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Impact of Simulation Based Education on Biology Student's Academic Achievement in DNA Replication

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Abstract
The aim of this study is to determine the effect of simulation methods in teaching Science on education students' academic achievement.70 students (35 control, 35 experimental) who studied at Srinivasa College of education, SV University in the Department of Education. 2015-2016 academic year students were participated in this simulation based instructional strategic research. Mixed methods approach, which included both qualitative and quantitative methods, were used. Instructional strategic methods were included from the biological science subject of DNA replication and transcription. Statistical results of the data obtained after the application showed that students of the experimental group who were taught using simulations were more successful than the students of the control group who were taught by the traditional approach. Also, it was determined that education students of the experimental group were satisfied by simulation-based education specially in science domain.
Keywords: DNA replication, Transcription, Science education, simulation-based education, education technology.

1. Introduction

DNA replication is one of the vital topics in genetics and considered it as a key topic in biology education. Due to its evolutionary steps in biological process it has become part of our day to day life. Evolutionary science and DNA replication evolving rapidly in recent decades. The findings of the researchers revealed new ideas and findings in biological sciences. In present scenario people have at least basic knowledge in understanding the DNA replication and genetics. First and foremost, scientific world need to inform and inculcate the results and findings of genetics to the society. Beyond the above in educating the society, education sector, universities and schools play a vital role (Knippels M 2002). Study of DNA replication and genetics give important knowledge on how the living beings are living and biological reactions takes place inside our body. The development of technology and genetics research has shown a considerable impact on medicine, health, lifestyles and food production. However, due to its complexity nature of DNA replication most of the university students and education students consider it as difficult to learn. It leads to misunderstanding and misconceptions towards the genetics and as well as DNA replication concepts in biology. Comprehensively DNA replication in genetics play an important role in biology but there are considerable constraints in understanding (Chu YC 2008). Most of the students and teachers perceived and considered DNA replication as one of the difficult topics in genetics (Knippels M Waarlo AJ and Boersma K 2005).

Inherently, the complexity of these in vivo processes and their association is often difficult for the beginners and newcomers to understand the steps that involve in genetics. For instant, students in the process of learning DNA transcription, the role of polymerase is often not understood due its wide variety of uses in transcription. Novice students may not understand and realize that RNA polymerase does not act alone, but its multicomplex nature plays a vital role in transcription process. Each complex of Polymerase plays an essential role in the production of RNA. Novice students feel difficult to visualize the complexities underlying in molecular and cellular processes. Furthermore, to teach these complex processes to the newcomers is a major challenge to the instructors. These challenge, many instructors no longer simply focus on delivering the lectures in class, give assignments and assign homework from reference textbooks. Most instructors are looking for new technological approaches that enhance student's understandability and learning of biological processes. The utilization of visualization is significant among these approaches (Mc Clean P Johnson C Rogers R Daniels L Reber J Slator BM Terpstra J and White A 2005).

Computer based flash animation technology, a new educational tool that promotes long-term memory and ease to learn (Rieber LP 1994). The significant importance of animations appears to be associated with the dual-coding theory (Paivio A 1991). Dual coding theory revealed that the long-term memory retention achieved by a combination of verbal and visual cues. Fundamentally animations are the one of the most important and valuable aids in learning process and visual aspects support in long-term memory (Mayer RE and Anderson RB 1991).

In recent decades, classroom education has adopted use of information technology and simulation based animations strategic methods in science education for better understanding and traditionally adapt the prevailing

levels of science and technology rote learning in education and facts (Sasikala P and Siriwan Tanyong 2016). This is a legacy of behaviouristic ways to teach science and instructional techno models that adapted to focus on the direction that attention on the science segments and building blocks of science discipline rather than engaging students in the actual practices with the envision of the building blocks must be mastered before proceeding to overarching processes. These standard implications of learning, educating, and evaluation, regardless, don't acclimate to the national measures for science preparing and the broader 21st century aptitudes saw as fundamental for all subjects including sciences, the NRC report, Taking Science to School (Knippels M (2002, Sasikala P and Siriwan Tanyong 2016) coordinates current perspectives on goals for science learning.

It is therefore pertinent to provide tools that can make teaching and learning difficult biology concepts such as genetics easier and concrete. One such tool may be Computer Simulation Instruction strategy, the basis of this research in which computer simulation was used in teaching some undergraduate students DNA replication and transcription concepts. In light of the available literature, there are diverse studies have been attempted on simulation models to understand the concepts of biology.

However, there is a lacuna of literature on the effect of simulations on academic success of education students. In future where they are going to be used as a tool for supporting theoretical lectures. Therefore, the purpose of the present study is to evaluate the academic success rate in education students by simulation methods. In order to fulfil the purpose of the study, the authors have sought answers to the following questions:

Difference between achievement scores of education students of biology, taught DNA replication concepts by using simulation instructional strategy and when compared with control groups taught the same concepts using lecture method.

Difference in the retention of biology education students taught DNA replication concepts using computer based simulation instructional strategy and when compared with the control groups (taught using conventional lecture method). difference in the mean scores of male and female students in experimental and control groups in their academic success in DNA replication.

2. Methodology

In this study, an experimental paradigm which consists pre-test and post-test of the control group. A mixed paradigm which consists the qualitative data were used to achieve the objective of the study. A deep analysis is required in order to make sure to show all aspects of the present study done in scientific research. To achieve such objectives, it is very important for the findings of research study that based on the paradigm of mixed research where both qualitative and quantitative research patterns are to be reliable (Sasikala P and Siriwan Tanyong 2016) adapted and modified (Sasikala P and Siriwan Tanyong 2016).

Graduate students supported by simulations constituted the experimental group and those who are not supported by simulations constituted the experimental control group. Students of the control group lessons were taught and given by the researcher with traditional methods in teaching namely black board, where as in case of the experimental group students were received the simulation based teaching. A “Success Test” was conducted for both groups before and after experimentation based on Biology. Also, an interview was conducted based on semi structured questions at the end of the experimentation.

Study Group 70 students (35 control, and 35 experimental groups) who studied bachelor of education (B. Ed, and D. Ed) course in the Department of Education, students of the first semester of the academic year 2015-2016 were selected for the study. The age of the students, who participated in the present research ranged from 20-23.

DNA Replication Biology Success Test (DRBST) (Pre-Test/Post-Test) was used as tool to collect the data. Researcher prepared a multiple-choice success test on DNA replication process and its importance in genetics in day to day life. To analyse the reliability and validity of the data, a test was conducted to 45 students apart from the students who participated in the study and taught the Biology by traditional methods to students. The percentage of correct answers in the test and the percentage of the item known were calculated. The research data collected by DRBST pre-test from experimental and control groups before and after the study.

Data Analysis Qualitative and quantitative research methods were used together in this study. SPSS 22.0 was used to analyse the quantitative data. Independent t-test was used to analyse the quantitative data obtained from the success test.

3. Results and Discussion

Table 1. Pre-test scores of the control and experimental and control group graduate students of education on DNA replication.

Group	N	Mean ± SD	Std. error difference	P	t value
Control	35	39.22±2.39	0.729	P= 0.941	0.0762
Experimental	35	39.27 ± 1.50			

Pre-test results revealed that the mean of the pre-test score card points of the experimental graduate

students was 39.27 when compared to their respective control group 39.22. The study results were not significantly varied between the means of control and experimental group students of education. Results of the present study evidenced that the both group students have the same levels of cognitive skills on DNA replication at the time of pre-test.

Table 2. Post-test scores of achievements of education students of biology, taught DNA replication concepts by using simulation instructional strategy and control groups taught the same concepts using lecture method.

Group	N	Mean± SD	Std. error difference	P	t value
Control	35	57.67 ± 3.28	1.93	p < 0.001	11.844
Experimental	35	80.56 ±5.39			

The post-test results demonstrate that the average marks of the experimental graduate students of the education is 80.56 when compared to their respective control group 57.65. The results of the present study show that statistically significant variations between the means of control and experimental group students of education ($p< 0.001$). The results evidenced that the experimental students have improved significantly in their cognitive skills than that of the control group students. Hence, that animated based simulation-supported strategic teaching methods in genetics and DNA replication is much more effective than the traditional teaching methods science education domain.

Table 2. post test results on retention ability of biology education students taught DNA replication concepts using computer based simulation instructional strategy and when compared with the control groups (taught using conventional lecture method).

Group	N	Mean± SD	Std. error difference	P	t value
Control	35	21.11 ± 1.17	0.444	p < 0.001	23.75
Experimental	35	31.67 ± 1.87			

Table 2 demonstrates that the experimental groups students are significantly improved in their rote-learning and retention cognitive skills when compared with their respective control groups. Hence, the study results provided concrete evidence on simulation-supported strategic teaching methods in genetics and DNA replication.

Table 3 post-test results on academic achievement of male and female biology education students in DNA replication.

Group	N	Mean± SD	Std. error difference	P	t value
Male	39	3.36 ± 0.39	0.152	p < 0.001	10.05
Female	31	3.89 ± 0.33			

From the post test results on academic achievement of the students (table 3) revealed that academic achievements of female students are significantly increased in DNA replication.

Table 4. DNA replication pre-test scores of different sections.

Factor	Control	Experimental	Std. error difference	P	t value
Fill in the blanks (10)	3.76 ± 0.28	3.83 ± 0.48	0.383	P= 0.577	1.86
Matching (10)	3.88 ± 0.87	3.85 ± 0.187	0.33	P= 0.366	1.00
Short answer (10)	4.40 ± 0.51	4.41 ± 0.47	0.06	p =1.00	0.00

The findings of the present study pre-test results of different sections namely fill in the blanks, matching, and short answers shows that the mean of the pre-test score card points of the experimental graduate students of the education are 3.76, 3.88, and 4.40 when compared to their respective control group as 3.83, 3.85 and 4.41respectively. The results of the present study show that there are no significant variations between the means of control and experimental group students of education in different sections namely fill in the blanks, matching, and short answers in genetics and DNA replication. That means the both control and experimental group students has the same cognitive levels of at the time of pre-test.

Table 4. Post-test scores of the control and experimental graduate students of education in different sections.

Factor	Control	Experimental	Std. error difference	P	t value
Fill in the blanks (10)	5.5 ± 0.59	7.53 ± 0.58	0.29	P< 0.001	6.35
Matching (10)	4.91 ± 0.58	8.00 ± 0.77	0.37	p < 0.001	8.23
Short answer (10)	5.75 ± 0.59	8.33 ± 0.70	0.33	p < 0.001	7.84

The post-test results of the present study show that the average marks in different sections namely fill in the blanks, matching, and short answers of the experimental graduate students of the education is 7.53, 8.0, and 8.33 respectively when compared to their respective control groups 5.5, 4.91 and 5.75. The results of the study showed that statistically significant variations between the means of control and experimental group students of education ($p< 0.01$, $p< 0.001$, and $p< 0.001$).

4. Summary and Conclusion

The results evidenced that the experimental students have improved significantly in their cognitive skills than

that of the control group students. Experimental group student's rote-learning and retention cognitive skills significantly improved. Academic achievements of female students have been significantly increased in DNA replication. The results of the different sections revealed and evidenced that statistically significant variations between the means of control and experimental group students of education. Hence, that animated based simulation-supported strategic teaching methods in genetics and DNA replication is much more effective than the traditional teaching methods science education domain.

References

[1]. Knippels, M. (2002). Coping with the abstract and complex nature of genetics in biology education – The yo-yo learning and teaching strategy. Utrecht: CD-β Press, Centrum voor Didactiek van Wiskunde en Natuurwetenschappen, Universiteit Utrecht (CD-β Wetenschappeliike Bibliotheek, nr. 43)

[2]. Chu, Y.C. (2008). Learning Difficulties in Genetics and the Development of Related Attitudes in Taiwanese Junior High Schools. (An unpublished PhD dissertation). Centre for Science Education Educational Studies, Faculty of Education University of Glasgow, United Kingdom

[3]. Knippels, M., Waarlo, A. J and Boersma, K. (2005). Design criteria for learning and teaching genetics Journal of Biological Education 39(3): 108-113

[4]. McClean, P., Johnson, C., Rogers, R., Daniels, L., Reber, J., Slator, B.M., Terpstra, J and White, A. (2005) Molecular and Cellular Biology Animations: Development and Impact on Student Learning. Cell Biology Education Vol. 4: 169–179

[5]. Rieber, L.P. (1994). Computers, Graphics, and Learning, Madison, WI: Brown and Benchmark.

[6]. Paivio, A. (1991). Dual coding theory: retrospect and current status. Can. J. Psychol. 45, 255– 287.

[7]. Mayer, R.E., and Anderson, R.B. (1991). Animations need narrations: an experimental test of a dual-coding hypothesis. J. Educ. Psychol. 83: 484–490.

[8]. Sasikala P, and Siriwan Tanyong. (2016). A Study on Simulation Methods in Academic Success with Reference to Teaching Biology for Education Students. J. Edu. Pract. 7(11): 164-168.