, through participation in valuable group work that also provides the opportunity for healthy competition. Identifying students' current capacity to learn, evaluation methods and grouping also play a decisive role in expanding their mindset [10]. According to research [17], in two approaches of implementing the reverse learning method, one with the help of Salazar's grouping (initiative study method) and the other in the form of small groups, a significant improvement in students' grades was achieved. Reverse learning method with a group research strategy has a positive effect on the level of enjoyment of mathematics [8]. To ensure the improvement of students' learning level to the highest possible level, it is necessary to continuously focus on the best method of grouping based on different educational environments; This issue is one of the most vital components in improving students' mathematical progress [14].

3 Research objectives

Sometimes, the use of innovative criteria in the implementation of the reverse learning method can provide a suitable platform for a more detailed analysis of students' mathematical performance. In order to achieve this goal, the authors of the article decided to consider the personality dimension of students among the members of their statistical society both in general and in the discussion as an effective factor for class grouping, and this led to the comparison of their innovative strategy with one of the simplest Create aspects of the implementation of the mentioned method. Based on the searches, no research literature was found considering the results of the DISC Personality Test for reverse learning method groupings, comparing the grouping strategy using the DISC Test with voluntary grouping and examining the relevant functions; as a result, this article is the first study in the mentioned field.

Maybe some of the challenges in the reverse learning method are due to the lack of attention in the relatively hidden aspects of education and as a result of the fatigue and discouragement of students; Therefore, it is necessary to discuss deeper layers of education. In this regard, the purpose of our study is to pay special attention to some psychological issues, to reduce the concerns faced by students, to build confidence in fair evaluation, and finally to examine and compare the mathematical performance obtained in two strategies for implementing the reverse learning method (grouping according to the student's choice and grouping based on the results DISC Test and discretion of the instructor). In order to achieve the mentioned goal and according to the initial platform created, the following research questions should be answered:

1) Is the performance of girls by arbitrary grouping better than girls by DISC grouping?

2) Is the performance of boys in arbitrary grouping and boys in grouping with DISC Test the same?

3) Is the performance of introverts better in grouping by DISC Test compared to introverts in arbitrary grouping?

4) Is the performance of extroverts better in arbitrary grouping compared to extroverts in grouping by DISC Test?

5) Do the Arbitrary. Neutral, Arbitrary.MoreIntrovert, DISC.Introvert and DISC. More introverted groups have the same performance?

6) Is a reverse learning strategy with arbitrary grouping better compared to reverse learning with DISC grouping?

4 Research methods

The present article is a descriptive-analytical study that was conducted in the second semester of 2022-2024 academic year in order to investigate the mathematical performance of undergraduate students using two strategies for implementing the reverse learning method. SPSS version 27 statistical software was used to analyze the results.

The statistical population includes four general mathematics classes, two from the computer science field of the Islamic Azad University, Tehran Science and Research Unit; These classes consist of 37, 22, 35 and 41 students respectively (135 people in total). Before the start of the course, the instructor prepared files and educational videos related to all the sessions and uploaded the prepared videos to the channel of his Aparat site. He created a virtual group for each class in the iGap software so that he could share files and the Internet address of his educational videos, and after the end of each session, student-student and instructor-student interactions would take place under his supervision.

Educational files and videos were compiled in such a way that one-third of the academic load of each session was allocated, and the remaining two-thirds were transmitted through exercises and in-class discussions with the presence of students in class. This work had at least three benefits: firstly, in order to fully receive the scientific content of each session, unjustified absences were reduced, secondly, students were encouraged to have group work, and thirdly, the volume and duration of the films was reduced to the minimum possible.

At the beginning of the training course, everyone joined the defined virtual groups; They were fully explained about the teaching method and then they participated in the online DISC Personality Test, which was carefully recorded with the help of the four main categories defined in this test and their classification into introverts and extroverts. In the first and second classes, groupings of four people were done arbitrarily, and in the rest of the classes, students were placed in their groups according to the results of the DISC Personality Test and at the teacher's discretion to interact with each other in each session. In the two classes where the method was supposed to be implemented based on DISC grouping, the teacher tried to select one person from each class defined in this test as much as possible.

By using the reverse learning method, the students of each class received relevant training during twelve sessions of one hundred and twenty minutes. They had to do intra-class and intra-group interactions through class exercises. After the end of each session and to stabilize the scientific load received in both strategies of implementing the reverse learning method, a number of exercises under the title of excess exercises were provided to the students, who had the opportunity to submit their answers through the designated communication channels until the next session. should be provided to the teacher. At the end of the course, the share of classroom activities and extra exercises were five points each, and the share of the exam paper was taken into account, and the student's final score was obtained by summing the points obtained in these three sections.

5 Research findings

According to the research questions raised, the following hypotheses are stated; Then, their correctness is analyzed with the help of SPSS software.

5.1 First research question

Hypothesis 1: The performance of girls in arbitrary grouping is better than girls in grouping with DISC Test.

Table 1: Kolmogorov-Smirnov test results to determine the distribution of dependent variables

The Significance Level	Test Statistics	Standard Deviation	Average	Number	The variable
<0/001	0/289	2/84	18/19	31	Desired.Girls.Score
0/020	0/170	3/11	16/16	32	Disc.Girls.Grade

Since the significance levels of the Kolmogorov-Smirnov test in arbitrary variables girls' score and discus girls' score are smaller than 0.05 (0.001 and 0.020), the data distribution is not normal (see Table 1).

Table 2: U-Mann-Whitney test to compare the means of two abnormal populations

The Significance Level	Test Statistics	U Man-Whitney	Average Rank	Number	Variable
			39/48	31	Desired Girls.
			24/75	32	Disc Score
0.001	-3/255	000/264		63	Total

The U-Mann-Whitney test was used to determine if there was a difference in girls' math performance in the discretionary and DISC groupings (see Table 2). The obtained results (264.000 and 0.001) indicate the existence of a significant difference between these two groups of girls. Since the average of girls by arbitrary groupping (18.19) is higher than the average of girls grouped by DISC Test (16.16). Then, hypothesis 1 is accepted. On the other hand, by using -3.255 and 63, the average effect size is obtained (-0.41).

5.2 Second research question

Hypothesis 2: The performance of boys in arbitrary grouping and boys in grouping with the DISC Test is the same. Since the significance levels of the Kolmogorov-Smirnov test for arbitrary variables boys' score and discus boys' score are not greater than 0.05 (0.001 and 0.200), the data distribution is not normal (see Table 3).

Table 3: Kolmogorov-Smirnov test results to determine the distribution of dependent variables

The Significance Level	Test Statistics	Standard Deviation	Average	Number	Variable
0.001<	0.242	31/3	17/05	28	Desired.Boys.Score
0.200	0.099	3/05	16/06	44	Disc. Boys .Score

A U-Mann-Whitney test was used to determine whether there was a difference in boys' mathematical performance in the arbitrary and disc groupings (see Table 4). The obtained results (485.000 and 0.126) show that there is no significant difference between these two groups of boys; Therefore, there is no difference in the mathematical performance of boys grouped arbitrarily and boys grouped by the DISC Test; Then hypothesis 2 is accepted. Also, since there is -1.531 and 72, the effect size is weak (-0.18).

Table 4: U-Mann-Whitney test to compare the means of two abnormal populations

The Significance Level	Test Statistics	UMan-Whitney	Average Rank	Number	Variable
			41/18	28	Desired Boys.
			33/52	44	Disc Score
0.126	-1/531	000/485		72	Total

5.3 Third research question

Hypothesis 3: The performance of introverts in grouping with DISC Test is better compared to introverts in arbitrary grouping. Since the significance levels of the Kolmogorov-Smirnov test for the variables arbitrary.introvert score and DISC. Introvert score are smaller than 0.05 (0.001 and 0.002), the data distribution is not normal (see Table 5).

Table 5: Kolmogorov-Smirnov test results to determine the distribution of dependent variables

The Significance Level	Test Statistics	Standard Deviation	Average	Number	Variable
0.001<	0.286	3/44	17/42	39	Desired Introverted Grade
0.002	0.170	3/19	16/40	47	Disc Introvert Score

A U-Mann-Whitney test was used to determine whether there was a difference in the mathematical performance of introverts in arbitrary and disk groupings (see Table 6). The obtained results (673.500 and 0.031) indicate the existence of a significant difference between these two categories of introverts. Since the average of the arbitrarily grouped introverts (17.42) is higher than the average of the introverts grouped by the disc test (16.40). Then, hypothesis 3 is rejected. On the other hand, using -151.2 and 86, the effect size is obtained in a medium ratio (-0.23).

Table 6: U-Mann-Whitney test to compare the means of two abnormal populations

The Significance Level	Test Statistics	U Man-Whitney	Average Rank	Number	Variable
			49/73	39	Desired Introvert
			38/33	47	Disc Score
0.031	-2/151	673/500		86	Total

5.4 Fourth research question

Hypothesis 4: Extroverts' performance in arbitrary grouping is better compared to extroverts in grouping by DISC Test.

Table 7: Kolmogorov-Smirnov test results to determine the distribution of dependent variables

The Significance Level	Test Statistics	Standard Deviation	Average	Number	Variable
0.003	0.245	30/2	18/10	20	Desirable Extroverted
0.200	0.074	2/80	15/60	29	Disc Extrovert Score

Since the significance levels of the Kolmogorov-Smirnov test for arbitrary variables, extroversion score and DISC extroversion score are not greater than 0.05 (0.003 and 0.200), the data distribution is not normal (see Table 7).

Table 8: U-Mann-Whitney test to compare the means of two abnormal populations

The Significance Level	Test Statistics	U Man-Whitney	Average Rank	Number	Variable
			32/48	20	Desired Extrovert
			19/84	29	Disc Score
0.002	-3/068	140/500		49	Total

A U-Mann-Whitney test was used to determine whether there was a difference in math performance of extraverts in arbitrary and DISC groupings (see Table 8). The obtained results (140.500 and 0.002) indicate the existence of a significant difference between these two groups of extroverts. Since the average of the extroverts grouped arbitrarily (18.10) is higher than the average of the extroverts grouped by the disc test (15.60). Then, hypothesis 4 is accepted. On the other hand, by -3.068 and 49, the effect size is relatively large (-0.44).

5.5 Fifth research question

Hypothesis 5: Desired.Neutral, Desired.More Extravert, Disc.Introvert and Disc.Introvert groups do not have the same performance.

Table 9: Kolmogorov-Smirnov test results to determine the distribution of dependent variables

The Significance Level	Test Statistics	Standard Deviation	Average	Number	Variable
0.006	0.382	3/06	18/12	6	Favorite Group Neutral
0.200	0.202	2/55	88/17	6	Favorite Group Introvert
0.012	0.345	2/37	16/32	7	Disc Group Introvert
0.200	0.235	1/86	16/71	7	Disc Group Inner

According to the results obtained from Table 9, because the significance levels of the Kolmogorov-Smirnov test for the variables arbitrary.neutral.group, arbitrary.group.introvert, disc.introvert.group and disc.group.introvert are simultaneously greater than 0.05 are not more, the distribution of the dependent variable cannot be normal (0.006, 0.200, 0.012 and 0.200). Kruskal-Wallis test was used to determine whether there was a difference in mathematical performance depending on the four defined variables (see Table 10). The obtained significance level (0.133) indicates that there is no significant difference between the respective functions; Therefore, hypothesis 5 is rejected.

5.6 Sixth research question

Hypothesis 6: In reverse learning method, arbitrary grouping is better compared to grouping by DISC Test. Since the significance levels of the Kolmogorov-Smirnov test for arbitrary variables.score and disc.score in Table 11 are less than 0.05 (0.001 and 0.003), the data distribution is not normal.

A U-Mann-Whitney test was used to determine whether there was a difference in the mathematical performance of arbitrary and DISC groupings (see Table 12).

Table 10: Kruskal-Wallis test to compare the averages of four abnormal populations

The Significance Level	Degrees Of Freedom	Kruskal-Wallis	Average Rank	Number	Variable
			18/25	6	Arbitrary Neutral
			16/17	6	Desired More Inner
			9/64	7	Disk Introvert
			00/11	7	Inner Disc
0.133	3	600/5		26	Total

Table 11: Kolmogorov-Smirnov test results to determine the distribution of dependent variables

The Significance Level	Test Statistics	Standard Deviation	Average	Number	Variable
0.001<	0.267	3/10	17/65	59	Desired Score
0.003	0.129	3/06	16/10	76	Disc Score

Table 12: U-Mann-Whitney test to compare the means of two abnormal populations

The Significance Level	Test Statistics	U Man-Whitney	Average Rank	Number	Variable
			80/95	59	Desired Score
			95/57	76	Disc
0.001<	-3/440	000/1478		135	Total

The obtained results (1478.000 and 0.001) indicate the existence of a significant difference between these two groups of students. Given that the average performance of students grouped arbitrarily (17.65) is higher than the average of people grouped by the disc test; Then, hypothesis 6 is accepted. Also, since it is -3.440 and 135, the average effect size is obtained (-0.30).

6 Discussion and Conclusion

Many psychological theories emphasize the existence of the need for education among the basic human needs, so it is necessary that an organized educational system, formally and from the beginning of childhood, is responsible for addressing this important aspect of needs. The main goal of education is the correct and optimal transfer of course material to students, most of which is realized through basic teaching and learning. The teacher should choose the best teaching method according to the educational environment and academic level of the students and make his performance as close as possible to its standards. The reverse learning method is one of the new educational methods that, due to its special infrastructure, can provide the conditions for creating deeper learning; Of course, it also brings challenges. A teacher who has chosen this educational method should seek to define innovations that provide the context for a more detailed study of hidden layers and existing challenges.

It seems that examining students' performance based on psychological issues can reveal some hidden aspects of this method; Perhaps, by this means, a step can be taken in the direction of identifying the challenges in more detail and solving them optimally. In the current research, considering this issue and based on the results of the DISC Personality Test, the introversion or extroversion of the students was determined and recorded. According to this research, in some classes, grouping was done according to the student's choice, and in others, it was done by the DISC Test and at the teacher's discretion, in order to create the possibility of organized interaction during the training course. Of course, in addition to the factors of introversion and extroversion, gender was also considered to separate the students in order to provide a basis for comparing their performance in more detail. The limitations related to the results of the DISC Test and the conditions of the classes caused the formation of neutral groups (with an equal number of introverts and extroverts), introverts (only including introverts), extroverts (only including extroverts), more introverts (with a dominant number of introverts) and more extrovert (with provided the dominant number of extroverts); In this way, the ability to study and examine newer dimensions was provided. According to the findings of this research, the following are important:

1) The performance of only female students, only introverts and only extroverts in the reverse learning method with arbitrary grouping has been better compared to this method with the grouping strategy by disk test. Male students performed similarly in both strategies (grouping according to choice and grouping by DISC Test).

2) There is no significant difference between the mathematical performance of neutral and more introverted groups of students in arbitrary grouping and introverted and more introverted groups in grouping by DISC Test.

3) Students perform better in reverse learning method with arbitrary grouping compared to the same method with grouping by DISC Test.

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