FLIPPED CLASSROOM PEDAGOGY ENHANCES STUDENT SATISFACTION AND VALIDATED MOTIVATED STRATEGIES IN GENETICS CLASSROOMS

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ABSTRACT

This paper aims to discuss the impact on promoting student satisfaction and improving their involvement in their own learning when applying a "Flipped classroom" design in a third-year students in molecular biology major. The participants involved in this study were lecture genetics. At the end of the flipped classroom activities, students were asked to participate in an online questionnaire. The retrospective survey was used to determine the effectiveness of the instructional module. The mean scores for the five questions asked were very high (all greater than 2.5) and it ranged from 3.85 to 4.04. The students' responses to the retro-pre-questionnaire before and after the structured genetics examination skills training were analyzed. Out of the 27 students trained, 20 completed the retro-pre-questionnaires. The increase in scores was statistically significant In addition, we found that flipped-class pedagogy enhanced the validated motivated strategies for observation, comprehension, organization, reasoning, and application except comparison.

Keywords: Flipped classroom, genetics, student satisfaction, validated motivated strategies.

INTRODUCTION

Educating the next generation is a chance that needs to be implemented starting from the school level. As the new millennium is well underway, colleges and universities are challenged to meet the demands of the 21st century student with learning environments that are student centered, self-directed, technology enhanced, and flexible (Flumerfelt & Green, 2013; Guy & Marquis, 2016). A flipped classroom is a new pedagogical method which consists of video lectures (the videos can be those that are available from the Internet, or pre-recorded by teachers themselves) that students watch at their own time and pace prior to attending classes in which they participate in group activities or the teachers answer their questions (Stone, 2012). The adoption of enabling technologies by universities provides unprecedented opportunities for flipping the classroom to achieve student-centered learning. The flipped classroom-pedagogy can provide a solution to the use of education technology in a classroom environment. Maureen et al. (2000) described a similar approach as the inverted classroom. Flipped classroom pedagogy is an alternate to lecture instruction and shifts the focus of student learning from passive to active by facilitating a student-centered classroom environment. The 'flipped' classroom is usually associated with providing course materials, frequently in the form of videoed lectures, for students to engage with outside the classroom, enabling in-class time to be repurposed for student-centered collaborative learning activities that build on the learning resources provided. It has been argued that the flipped classroom enables a shift away from traditional information transmission, teacher-led lectures where students sit and listen as passive learners, to offer an active and collaborative learning environment, where students assimilate knowledge through application and evaluation, more

conducive to facilitating deeper approaches to learning through encouraging higher order critical thinking and creativity (Mazur, 2009; Wallace et al., 2014; Westermann, 2014).

Flipped classroom-pedagogy allowed experiments offered a good vantage point to observe the students how well they managed with given tasks, or if they needed more exercise with certain topics. It also allowed more possibilities for one to one attention with those students who seemed to need help, encouragement or positive feedback to be able to continue with difficult and demanding topics.

The pre-class assignments that students complete as evidence of their preparation can also help both the instructor and the student assess understanding. Pre-class online quizzes can allow the instructor to practice Just-in-Time Teaching (Novak et al., 1999), which basically means that the instructor tailors class activities to focus on the elements with which students are struggling. Specifically, the researcher aimed at finding out the participating teachers' and students' perceptions towards this new approach and investigating whether the flipped classroom could be a pedagogy for fostering teachers' reflective abilities and developing students' generic skills. The effects of flipped-class pedagogy on learning are much less reported in higher education (van Vliet et al., 2015). A survey of research by Bishop and Verleger (2013) gives an overview of 24 studies that investigated the effects of the flipped classroom. In these studies, there was only one (Papadopoulos & Santiago-Román, 2010) studying the effects of employing a partial flipped classroom using a matched (within the same group of students) pre- and posttest design. In this study, we used a pre- and posttest design to investigate the effects of flipped-class pedagogy on learning strategies in university education and study whether the effects of a flipped classroom were persistent. This study showed a gain in student learning in favor of flipped-classroom pedagogy.

METHODOLOGY

Flipped classroom approach

Details about methodology should be given in this section. Font Size 12, Times New Roman, single spaced. All the subheadings in this section should be in font size 12 Bold, Times New Roman, single spaced. The first letter of each word in subheading should be capital. The current study is an action research examining the use of the flipped classroom approach in genetics. The participants involved in this study were lecture Genetics (textbook: Essentials of Genetics, 9/e and Concepts of Genetics, 11/e, William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino, Benjamin-Cummings Publishing Company) students (Molecular Biology Major) from Dong-eui University in Korea (students are divided into two bands with Band 1 being the traditional teacher-centered model and Band 2 flipped classroom, so a Band 3 school was selected for analysis because the researcher would like to find out if the flipped classroom pedagogy can benefit the learning of lower achievers).

The researcher explained the participating students for a briefing session (for about an hour) on 2 March 2016 to let them know about the 'flipped classroom' pedagogy. Before the briefing session, the researcher enrolled the website of 'Flipped Classroom: Teachers' Site' (http://cyber.deu.ac.kr/main/viewMainIndex.do) to give the participating students an opportunity to experience a flipped classroom before they implemented it in their own classrooms so that they could have a better understanding of this pedagogy. At the end of the flipped classroom activities, students were asked to participate in an online questionnaire. The retrospective survey was used to determine the effectiveness of the instructional module. This type of survey, which requests both retrospective and current assessments of the instruction after completing the module, allows participants to maintain a consistent frame of

reference when responding and limits the number of incomplete responses that can occur with pre- and post-tests (Raidl et al., 2004, Shimamoto, 2012).

The difference between the overall scores before and after was found to follow the normal distribution, as confirmed by the Shapiro-Wilk test. The data were analyzed using SPSS ver. 21 (SPSS Inc., Chicago, IL, USA).

Retro Pre-Post Survey

Data from the surveys was loaded into an Excel spreadsheet that captured the difference between the pre-participation and post-participation scores. In this study, a self-assessment instrument, a retro-pre-questionnaire, was used to study the perceived effect of structured genetics examination skills training (SGEST) imparted to third-year undergraduate students. The objective item scores were added to obtain the overall score and the descriptive statistics for before and after the training. A paired t-test was used for evaluating the difference in the overall scores.

RESULTS

A total of 38 questionnaires were returned, representing a return rate of 78.9%. Table 1 shows that students highly regarded the flipped classroom activities. The mean scores for the five questions asked were very high (all greater than 2.5) and it ranged from 3.85 to 4.04. The standard deviations for all 5 questions were very different, ranging from 21 to 38. It was very encouraging to know that they rated "I have improved my academic achievement" the highest, followed by "I am satisfied with Flip-U efficiency."

Table 1. Students feeling about flipped classroom experience

Degree of satisfaction	Observation	Comprehension	Comparison	Organization	Reasoning	Application	Total
I am satisfied that Flip-U meet my learning needs	2	4	5	7	1	2	21
I am satisfied with Flip-U efficiency.	7	5	3	4	3	3	25
I am satisfied with Flip-U effectiveness.	2	2	2	2	3	5	16
I am satisfied with the Flip-U motivation.	5	3	4	2	2	4	20
I have improved my academic achievement	4	6	6	5	11	6	38

The students' responses to the retro-pre-questionnaire before and after the structured genetics examination skills training were given in Table 2. Out of the 27 students trained, 20 completed the retro-pre-questionnaires. The increase in scores was statistically significant (mean±SD, 5.54±5.76; 95% confidence interval, 3.16 to 7.92), which implied that the students perceived that they learned most of the skills after the SGEST module and that the course was effective. Further, the paired correlation was not very high (r = 0.178), but it was

in the positive direction and was statistically significant ($p > 0.05$), implying that the questionnaire before score had a low impact on the questionnaire after score.

Table 2. Student response to the retro-pre- questionnaire before structured genetics examination skills training in Dong-eui University

No.	Chapter	Not confidence		Confidence	
		Before training	After training	Before training	After training
1	Introduction to Genetics	25.0	23.4	2.5	7.3
2	Mitosis and Meiosis	80.0	75.5	58.9	63.6
3	Mendelian Genetics	100.0	92.7	75.5	88.0
4	Extensions of Mendelian Genetics	30.5	25.6	0.0	1.6
5	Chromosome Mapping in Eukaryotes	100.0	90.5	35.5	33.7
6	Genetic Analysis and Mapping in Bacteria and Bacteriophages	52.3	45.8	12.8	10.2
7	Sex Determination and Sex Chromosomes	83.5	75.6	55.6	60.2
8	Chromosome Mutations: Variation in Number and Arrangement	23.3	24.2	50.2	63.3
9	Extranuclear Inheritance	20.6	15.5	25.7	20.0
10	DNA Structure and Analysis	18.6	20.0	15.9	20.4
11	DNA Replication and Recombination	56.5	45.2	20.7	34.7
12	DNA Organization in Chromosomes	29.6	25.5	26.9	42.5
13	The Genetic Code and Transcription	33.6	30.2	15.5	23.4
14	Translation and Proteins	44.5	42.5	15.3	16.6
15	Gene Mutation, DNA Repair, and Transposition	45.5	45.7	15.5	22.2
16	Regulation of Gene Expression in Prokaryotes	27.2	33.5	10.0	10.8
17	Regulation of Gene Expression in Eukaryotes	11.3	10.1	0.0	4.4
18	Developmental Genetics	100.0	88.8	80.0	90.9
19	Cancer and Regulation of the Cell Cycle	95.1	91.2	80.0	85.8
20	Recombinant DNA Technology	55.6	55.2	66.7	74.6
21	Genomics, Bioinformatics, and Proteomics	57.7	50.0	30.7	26.5
22	Applications and Ethics of Genetic Engineering and Biotechnology	56.8	59.9	33.3	42.6
23	Quantitative Genetics and Multifactorial Traits	66.7	56.5	52.4	49.9
24	Neurogenetics	20.3	22.8	20.8	18.8
25	Population and Evolutionary Genetics	33.6	35.2	24.3	30.5

Lastly, 20 students were to answer whether students will have a significant gain in the knowledge of the lesson topic trailed in this study. With the calculation of the difference between the means of pre-test and post-tests (i.e. before and after the use of flipped classroom pedagogy) in ‘Observation’ by using a paired sample t-test, it can be found that there was a statistically significant difference in the scores obtained in the pre-test (M= 33.80, SD=9.63)

and post-test (M=35.75, SD=10.17); t = 3.347, p >0.01) (Table 3 for details of the results of paired samples t-test). The increase in scores was statistically significant (mean±SD, 1.95±2.61; 95% confidence interval, 0.73 to 3.17). The differences between the mean scores of pre-test and post-tests for 'Comprehension' were also calculated separately to see if there was any difference in the results. There was a statistically significant difference in the scores obtained in the pre-test (M=37.0, SD=7.33) and post-test (M=40.4, SD=7.78); t = 5.93, p > 0.001). The increase in scores was statistically significant (mean±SD, 3.40±2.56; 95% confidence interval, 2.20 to 4.60). The differences between the mean scores of pre-test and post-tests for 'Comparison' were also calculated separately to see if there was any difference in the results. There was not shown a statistically significant difference in the scores obtained in the pre-test (mean±SD, 0.85±1.90; 95% confidence interval, -0.04 to 1.74). The differences between the mean scores of pre-test and post-tests for 'Organization' were also calculated separately to see if there was any difference in the results. There was a statistically significant difference in the scores obtained in the pre-test (mean±SD, 4.75±4.68; 95% confidence interval, 2.56 to 6.944).

The differences between the mean scores of pre-test and post-tests for 'Reasoning' were also calculated separately to see if there was any difference in the results. There was a statistically significant difference in the scores obtained in the pre-test (mean±SD, 2.20±4.0; 95% confidence interval, 0.33 to 4.07). The differences between the mean scores of pre-test and post-tests for 'Application' were also calculated separately to see if there was any difference in the results. There was a statistically significant difference in the scores obtained in the pre-test (mean±SD, 3.95±3.33; 95% confidence interval, 2.39 to 5.51).

Table 3. Results of t-test and 95% confidence interval of the difference for paired samples (pretest-posttest)

	Mean	SD	SE	Difference		T value	Significance
				Lower	Upper		
Observation	1.95	2.605	0.583	0.731	3.169	3.347	**
Comprehension	3.40	2.563	0.573	2.201	4.599	5.933	***
Comparison	0.85	1.899	0.425	-0.039	1.739	2.001	NS
Organization	4.75	4.678	1.046	2.561	6.939	4.511	***
Reasoning	2.20	3.995	0.893	0.330	4.070	2.463	*
Application	3.95	3.332	0.745	2.391	5.509	5.302	***

NS: Not significance, *: 5%, **: 1%, ***: 0.1%.

DISCUSSION

In the traditional teacher-centered model, the teacher is the main source of information, the teacher is the "sage on the stage" (King, 1993), i.e. the sole content expert who provides information to students, generally via direct instruction lecture. In the Flipped Learning model, there is a deliberate shift from a teacher-centered classroom to a student centered approach, where in-class time is meant for exploring topics in greater depth and creating richer learning opportunities. The most widely used evaluation tool is a traditional "pre-then-post" test, where participants are asked a series of questions at both the start of a program (pre-test) and then again at the end of program (post-test) (Piryani et al., 2013). This tool is believed to measure changes in participant knowledge, attitudes, or behaviors regarding whatever the program content is (Colosi & Dunifon, 2006). However, implementing program evaluations to measure change using a traditional pretest-posttest model can be difficult to plan and execute (Lynch, 2002). The criticism of the traditional pre/post tool has led to the

use of a "retrospective pre-test" tool. In essence, a retrospective pretest is distinguished from the traditional pretest by its relationship to the intervention (or program). That is, a retrospective pretest is a pretest administered post-intervention, asking individuals to recall their behavior prior to an intervention (Allen & Nimon, 2007).

The perceived impact of SGEST imparted to third-year undergraduate molecular major students from the paired t-test showed that the difference between before and after the SGEST was statistically significant, which implied that the students did learn most of the skills after the implementation of the SGEST module and that the training was effective. It is important to acknowledge that all self-confidence could be considered somewhat subjective. In addition, we found that flipped-class pedagogy enhanced the validated motivated strategies for observation, comprehension, organization, reasoning, and application except comparison.

CONCLUSIONS

Flipped classroom instruction is an emerging educational trend in higher education, implemented across academic disciplines. Our study on the effects of flipped-class pedagogy on motivation and strategies for genetics shows that flipped-class session for traditional lecture sessions appeared to be sufficient to achieve changes in learning strategies of students toward deep-learning strategies.

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