



Interaction Effect Of Gender And Teaching Methods On Students' Interest, Achievement And Retention In Sexual Reproduction In Plant

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ABSTRACT

This study investigated the interaction effect of gender on teaching methods. The research designed used in the study was Quasi experimental design, the sample size was 178 students (84 females and 94 males). Three research questions were asked and three null hypotheses formulated and tested at 0.05 level of significance. Two instruments employed for the study were Plant Reproduction Interest Inventory (PRII) and Plant reproduction Achievement Test (PRAT) and the validity indices were 0.88 and 0.81 respectively. The findings of the study revealed that there is no significant interaction effect of Computer Simulation Strategy and Conventional Teaching Method and gender on students' interest, with p -value of 0.963, no significant interaction effect of gender and teaching Method on students' achievements with F -ratio = .533 and p -value of 0.466 and there was no difference in the interaction effect of both sexes with teaching strategies on students' retention score with F -ratio 1.666 and p -value of 0.199. It was concluded that the males and females have not responded to the treatment differently, hence, gender is not a factor in designing the intervention. Based on the results of the findings, it was recommended among others that Computer Simulation teaching Strategy should be employed in teaching Biology in Secondary Schools in Niger state.

Keywords: computer Simulation, conventional teaching method, Biology

INTRODUCTION

Science subjects such as Biology are taught in secondary schools to prepare students to study science and technological related courses which will enable them pick up science and technology related professions after graduation. Biology is an experimental science which is concerned with the composition, properties, and activities of living things. However, the West African Examination Council (WAEC 2021) Chief Examiner's report on Biology results indicates that students' performance in Biology is not encouraging in the Senior Secondary School Certificate (SSCE). The WAEC Chief Examiner's attributed the poor achievement of students to their unfamiliarity with the use of simple laboratory equipment, inadequate exposure to laboratory techniques, lack of observational skills, omission of units in calculated values, inability to draw and label diagrams correctly, inability to spell some Biology terms correctly, among others. This problem of Biology students' under-performance in secondary schools in Nigeria has been worrisome. In solving any problem however, it is pertinent to understand the causes of such problems. These causes are looked into from several perspectives including the role of the students, teachers, parents or family, school environment, society, government and also the teaching methods and practices among others. Gender is one of the factors identified by several researchers in the literature to have significant influence on students' academic achievement especially in science subjects like Biology (Nkok 2019). Generally, what are regarded as complex and difficult tasks are allocated to boys whereas girls are expected to handle the relatively easy and less demanding tasks. Conventionally, girls in our society have been encouraged to conform, whereas boys are expected to be active and dominant risk-takers. Thus, social expectations and conformity pressures may create cultural blocks to girls in Biology classrooms Okeke (2007). This results to a Nigerian girl child going to school with these fixed stereotypes which

can influence the interests, achievement and retention rate of Biology students in secondary schools (Adu, 2018)

In view of the fact that gender disparity may have impact on the students' academic performance in Biology. Gender differences in Biology achievement have been examined for some time resulting in a substantial body of literature. Treatment interaction generally implies that different learners with different characteristics may benefit by means of understanding the concept taught from one type of instructional method than from another therefore it may be possible to find the best match of learners' characteristic and instructional method in order to maximize learning outcomes.

In Nigeria, there has been recurring arguments on the interacting effect of gender and treatment on mean retention score of Biology students taught using different teaching strategies, a lot of researches have been carried out on treatment interaction in order to ascertain the best teaching strategy most especially in the field of pure sciences, but most results have been inconclusive, or proven wrong due to the recent performances of the students. Therefore, ascertaining the existing treatment interactions, and also determining a suitable teaching strategy in the field has not been achieved. The importance of examining instructional strategy in relation to gender is based primarily on the socio-cultural differences between girls and boys. Computer simulation strategy as one of the innovative teaching strategies might produce an interesting results when examined with respect to gender.

According to Thompson, Simonson and Hargrave (1996) Computer simulation is an instructional strategy that represents the model of an event, object, or some phenomenon. In science education a computer simulation strategy according to Akpan and Andre (1999) is the use of the computer to simulate dynamic systems of objects in a real or imagined world. Computer simulation models are simulation models that can bring into the classroom, aspects of the world or universe that are too expensive, dangerous, difficult, too slow or too fast in occurrence to be experienced firsthand. In Biology classrooms, simulation can play an important role in creating virtual experiments and inquiry (Alessi and Trollip, 1991). Computer base simulation instructional package is an innovative teaching strategy which combines both audio and visuals in a near real life situation in class rooms. It is an interactive instructional strategy that allows students learn at their own pace, reduces teachers workload as the act as learning facilitators, encourages active participation of learners, gives room for repeated trials of an experiment among others advantages, Since the nature of Computer simulation strategy connotes the Nigerian Biology Curriculum, it is therefore assumed that the use of computer simulation teaching strategy may lead to meaningful learning by sustaining students' interest in the learning process, greater retention of the concept taught, and improved academic achievement in external examinations (WAEC and NECO).

While it has not been substantiated that the current poor performance of students in senior school certificate Biology examinations is as a result of the non-application of Computer Simulation Strategy to Biology instruction, analysis of the effects of a Computer Simulation Strategy on students' achievement and retention in Biology and its effect on gender may have interesting implications, which are worth exploring.

Because Computer Simulation Strategy may be gender based (depending on stimulus utilized) it may be worth speculating that it may have fascinating implications for male and female students in Biology classroom. It is therefore, worthwhile to see how Computer Simulation Strategy may bridge the gap of gender inequality. Thus, this paper seeks to examine the interaction effect of gender and teaching methods on mean interest and retention score of Biology students taught using Computer Simulation Instructional strategy (CSIS)

1.1 Research Questions

The following research questions were raised to guide the study:

- 1) What are interaction effects of gender and teaching methods on the mean interest ratings of students taught Sexual Reproduction in Plant?
- 2) What are the interaction effects of gender and teaching methods on the mean achievement scores of students taught Sexual Reproduction in Plants?
- 3) What are the interaction effects of gender and teaching methods on the mean retention scores of students taught Sexual Reproduction in Plants?

1.2 Hypotheses

The following hypotheses, were formulated and were tested at 0.05 level of significance:

- HO₁: There is no significant interaction effect of gender and teaching method on the mean interest ratings of students taught Sexual Reproduction in Plants concept.
- HO₂: There is no significant interaction effect of gender and teaching methods on the mean achievement scores of students taught Sexual Reproduction in Plants concept.
- HO₃: There is no significant interaction effect of gender and teaching methods on the mean retention scores of students taught Sexual Reproduction in Plants

METHODOLOGY

The study employed a survey research design. The population of the study was all senior secondary Biology students in Education zone B of Niger State and the sample size was 178 (84 girls and 94 boys). Biology students from four randomly selected coeducational secondary schools. Two questionnaires titled Plant Reproduction Interest Inventory (PRII) and Plant reproduction achievement Test (PRAT) were constructed and used to obtain information on the students' Interest and achievement in plant reproduction. . The validity and reliability indices of PRAT were determined to be 0.88 and 0.81 respectively. The students' response to the objective questions with four option SA for strongly Agree, A for Agree SD for strongly disagree and D for disagree, was used to test the students' interest in sexual reproduction in plants.

Plant Reproduction Achievement Test (PRAT) was administered on the students before the experimental treatment. The students' scores in the first administration served as pretest scores of the study. After the pretest, the treatment commenced and lasted for six weeks. The Plant Reproduction Interest Inventory (PRII) was adapted by the researcher from Hidi and Renninger's (2006) four-phase model as the theoretical foundation. The instrument was modified in line with the present study for data collection and to reflect students' interest in sexual reproduction in plants. The Computer Simulation Strategy was employed in the experimental group. The class was taught the concepts of sexual reproduction in plants using the Computer Simulation Strategy. The instructions were introduced by the teacher and presented by computer simulations package to students, students were actively involved in the learning process by manipulating the variables to notice the effects of change, listen to the explanations as presented by the computer and also watch the simulations on each of the lessons. After each lesson is evaluations based on the lesson, the students attempted it to assess their understanding of the lesson. At the expiration of the treatment, the items of this instrument were reshuffled, produced in a colored question paper and re-administered on the students. Information on the achievement of the students in the contents were elicited. This was administered on the experimental and control groups as pretest and posttest respectively. The hypotheses were tested using Analysis of Covariance (ANCOVA) using Statistical Package for Social Sciences (SPSS). The significance of the various statistical analyses were ascertained at 0.05 alpha levels.

RESULTS

Research Question 1: *What is the interaction effect of gender and teaching method on the mean interest ratings of students taught sexual reproduction in plants?*

The mean and standard deviation scores of interaction effects of gender and teaching methods in PRII is presented in table 1.

Table 1. The mean and standard deviation scores of interaction effects of gender and teaching methods in PRII

Teaching Method	Gender	Mean	SD	N
Computer Simulation	Male	67.48	9.208	46
	Female	66.00	13.141	36
Conventional Method	Male	34.54	16.735	56
	Female	35.68	13.135	41

Table 1 shows that the mean interest ratings and standard deviation of the interaction of gender and teaching Methods. From the table, the mean interest ratings of male students in CSS and CTM were 67.48 and 34.54 with standard deviation 9.208 and 16.735 respectively; while the mean interest ratings of the female students were 66.00 and 35.68 respectively for CSS and CTM with standard deviations of 13.141 and 13.135 respectively

Research Question 2: *What are the interaction effects of gender and teaching methods on the mean achievement scores of students taught sexual reproduction in plants?*

HO₁ There is no significant interaction effect of gender and teaching methods on the mean interest ratings of students taught sexual reproduction in plant.

The result of interaction effect of gender and teaching method in P_{RII} is shown on table 1

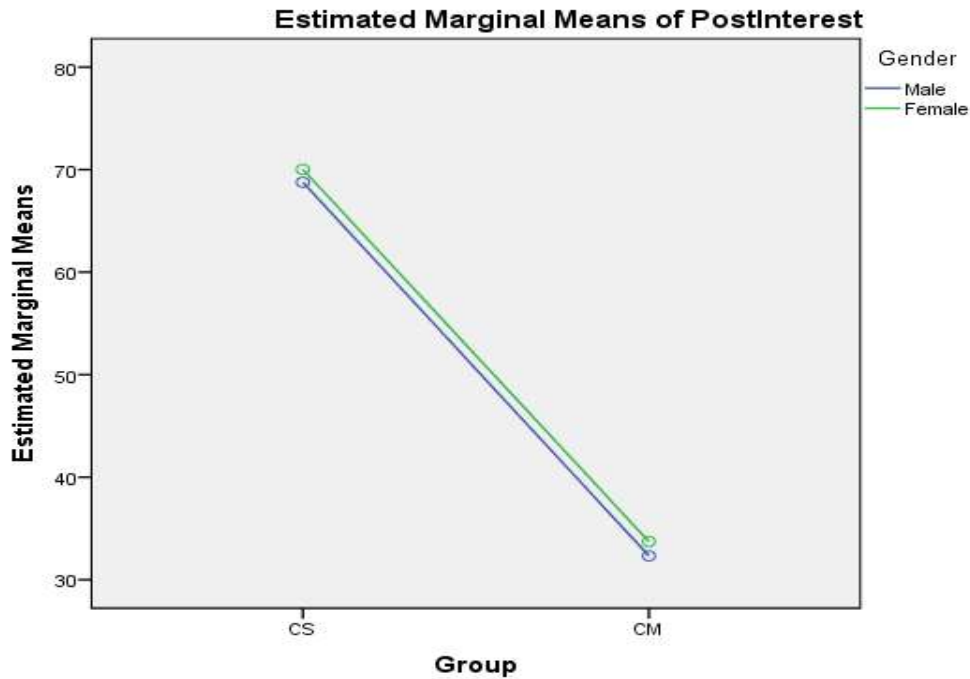
Table 2. Results of ANCOVA on Students' Interest Ratings in P_{RII} Based on Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	56942.561 ^a	4	14235.640	122.281	.000	.738
Intercept	33371.404	1	33371.404	286.652	.000	.622
Pre-Interest	11907.617	1	11907.617	102.284	.000	.370
Group	53275.044	1	53275.044	457.620	.000	.725
Gender	76.028	1	76.028	.653	.420	.004
Group * Gender	.245	1	.245	.002	.963	.000
Error	20256.668	174	116.418			

a. R Squared = .738 (Adjusted R Squared = .732)

The result in table 2 reveals that there is no significant interaction effect of teaching methods and gender on students' interest ratings as measured by P_{RII} at 0.05 alpha levels.

From table 2 the F-ratio is 0.100 and p-value of 0.963. Since the p- value of 0.963 is greater than 0.05, then the null hypothesis upheld. This implies that there is no significant interaction of teaching strategies and gender as measured by P_{RII}. This interaction effect suggests that males and females have not responded differently to the treatments. Therefore, gender is not a factor in designing the intervention.



Covariates appearing in the model are evaluated at the following values: PreInterest = 30.70

Fig 1: A Graph Representing Interaction Effect of Teaching Strategies with Gender on Mean interest scores.

Figure 1, Graph showing the relationship between teaching methods and gender on PRII ratings. In the plot, gender 1.00 and 2.00 represents male and female respectively while in the group CSS and CTM. The lines are parallel. Since the lines are parallel, we say that we have no interaction. Therefore, the plot above shows that the males and females have not responded to the treatment differently, hence, gender is not a factor in designing the intervention.

Table 3: Mean and standard deviation of interaction effects of gender and teaching methods on Students' achievement scores in PRAT

Teaching Method.	Gender	Mean	SD	N
CSS	Male	78.41	10.994	45
	Female	79.33	11.928	36
CTM	Male	57.64	12.134	56
	Female	62.09	13.185	41

H02: There is no significant interaction effects of gender and teaching methods on the mean achievements score of students taught sexual reproduction in plants

Table 3 shows that the mean achievement scores and standard deviation of the interaction of gender and teaching strategies. From the table, the mean achievement scores of male students in CSS group were 78.41 and CTM 57.64 with standard deviation 10.994 and 12.134 respectively; while the mean achievement scores of the female students were 79.33 and 62.09 respectively for CSS and CTM with standard deviations of 11.928 and 13.183 respectively.

Table 4: ANCOVA on Interaction of Teaching Methods and Gender on Student Achievement Scores in PRAT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	18053.652a	4	4513.413	32.238	.000	.427
Intercept	352133.300	1	352133.300	2515.189	.000	.936
Pre-Test	1126.986	1	1126.986	8.050	.005	.044
Group	16661.360	1	16661.360	119.007	.000	.408
Gender	203.566	1	203.566	1.454	.230	.008
Group * Gender	74.668	1	74.668	.533	.466	.003
Error	24220.466	173	140.003			

a. R Squared = .427 (Adjusted R Squared = .414)

Table 4 shows the summary of the two-way ANCOVA table on interaction of the instructional strategies and gender on students' achievement scores in PRAT. It shows the mean scores of students of the two levels of teaching strategies and gender relationship. The result in table 4 reveals that there is no significant interaction effect between teaching strategies and gender as measured by PRAT at 0.05 alpha levels. From table 4 the F-ratio is .533 and p-value of 0.466. Since the p-value of 0.466 is greater than 0.05, then the null hypothesis upheld. This implies that there is no significant interaction of teaching strategies and gender as measured by PRAT. This interaction effect suggests that males and females do not respond differently to the treatments. Therefore, gender is not a factor in designing the intervention.

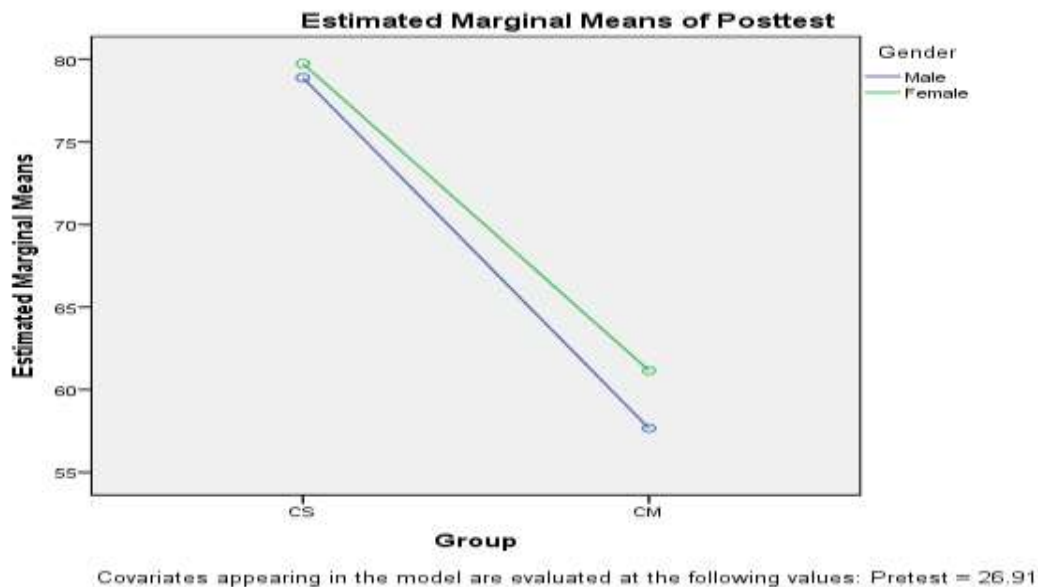


Fig 2 A Graph Representing Interaction Effect of Teaching Strategies with Gender on Mean achievement scores.

Figure 2, Graph showing the relationship between teaching methods and gender on PRAT scores. In the plot, gender 1.00 and 2.00 represents male and female respectively while in the group CSS and CTM. The lines are parallel. Whenever the lines are parallel, there is no interaction. Therefore, the plot above shows that the males and females do not respond to the treatment differently, hence, gender is not a factor in designing the intervention.

2.7 Research Question 3

What are the interaction effects of gender and teaching methods on the mean retention scores of students taught sexual reproduction in plants?

Table 5. Means and standard deviation of interaction effect of gender and teaching strategies on students' retention scores in PRAT.

Teaching Methods	Gender	Mean	Std. Deviation	N
CSS	Male	78.73	38.48	45
	Female	78.71	11.198	36
CTM	Male	39.29	10.614	56
	Female	38.48	9.064	41

Table 5 shows the mean retention scores and standard deviation of the interaction of gender and teaching strategies. From the table, the mean retention scores of male students in computer simulation group were 78.73 and conventional method were 39.29 with standard deviation 38.48 and 10.614 respectively; while the mean retention scores of the female students are 78.71 and 38.48 respectively for CSS and CTM with standard deviations of 11.198 and 9.064 respectively.

H₀₃: There is no significant interaction effects of gender and teaching methods on the mean retention scores of students taught sexual reproduction in plants.

Table 6. ANCOVA on interaction of teaching methods and gender on student's retention scores in PRAT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	79720.737 ^a	4	19930.184	346.633	.000	.889
Intercept	1234.349	1	1234.349	21.468	.000	.110
Posttest	9858.988	1	9858.988	171.471	.000	.498
Group	20988.024	1	20988.024	365.031	.000	.678
Gender	187.184	1	187.184	3.256	.073	.018
Group * Gender	95.796	1	95.796	1.666	.199	.010
Error	9946.904	173	57.497			

a. R Squared = .889 (Adjusted R Squared = .887)

Table 6 shows the summary of the two-way ANCOVA table on interaction of the instruction strategies and gender on students' retention scores in PRAT. It shows the mean scores of students of the two levels of both teaching methods and gender. The result in Table 4 reveals that there is no significant interaction effect between teaching strategies and gender as measured by PRAT at 0.199 alpha levels. From table 6 the F-ratio is 1.666 and p-value of 0.199. Since the p-value of 0.199 is greater than 0.05, then the null hypothesis upheld. This implied that, we do not reject the null

hypothesis since there is no difference in the interaction effect of both sexes with teaching strategies. This interaction effect suggests that males and females do not respond differently to the treatments. Therefore, gender is not a factor in designing the intervention.

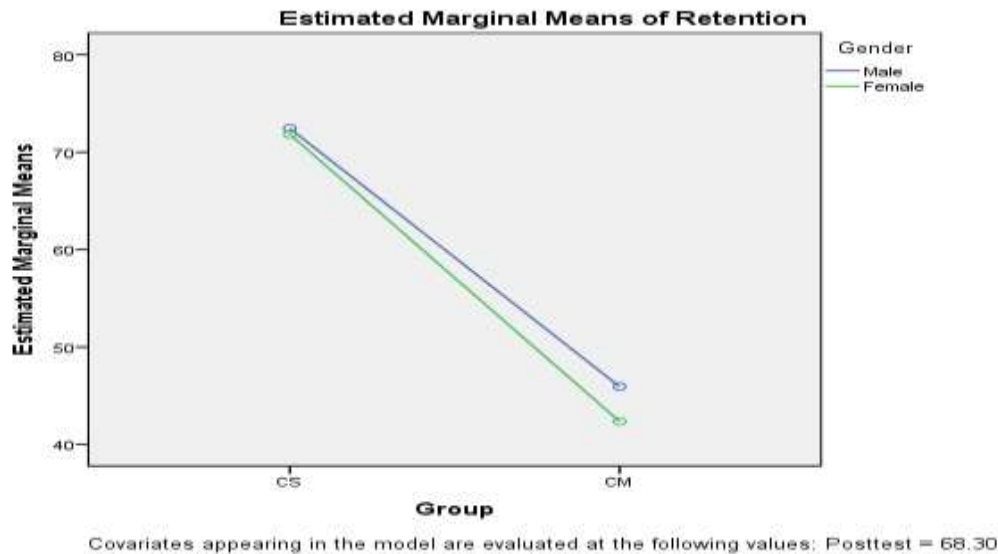


Fig 3: A Graph Representing Interaction Effect of Teaching Strategies with Gender on Mean retention scores.

Figure 3 Graph shows the relationship between teaching methods and gender on PRRT scores. In the plot, gender 1.00 and 2.00 represents male and female respectively while in the group there is CSS and CM. The lines are parallel. Whenever the lines are parallel there is said to be no interaction. Therefore, the plot above shows that the males and females do not respond differently to the treatment, hence, gender is not a factor in designing the intervention

DISCUSSION OF FINDINGS

Findings of the interaction effect reveal no significant interaction effect of Computer Simulation Strategy and Conventional Teaching Method and gender on students' interest in sexual reproduction in plants. However, since teaching method by gender interaction is not significant, it followed that the difference in the mean interest of male and female students is not due to the teaching strategy. This implies that the mean of the levels of both teaching methods and gender shows a consistent trend; thus, computer simulation Strategy which has been found to enhance male and female students' interest in sexual reproduction and which can be incorporated by Biology teachers in both male and female secondary schools. This is because the use of Computer Simulation Strategy in the study has proved no significant difference in the male and female students taught sexual reproduction in plants. This finding is in agreement with Abanikannda (2018) and Audu (2018) who reported that gender has no significant effect on students' interest.

Findings of interaction effect of gender and teaching methods on students' achievement reveal no significant interaction effect of gender and teaching Method on students' achievements. Computer Simulation Strategy interacted with gender to produce high mean achievement scores with the male students achieving higher than their female counterparts. Conventional Teaching Method interacted with gender to produce low mean achievement scores with the female students achieving higher than their male counterparts. Since interaction was not significant, the effect of Computer Simulation Strategy would enable male and female students to achieve at same pace. This finding is in agreement with the findings of Audu (2018) and Veselinovska (2018) who reported that there was no significant difference in the interaction effect of learning strategies and gender on students' achievement.

The findings of interaction effect of gender and teaching method on students' retention score reveal no significant interaction effect of retention on teaching methods, Computer Simulation Strategy interacted with gender to produce high mean retention scores with the male students retaining higher

than their female counterparts in the experimental group. While the Conventional Method interacted with gender to produce a lower mean retention score with male students retaining greater than their female counterparts. This result is also in agreement with that of Mihindo, Wachanga, and Anditi (2016)

CONCLUSION

Based on the findings of this study, Computer Simulation Strategy has same effect on male and female students' interest, achievement and retention ability level on sexual reproduction in Plants. It is therefore concluded that computer simulation instructional strategy is not gender biased as both male and female students achieved and retained the concept taught at the same pace.

Recommendation: From the findings of the study, it is recommended that

- 1) Biology teachers should always employ and apply computer simulation teaching strategies in teaching Biology in Nigeria secondary schools as computer simulation teaching strategy is gender friendly
- 2) Government should create opportunity for in- service training for teachers on the development and application of computer Simulation to teaching Biology
- 3) Teachers trainee should be taught the processes involved in development and application of computer simulation strategies for teaching and learning

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