Flipped Classroom & Kirkpatrick: Steps Toward Innovation in Education & Evaluation

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ABSTRACT

The present study aims at investigating the effect of teaching through flipped classroom on learning level of students at basic science level in the medical faculty of Iran University of Medical Sciences based on the evaluation model of Kirkpatrick. This is a quasi-experimental study following the pre-test and post-test nonequivalent group design. Census sampling was used due to the limitation of the statistical population. The students were divided into two groups of experimental group and control group. The experimental group was taught in flipped classroom and the control group was taught through speech-based method. The experts in the general medical group were consulted with regarding the selection of the lesson and the subject to be taught. When both groups were taught, the level of students’ learning was evaluated in the study using the evaluation model of Kirkpatrick.

The experimental group watched the electronic content of each session on a CD, studied the textbook and attended the class prepared. However, no content was available for the speech-based group and they attended the class as usual. Research tools included a researcher-made learning questionnaire (with a reliability of 0.82) based on the Kirkpatrick four-level teaching evaluation model which was once distributed among the control and experimental groups before the classes begin and once again they were distributed a month later among them. The data was interpreted after being collected. Results of data analysis showed that teaching through flipped classroom has positive effects on the students’ learning level. The stability of the contents in flipped classroom was approximately twice as much as the speech-based method. The professors and the faculty members are recommended to use this approach when teaching and to design their lesson plan based on the flipped classroom model.

Introduction

Quality improvement is one of the major purposes of higher education throughout the world. According to the International Federation of Medical Education over the last two decades, the medical teaching has been expanding uncontrollably (at least at the level of general medicine) [1], while people’s expectations from physicians is increasing due to the increase in the level of their awareness. Accordingly, it can be stated that the condition of medical education in Iran is similar to what has been addressed in the report by the International Federation of Medical Education and this fact has made the educational officials in Iran to improve the educational quality by new methods of education in the field of general medicine [2]. In their study, Dent and Harden stated that a physician is a unit of abilities, while many medical universities might train physicians whose identity as a professional person is unknown [3]. A look at the changes in the higher education system of Iran over the last two decades in terms of student population indicates the quantitative growth and lack of sufficient attention to the quality of the universities and their improvement. Quality improvement calls for the establishment of an appropriate educational mechanism [4].
Different active and new learning methods include (case-based learning, competency-based learning, discovery learning, experimental learning, open learning, flipped classroom). One of the active teaching methods that has become a new technology over the last years is the "flipped classroom". The flipped classroom is a pedagogical model in which the group space moves toward individual space and consequently, the learning environment becomes active and interesting for learning through which the teacher’s guide the students and students participate creatively in teaching the lessons [5]. In fact, this is considered a learner-centered approach in which the learners are more active than the teacher in learning and the teacher acts as a facilitator to motivate, guide and receive feedback from students’ performance [6]. In this method the house and school change places, such that the teacher provides the learners with videos on the lesson so that they can watch them at home before coming to the school in order to use the class time to gain knowledge.

Accordingly, in flipped classrooms, what used to be done in the classrooms in the past is now done at home as an exercise. The learners attend the classes with preparation and the teacher, and the learners cooperate with each other to read, understand and complete the exercises in the class [7]. Flipped learning includes the following advantages: flexibility, improvement of interactions, professional skills and learners’ participation. In addition, Schiller and Herreid stated that flipped classroom also develop thinking skills among other advantages, while many educational experts such as Gold and Sirantic believe that the sovereignty of traditional teaching methods leads to poverty of thought in learners [8]. Therefore, one of the reasons for active learning is that the information and scientific knowledge advance fast and no learner can store the produced information in mind. Hence, the learners should be taught how to solve problems.

Today, many curricular designers and educational programmers are dissatisfied with the common teaching methods and consequently, they welcome innovation and creativity in teaching methods. The effectiveness of methods such as speech-based teaching, information transfer from teachers to students and memorization and focusing on memorization which are the bases of traditional teaching methods have been questioned and criticized for a long time. To compensate the shortcomings of such methods, a number of experts recommend using new teaching assistant tools and new teaching methods such as class discussions, problem solving and etc. and some others have replaced the old methods by discussion and question and answer sessions and individual and group experiments [9]. Studying the interview of Shubert and Ralf Tyler published in 1986, Mehr Mohammadi introduced the flipped curriculum design as an innovative idea in higher education curriculum design.

Discussing about his early experiences regarding the curriculum design for applied sciences and engineering education in mid-twentieth century, in the interview, Tyler mentioned that the environmental experiences were prior to classroom topics in this model. From his experience of curriculum designing for masters of social sciences in Cornell University, Shubert emphasized that environmental experiences are prior to class activities and topics. Of course, the priority of clinical experiences to class topics and theories in flipped classroom curriculum does not mean that theoretical issues are neglected or are negligible; but the applicable content is the main purpose. Flipped curriculum is the opposite of the common and traditional curriculum. In traditional curriculum, the mere priority is with the theoretical issues and the clinical experiences are learned in the form of internship. However, in flipped curriculum, the priority is with the clinical experiences and environmental experiences and the class content are in line with the workplace experience and issues with the applicable contents being the main focus. Moreover, the content is not predetermined.

In this type of curriculum, the theoretical knowledge is not superior to the practical knowledge, but it owes itself to the mind mingled with issue and is disposed with its exploitation [10]. It also emphasizes the perceived necessity against the necessity-dependent approach. That is, it is not dependent on the idea of transferring knowledge to be applied in the future, but the nature of the problem determines what type of knowledge and content is required [11]. Flipped classroom is an educational and a compound learning strategy that converts education to a student-centered model in which the class time is spend on deeper subjects and on creating interesting learning conditions [12]. Indoor lesson in a flipped classroom might include learning based on activities that were considered homework in traditional education. On the other hand, in this type of learning, more time is dedicated to thinking skills in class and the learners are more active in the process of learning and creating more knowledge, meanwhile evaluating their knowledge [13]. In a study conducted in 2017 by Hong in the National Taiwan University on two groups of 20 English students, it was concluded that flipped classrooms can provide interactive learning opportunities that increase the learners’ tendency to establish communication and help others. In addition, the verbal skills are developed and the satisfaction level increased.

This method increased the motivation of learners who are less inclined to interact with others and establish communications with their teacher and peers. Hence, the learners’ motivation increased in the class activities in this method [14]. In a study conducted in 2017 by Robby Yang in Hong Kong on 57 learners, it was concluded that the learners had a positive idea about flipped classrooms. The teachers stated that flipped classroom is a creative method that might only be useful to teach English grammar [15]. In the study conducted in 2017 by Key Van Lou and Fun Hue on twelfth grade students in mathematics class, it was concluded that after the examination of the students’ scores in the pretest and post-tests of t-test, their scores had significantly improved in the post-test and the learners’ idea about the flipped classroom was positive in general [16]. According to a study by Kajanto and Lee in Sungkyunkwan...
wan University in South Korea at algebra class, it was found that the learners taught in flipped classrooms outperformed in problem solving and social skills [17].

According to the study that Halili and Zeinaldin conducted in 2016 based on the content analysis of 20 articles on flipped classroom done from 2013 to 2015, it was found that flipped classrooms had positive effects on learners’ learning activities such as their success, motivation and interactions [18-20]. The main purpose of flipped classroom is to improve the learning experience of the learners and the teachers’ teaching experience before, during and after teaching [21]. Implementing flipped classroom requires a target educational content and distributing it to the learners’ outside the educational environment so that they will be prepared for what they have studied when they attend the class. Since flipping the class takes place by a focus on learners’ active learning the learners need to study the lesson deeply before they attend the class. As it was mentioned earlier, considering the significance of the medical education through new methods, attempts were made to use the method to increase the quality of education in Iran University of Medical Sciences. In other words, the purpose of this study was to investigate the effect of teaching through flipped classroom on the learning of students at basic science level in Iran University of Medical Sciences according to Kirkpatrick Evaluation Model.

**Table 1: Features of methodology.**

| Study Method       | Statistical Society                                      | Sample                        | Tool                                      | Number of groups |
|--------------------|----------------------------------------------------------|-------------------------------|-------------------------------------------|------------------|
| Quasi-experiment   | Medical students of basic sciences School of Medicine, Iran University of Medical Sciences | Per group 20 students        | Questionnaire (pre-test-post-test)        | 2 Groups:        |
|                    |                                                          |                               |                                           |                  |
|                    |                                                          |                               | One group teaching with flipped classroom method |                  |
|                    |                                                          |                               | One group teaching with Lecture method    |                  |

**Ethical Considerations:**

- a) Obtaining permission from the Research Center officials of Iran University of Medical Sciences and the medical faculty of Iran University of Medical Sciences
- b) Obtaining permission from the ethics committee
- c) Providing research subjects with the necessary explanations and research objectives
- d) Obtaining the informed consent
- e) Confidentiality and anonymity of the information

**Findings:** The information about the research questions is used in this section in descriptivive level (frequency, percentage, mean and standard deviation) and inferential level in Kolmogorov-Smirnov test to test the normalization of the statistical sample and the analysis of covariance was used to test the research hypotheses.

**Descriptive Statistics of The Groups**

(Tables 2 & 3) The data presented in the above table indicate the age of subjects in both groups and it shows that most of the subjects are in the age range of 22 years old. (Table 4). The data presented in the above table shows the gender of the subjects in both groups which indicates that 55 percent of the subjects in the flipped classroom were girls and 45 percent of them were boys, while 50 percent of the subjects in the speech-based group were girls and 50 percent were boys (Table 5). According to the data, the mean of learning level in pretest and post-test in the control group was 28.55 and 56.36, respectively and the mean of learning level in the pre-test and post-test in the experimental group was 54.39 and 92.28, respectively (Table 6). According to the results of the above table, the significance levels for the research variables were greater than 0.05. The data related to all variables were normal and parametric tests can be used to test each of the variable (Table 7).

**Table 2: Distribution of the statistical sample in terms of gender.**

| Group                   | Frequency | Percent |
|-------------------------|-----------|---------|
| Flipped Classroom Group | 20        | 50%     |
| Lecture Group           | 20        | 50%     |
| Total                   | 40        | 100%    |

According to the results obtained from Levene test, it can be stated that the obtained significance level (0.458) was greater than
the critical value at level 0.95 (0.05). Therefore, the homogeneity of the variance is confirmed. Determining and Comparing the Students’ Learning Level at Basic Sciences One Month after the Intervention in Control and Experimental Group The independent t-test was used to test this hypothesis. The results are presented in the following table (Table 8). According to the above table, it is observed that after one month, the mean value of learning for the first group (speech based group) was 20.1628 and the mean value of learning after one month for the second group (flipped classroom) was 43.0724. In addition, the standard deviation of the first group was 0.4516 and the standard deviation for the second group was 0.50073. Moreover, the standard mean for the first and second groups was 0.3285 and 0.6814, respectively. The significance level of this test shows that there is a significance difference in the learning level between the two groups after a month (Table 9).

**Table 3: Distribution of the statistical population in terms of age in the groups.**

| Group | Experimental (Flipped Classroom) | Control (Lecture) |
|-------|----------------------------------|-------------------|
| Age   | Mean & Standard Deviation        | Mean & Standard Deviation |
|       | 22 ± 2.8                         | 22 ± 3.26         |

**Table 4: Distribution of the statistical sample in terms of gender in the groups.**

| Group Sex | Experimental | Control |
|-----------|--------------|---------|
|           | Frequency    | Percent | Frequency | Percent |
| Male      | 9            | 45%     | 10        | 50%     |
| Female    | 11           | 55%     | 10        | 50%     |
| Total     | 20           | 100%    | 20        | 100%    |

**Table 5: Comparison of the mean and the standard deviation in pre-test and post-test in experimental group and control group in terms of the learning level variable.**

| Learning Level | Pre-test | Post-test |
|----------------|----------|-----------|
| Group          | Mean     | Standard Deviation | Mean     | Standard Deviation |
| Experimental   | 55.28    | 0.34       | 56.36    | 0.47     |
| Control        | 54.39    | 0.71       | 92.28    | 0.56     |

**Table 6: Kolmogorov-Smirnov test.**

| Statistical index | Variables | Reaction Level | Learning Level | Behavior Level | Results Level |
|-------------------|-----------|----------------|----------------|----------------|---------------|
| Z                 | 0.91      | 0.88           | 0.93           | 0.96           |
| P                 | 0.36      | 0.64           | 0.77           | 0.52           |
| Significance Level| 0.224     | 0.121          | 0.388          | 0.116          |

**Table 7: Results of Levene test to investigate the homogeneity of variance between the (experimental and control) groups.**

| Degrees of freedom 1 | Degrees of freedom 2 | Significance Level |
|----------------------|----------------------|--------------------|
| Groups               | Control              | Experimental       |
| Degrees of freedom 1 | 1                    | 39                 | 0.458             |

As it can be seen in the table above, the knowledge scores of the students in experimental and control groups at 4 dimensions of Kirkpatrick Evaluation Model were significantly different and the difference was also statistically significant (p = 0.0001) (Table 10). The results of the analysis of covariance in the above table show that there is a significant difference in the learning level between the experimental group and the control group (p > 0.01 and F = 20.83). The square root of this value is 0.86; that is, 86 percent of the learning level is related to teaching through flipped classroom. In other words, it can be stated that teaching through flipped classroom has a significant effect on the students’ learning level.

**Table 8: Independent t-test.**

| Learning Level | Number | Mean         | Standard Deviation | Standard Error | Significance Level |
|----------------|--------|--------------|--------------------|----------------|--------------------|
| Control        | 20     | 20.1628      | 0.4516             | 0.3285         | 0.0001             |
| Experimental   | 20     | 43.0724      | 0.50073            | 0.6814         |                    |

**Discussion and Conclusion**

The aim of the present study was to investigate teaching through flipped classroom on the students’ learning level at basic sciences of the medical faculty in Iran University of Medical Sciences based on Kirkpatrick Evaluation Model. Results of data analysis showed that teaching through flipped classroom had positive effects on students’ learning level. In a study in 2012 in line with the comparison between the effectiveness of flipped classroom and speech based method, Johnson concluded that when the content is prepared and provided for the learners, the flipped classroom method can be more effective in giving a deeper understanding of the contents compared to the speech based method [12]. In another study conducted by Zurideh in 2014 on the perception of the learners’ and teachers’ idea about the better method (speech based or flipped classroom), results indicated that the participants in the study had a higher tendency to use the flipped classroom method [13] Jafar Aghaee et al. conducted a study titled “Nursing Students’ Experience in a Flipped Classroom Method”.

**Table 9: Paired sample t-test to investigate the difference between the four important levels of Kirkpatrick Evaluation Model among the students of the two groups.**

| Variable | Group       | Mean | Standard deviation | t     | P-value |
|----------|-------------|------|--------------------|-------|---------|
| Reaction Level | Experimental | 4.39 | 2.54                | 3.76  | 0.0001  |
|          | Control     | 3.11 | 2.93                |       |         |
| Learning Level | Experimental | 3.52 | 2.8                 | 5.12  | 0.0001  |
|          | Control     | 2.41 | 4.09                |       |         |
Research results showed that most students (79.1%) preferred flipped classroom method over the traditional method in which most of the class time is spent on the teachers giving speeches. This study which was the first step in applying the flipped classroom method on nursing students in Iran showed that the students had positive experiences and views of applying this method. The present study showed that students recognized flipped classroom method important in gaining knowledge and found the activities before and during the class beneficial for their learning. The present study showed that students recognized flipped classroom method important in gaining knowledge and found the activities before and during the class beneficial for their learning. The present study showed that students recognized flipped classroom method important in gaining knowledge and found the activities before and during the class beneficial for their learning. The present study showed that students recognized flipped classroom method important in gaining knowledge and found the activities before and during the class beneficial for their learning.

Expansion of student-centered teaching methods like the flipped classroom in medical sciences can help to improve the learners’ learning process. Advocators of this approach believe that what happens in a classroom has a constructivist nature, such that the learners play an active role in gaining knowledge outside the class and what happens in the class focuses on the social and cooperative learning processes. Fulton with implementing the flipped classroom method in Byron High School in the U.S. and Abeysekera found out in his research that flipped classroom method has a positive effect on learners’ learning. Despite its special advantages, flipped classroom method calls for accurate educational planning and design. Flipped classroom is a teaching strategy and a compound learning method that converts teaching to a student-centered and design. Flipped classroom is a teaching strategy and a compound learning method that converts teaching to a student-centered and design. Flipped classroom is a teaching strategy and a compound learning method that converts teaching to a student-centered and design. Flipped classroom is a teaching strategy and a compound learning method that converts teaching to a student-centered and design. Flipped classroom is a teaching strategy and a compound learning method that converts teaching to a student-centered and design.

The lessons inside a flipped classroom might include learning based on the activities that were considered homework in traditional teaching methods [14]. On the other hand, in this type of learning, more time can be spent on thinking skills and the learners can be actively involved in learning and creating knowledge while evaluating their knowledge simultaneously [15]. In the field of teaching medical sciences, considering the continuous changes in the information and the importance of the knowledge being up-to-date in the field, it is necessary to teach students that will be continuously learning during their education and after that. The students being equipped with the self-directed learning abilities will turn them into lifelong learners because they will be trained to identify their needs and take steps to overcome them. Self-directedness in learning makes students take educational barriers as challenges and treat them successfully. Students prefer to have an active role in the class and learning. Nowadays, few students are found who prefer passive roles in class.

On the other hand, learning tools and conditions have also changed and students prefer to follow their learning process via electronic tools such as cell phones, tablets, laptops and other related tools. Furthermore, case studies have shown that with their audiovisual features, these tools engage more of the human senses (seeing and hearing). Consequently, they lead to deeper learning, while learning through textbooks where the content is provided in text format, the focus is more on one human sense (mostly hearing). Accordingly, considering the changes that have been made at the moment, one of the most important issues that need to be taken into consideration in university learning approaches in the field of medical sciences is the creation of interesting learning opportunities. This can be achieved by the use of audiovisual technologies and application of objective examples of the content.

The reverse class creates educational change; in the form of a teacher-centered classroom transforming into a student-centered classroom, and based on constructivism theory, learning is personalized and personalized rather than collectively. This study showed that the reverse-class approach makes the teacher and coach more active in comparison with the traditional classroom. The inverse class requires more time from the instructor and the professor. In the end, the reverse class as a sustainable learning pattern can be used for other teacher training courses. Reversing the design of the classroom will increase the learning experience of teachers and enhance their future teaching. As a result, much work has still to be done in this regard.

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Table 10: Results of analysis of covariance in experimental and control groups for the learning level.

| Learning Level Test       | Sum of Squares | Degree of Freedom | Average of Squares | F Value  | .sig  | Effect Size | Statistical Power |
|---------------------------|----------------|-------------------|--------------------|----------|-------|-------------|--------------------|
| Pre-test (Experimental Group) | 13.57          | 1                 | 38.46              | 20.83    | 0.001 | 0.86        | 0.05               |
| Post-test (Control Group)  | 13.35          | 39                | 14.02              | 8.66     | 1     | 0.04        | -                  |
| Group                     | 8.316          | 1                 | 8.316              | 34.24    | 0.000 | -           | -                  |
| Error                     | 26.92          | 20                | 52.48              | -        | -     | -           | -                  |
| Total                     | 255.99         | 38                | -                  | -        | -     | -           | -                  |

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Conflict of Interest

No conflicts of interest were reported by the authors.

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