Creative and Engagement Strategies in Teaching the Concept Diffusions as a Determinant of Academic Advancement of Students in Biology in United States of America

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ABSTRACT

The study sought to investigate the creative and engagement strategies in teaching the concept of diffusion as a determinant of academic advancement of students in biology. Comparative survey design was adopted for the study. The study was conducted in United States of America. The population of the study comprised all secondary school students offering Biology. Simple random sampling technique was used to select 150 female and 150 male biology students making a total of 300 respondents that constituted the sample size for the study. The Instrument used in this study for data collection was a questionnaire titled: "Creative and Engagement Teaching Strategies on the Concept Diffusion Questionnaire (CETSCDQ)". Face and content validation of the instrument was carried out by an expert in test, measurement and evaluation from University of California to ensure that the instrument has the accuracy, appropriateness and completeness for the study. The reliability coefficient obtained was 0.80 and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as independent t-test analysis. Test for significance was done at 0.05 alpha levels. It was discovered in the study that incorporating creative teaching activities is a positive addition to the curriculum. In doing so, higher education will continue to keep abreast of the needs of graduating students in a complex and rapidly changing professional environment. The study concluded that the roles of teachers in implementing innovative pedagogical practices, particularly those adopting inquiry-based learning have been widely recognized by researchers and educators. It was also concluded that there is significant difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategy. Finally, the result proved that there is significant effect of teaching strategies on the academic advancement of male and female secondary school students studying biology in United States of America. One of the recommendations made in the study was that biology teachers should always use appropriate teaching strategies such as creative and engagement teaching strategies in order to have them improve academic advancement of secondary school students in Biology.

KEYWORDS: Creative and Engagement Strategies, Teaching, Diffusion, Academic Advancement, Biology Students and United States of America

Introduction

Academic development units at universities around the world are often involved with supporting teachers who are in the process of writing a portfolio. The support ranges from individual supervision meetings, to workshops for larger groups, to online tutorials. Teaching portfolios are increasingly being used for assessing academic teachers' qualifications. According to Ryegård, (2013), one example is the assessment of teachers applying for membership of pedagogical academy. In addition to assessment, teaching portfolios are used for developmental purposes. Trevitt, Stocks, and Quinlan (2012) emphasize that writing a teaching portfolio has the potential of developing teachers' capacity to reflect when interpreting, making judgments, setting priorities, applying, and connecting what is learned about learning and teaching to their own practice. The teaching portfolio has been described as an interplay of text and action; it requires the teachers to verbalise their ideal teaching behaviour and then to live up to that ideal, and also to give the teachers a basis for evaluation and reflection where thinking may need to be re-negotiated in the light of its enacting (Buckridge, 2008). Writing a teaching portfolio thus offers a mechanism for developing and improving teaching practice (Buckridge, 2008). Although there is literature on the cognitive effects of portfolio writing (FitzPatrick & Spiller, 2010; Jones, 2010; Trautwein, Nückles, & Merkt, 2015), we have not been able to find any studies on its impact on teaching practice. And as such by inquiry-based learning, biology students will be capable of exploring authentic problems using the processes and tools they have learned of the biology disciplines. For inquiry-based learning to be successful the students must possess the basic skills to conduct scientific inquiry to investigate and/or solve a biological question.

Statement of Problem

Over the years, science education reformers have promoted the idea that learners should be engaged in the excitement of science but little has been put to practice. This, however, seems to create difficulties for the so-called working memory of biology students which again impairs their self-regulation competencies. Understanding the behavior of students in the academic institutions will provide a glimpse of how the instructions and academic practices are going on in the university therefore this paper will make a route for effective implementation. It is on this premise that this study is carried out to assess the way creative and engagement strategies are adopted in teaching the concept diffusions and to find out if this contributes to the academic advancement of students in Biology in United States of America.

Research Objectives

The following objectives were formulated to guide the study

1. To find out the difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategy.

2. To examine the effect of teaching strategies on academic advancement of male and female secondary school students studying biology in United States of America.

Research Questions

1. What is the difference in academic advancement between secondary school students studying biology in United States of America when taught with creative or engagement strategy?

2. What is the effect of teaching strategies on the academic advancement of male and female secondary school students studying biology in United States of America?

Hypotheses

$H0_1$: There is no significant difference in academic advancement between secondary school students studying biology in United States of America when taught with creative or engagement strategy

$H0_2$: There is no significant effect of teaching strategies on the academic advancement of male and female secondary school students studying biology in United States of America.

Conceptual Review

Concept of Teaching Strategies

Teaching strategies, also known as instructional strategies, are methods that teachers use to deliver course material in ways that keep students engaged and practicing different skill sets. A teaching strategy is the method you use to convey information to your students. Goodwin (2018) asserted that there may be a particular strategy that works well with your group of students one year that won't work with your students the next year. A solid foundation is always the most important, for without it, the structure becomes weak. An instructor may select different teaching strategies according to unit topic, grade level, class size, and classroom resources. Many kinds of instructional strategies are employed to achieve teaching and learning goals and support different kinds of students. There are various teaching strategies, including creative and engagement teaching strategy.

Concept of Creative Teaching Strategy

Creativity isn't always something that just happens. It can take quite a bit of work to nurture, grow, and develop creativity, even for those who are immersed in creative and dynamic fields (Staff 2015). Incorporating creative teaching activities is a positive addition to the e curriculum. Creativity is clearly an asset to the range of contemporary learning strategies. In doing so, higher education will continue to keep abreast of the needs of graduating students in a complex and rapidly changing professional environment.

Some tips that can help one get creative in the classroom in a variety of ways.

- **Be open to new ideas:** Even the most open-minded of us sometimes get stuck in a rut and can't see that there are other, potentially better ways of doing things. Break out of that and try to be open to new ideas, even if they seem strange at first.
- Get Active: Your brain needs lots of oxygen to think, and exercise gets it there faster.

- Think outside the box: Stop thinking about your classroom within strictly confined terms and be open to ideas that are outside of the norm. You might just find a creative idea that transforms some of your lessons.
- Look for ideas everywhere: Amazing ideas can come from anywhere at any time so always keep your eyes, ears, and mind open!
- Find excitement: One way to get your brain thinking creatively is to start learning about things that excite you. That excitement tends to get the brain motivated, and a motivated brain is an active and creative one.
- Get out of your comfort zone: It's hard to push yourself out of your comfort zone, but it may be just what you need to really get creative. Work with new groups of students, teach new topics, or try out something you're not comfortable with. It might work, it might not, but you'll never know if you don't try.
- Find inspirational places: Some lucky people may be able to find inspiration in a broom closet, but others of us need a place that pushes us toward inspiration. Whether it's a park, your living room, or even a place in your school, head there and get your creative juices flowing.

Concept of Engagement Teaching Strategy

Engagement Teaching Strategy is one of the modern learning processes adopted to increases learners' attention and focus as well as motivating them to practice higher-level critical thinking skills. It promotes meaningful learning experiences. Research has demonstrated that engaging students in class is success oriented.

Teachers with a greater sense of self-efficacy are more likely to attempt new ideas and incorporate high levels of instructional strategies, student engagement, and classroom-management strategies and test novel methods that bring about a change in student learning (Martin, Sass, & Schmitt, 2012). Encouraging students to use the 3R (read-recite-review; McDaniel, Howard, & Einstein, 2009) or SQ3R (Survey! Question! Read! Recite! Review!) reading methods is advisable because they are supported by research (Artis, 2008; Carlson, 2011). Students comprehend subject matter when taught using a variety of instructional techniques (Al–Alwan & Mahasneh, 2014). Thus, developing a setting to encourage student participation at the elementary and secondary levels leads to effective lessons, which increases learning (Watzke, 2005). Additionally, varied levels of efficacy can yield characteristics of effective or ineffective instructional strategies, student engagement, and classroom management (Tschannen - Moran & Woolfolk Hoy, 2001).

For many decades, science education reformers have promoted the idea that learners should be engaged in the excitement of science; they should be helped to discover the value of evidence-based reasoning and higher-order cognitive skills, and be taught to become innovative problem solvers (for review, see DeHaan, 2005 blue right-pointing triangle; Hake, 2005 blue right-pointing triangle; Nelson, 2008 blue right-pointing triangle; Perkins and Wieman, 2008 blue right-pointing triangle). But the means to achieve these goals, especially methods to promote creative thinking in scientific problem solving, are not widely known or used. An invention session such as that led by the fictional Dr. Dunne, may seem fanciful as a means of teaching students to think about science as something more than a body of facts and terms to memorize. In recent years, however, models for promoting creative problem solving were developed for

classroom use, as detailed by Treffinger and Isaksen (2005) blue right-pointing triangle, and such techniques are often used in the real world of high technology. There are various student engagement strategies for a Captivating Classroom such as:

- Connecting learning to the real world.
- Engagement with the students' interests.
- Filling “dead time”
- Using group work and collaboration.
- Encouraging students to present and share work regularly.
- Giving the students a say.
- Getting the students moving.
- Reading the room, Etc.

There are top strategies to adopt when teaching students in order to enrich the process of learning. These include addressing mistake, providing feedback and experiential learning as can be seen below:

Addressing Mistakes: If you’ve ever accidentally spelled a word wrong on the board, you know that students love to identify mistakes. When you’re teaching a new skill, try providing an example that includes mistakes. Let students practice the skill by identifying and fixing the mistakes for you. For example, many students cringe at learning grammar through traditional drills and lessons, but many can identify errors organically, even if they don’t know exactly how to fix them. Try passing out an assignment and deliberating including grammar errors, talk through the assignment in class, and see what students are able to catch. Then, have a discussion about why the mistakes might be wrong and see what students can come up with, then provide a mini lesson on the grammar errors at hand.

Providing Feedback: Students don’t always know if they’re doing a good job without you telling them so. Regularly provide written or verbal feedback for individual or group assignments and make this part of your classroom culture. Remember that students often don’t know why something is wrong, so whenever possible and time permitting, take a few moments to explain why you’ve marked something “incorrect” on tests and assignments. It’s also a great idea to conduct regular “group feedback” sessions based on patterns you’re seeing in your students’ work. If a fair share of your students seem to be struggling with a concept, it’s often more beneficial to create a lesson targeting that topic and discussing the patterns you’ve seen in class work generally.

Experiential Learning: Experiential learning (ExL) is the process of learning through experience, and is more narrowly defined as "learning through reflection on doing". Hands-on learning can be a form of experiential learning, but does not necessarily involve students reflecting on their product. In this case students learn by doing, so create experiences for them to see the concepts in action. Let them practice the concepts in a safe environment. Then, they

should reflect on the experience and discuss what they learned from it. Classroom activities that you could do for experiential learning include fun games, experiments, or simulations.

Concept of Diffusion

Diffusion is the net movement of anything (for example, atoms, ions, molecules, energy) from a region of higher concentration to a region of lower concentration. Diffusion is driven by a gradient in concentration (Wikipedia 2010). The concept of diffusion is widely used in many fields, including physics (particle diffusion), chemistry, biology, sociology, economics, and finance (diffusion of people, ideas, and price values). The central idea of diffusion, however, is common to all of these: a substance or collection undergoing diffusion spreads out from a point or location at which there is a higher concentration of that substance or collection. Rogers (2003) states that Diffusion is a social process that occurs among people in response to learning about an innovation such as a new evidence-based approach for extending or improving health care. In its classical formulation, diffusion involves an innovation that is communicated through certain channels over time among the members of a social system. Diffusion is the process of movement of molecules under a concentration gradient (BYJU'S 2017). It is an important process occurring in all living beings. Diffusion helps in the movement of substances in and out of the cells. The molecules move from a region of higher concentration to a region of lower concentration until the concentration becomes equal throughout.

Diffusion, derived from the Latin word "diffundere" meaning to spread out, is a mass transport phenomenon in both fluids (without requiring bulk fluid motion) and solids. Both macroscopic or phenomenological and microscopic or atomistic and molecular approaches are employed to introduce the concept of diffusion. According to the former approach, the diffusion transport goes from regions of high concentration to regions of low concentration, whereas according to the latter diffusion is a result of the random walk of the particles. In molecular diffusion, moving molecules are self-propelled by thermal energy (Gaur, Mishra, & Susanta 2014). Diffusion is movement of solute and water molecules by random thermal, Brownian motion; the motion results from the impact of one molecule hitting another, imparting momentum. The random motions of a spherical molecule in a uniform medium have the same statistical properties in all directions; diffusion is normally isotropic.

Concept of Academic Advancement

We believe that academic advancement should seek to contribute to a theory of "higher education" (Brew, 2002) as a field of the discipline of education, and that this should be a responsibility of all members of our profession. At present, such a position cannot be fully achieved while some developers are not employed to do research, are actively discouraged from doing so, or adopt a theoretical approach to their work (Rowland, 2001). Marginson and Considine (2000) suggest that academic disciplines should not have their potential set "according to the imaginative horizon of managers" because their expertise is not sufficient for the task. To attain academic status for our profession we will need to overcome structural and conceptual problems. There are many ways a university can manage its development function, and judging by the constant re-organizations many of us seem to experience, it appears that there is no canonical view on how to do this. Academic development might remain part of the administrative structure or be located in a regular academic faculty or department, such as

education, but neither of these options gives us the independence that would allow us to provide a genuine academic-based service to all members of the university community.

Creative and Engagement Strategies

According to Profiletree (2020), a creative strategy is sort of like an itinerary or a plan of what is going to happen so that you can see what is going on, another reason that creative strategies are important is that they provide a visual representation of what the advertising plan is going to accomplish. It can be difficult to understand what this or that means when it is explained in words but with a visual representation, it can be much easier to really see what is going on. It can help those that may not be able to understand with words to know what is going on and what the end goal for any advertising campaign really is. Lastly, a good creative strategy provides a benchmark system so you can really see what the advertising campaign has accomplished so far, what it is set to accomplish, and how the course of the campaign is going to unfold as it progresses. It really provides a plan for what is going on so that you can see what is happening and what is going to happen as well.

The first benefit we'll look at is this: it allows teams to express their ideas and hash out a plan before anything really begins. Instead of having to guess where an advertising campaign stands or what the next steps are, you can look to your creative strategy to see where the campaign is. Another benefit is that a creative strategy provides much needed organisation to the somewhat hectic advertising process. What might seem like a really difficult process can be greatly simplified by having a creative strategy in place. This sort of organisational tool can make a huge difference and can help smooth out wrinkles and make for a much smoother transition from each phase of the advertising process. Another benefit of a creative strategy is that it allows the creative team to really flex their muscles and come up with some brilliant ideas. There is some amount of freedom when it comes to the overall process of a creative strategy team and this really appeals to a large number of people. Those that were quiet and reserved may have a bigger part in the team that you thought possible and they may end up having ideas that you were never aware of that truly work for the overall advertising process. A creative strategy offers a chance for those that are looking to express ideas, those that have ideas to share, and those that may work better in a team to really voice their opinions and do something that they may not have been comfortable doing on their own before.

With the right creative strategy team and the right creative strategy in place, anyone can get their advertising campaign on track and can get the most out of it. The Engagement Strategy enhances the quality of research and supports the transfer of research into practice. It ensures the best possible experience for our students during and after their studies and serves to enhance the status and reputation of the University. Engagement strategy" was born out of her trying to create a tailor made mixture of services for each and every client individually. However, Engagement strategy is not a service based perspective. It looks at the whole business model from a very different angle, the one of communities. Engagement strategy begins with identifying the communities of a business, learning their language, the places they "hang in" (online and offline!), their actual needs from the client's business or brand, and from there stimulate the business growth process.

Universities adhere to the following principles in its internal and external engagement activities and these need to be upheld at an institutional, school, service and individual levels:

Openness–we perceive the University as a learning community and we wish to make the boundaries of this community permeable, particularly where circumstances, structures and social relationships may otherwise present barriers.

Mutuality–we recognize that we have much to learn from society to which we belong as well as a lot to contribute. We see engagement as a two-way process rather than something which the University 'delivers' to society.

Integrity – if our engagement is to be credible and have impact we need to display consistency between what we say and what we do.

Inclusivity – to provide experience and opportunities to engage with all of society, irrespective of background. We need to focus on 'hard to reach' groups.

Creativity is a crucial thinking skill to create educational innovation that is novel, valuable, and useful in education. Many creative instructional models have been used in higher education to promote creative thinking. For example, Prompan (2007) developed a WEB-based instructional model based on Brain-Based learning process in a design course to enhance creative thinking of undergraduate students.

Effect of Creative Teaching Strategy on the Concept of Diffusion

Diffusion can be assessed among individuals such as members of Congress, organizations such as health care insurers, or larger collectivities such as cities and states (Rogers 2003). Creative teaching strategy also contributes to the concept of diffusion by elaborating its complexity to the students in a corresponding sense. Creative teaching strategy can also instill on students by:

i) Brainstorming, collaboration, discussion, team-base/group work, project-based learning, or anything could stimulate critical ideas, such as using questions technique. Lecturers should provide feedback for learners regularly.

ii) Thinking outside the box. Questions inspire learners to think of new ideas. For example, learners could think of the alternatives, think of new things, think outside the box, think like six thinking hats, and think of techniques to brainstorm. Techniques of using questions and media to create originality are also mentioned.

iii) Technique of providing challenging questions to think creatively.

iv) Providing feedback or reinforcement technique. There should be positive reinforcement by giving prizes rather than things. It should be gamification, or games that have prizes which are challenging, fun, and modern. It should add levels of challenge and difficulty, and the rewards are given away regularly. In addition, the activities must be learners centered.

Effect of Creative Teaching on Performance in Biology

According to Edsys (2017), a good classroom environment always has some elements of creativity which makes the lessons more interesting and interactive. The right mix of creativity

along with curriculum helps students to be innovative and also encourages them to learn new things. Students can grow up as good communicators in addition to improving their emotional and social skills. Creative classrooms can really transform the way students acquire education and how they apply it in their real life. In fact, creative expression plays a key role in a student's emotional development. Let us have a look at how important is the role of creative teaching in performance of biology today:

Learning with fun: Creative classrooms give an opportunity for students to learn with fun. The teaching activities such as storytelling and skits help them to learn without the pressure of learning. Students are always fun loving and including creative activities along with curriculum gains which draws their interest for learning. Teachers should encourage this quality in students from the lower classes itself and inspire them to believe in one's own creativity. Fun team building activities can be organized so as to promote creative thinking in groups and helping them to learn about accepting others' ideas.

Freedom of Expression: Unlike the conventional teaching methods, the creative classrooms give them the opportunity to express themselves. Whether it is debate or classroom discussions or field trips, students have the chance to come out of their shelves and become a part of it. This freedom of expression gives them a sense of goodness and happiness. Making some contributions in the learning sessions gives them a sense of satisfaction too. A creative approach to learning makes them more open with the puzzles that come their way and gives them a feeling of accomplishment and pride.

Emotional Development: Creative expression is important for a kid to trigger up their emotional development. Importantly, this has to happen at their lower classes itself so that they grow up by responding well to the happenings around them. Creativity gives them that freedom to explore the surroundings and learn new things from them. Students would always love a classroom setting that helps them to explore freely without setting them any boundaries. When they can show off their true emotions in a creative manner in their classrooms, they can build up good confidence level.

Enhances thinking capability: Creativity can stimulate imaginative thinking capability in students. That is why teachers promote activities such as open-ended questions, creative team building activities, brainstorming sessions and debates amidst busy curriculum schedules. Some teachers tactfully use these techniques to teach tough lessons to make children learn with fun and ease. Activities such as puppet shows will keep the students feel interested in the learning sessions and the flow of images in their mind gives them the pleasure of creativity. The open-ended questions will open them a world of imaginative thinking and they can come up with creative responses.

Effect of Engagement Teaching Strategy on Concept of Diffusion

The essential role of teachers in implementing innovative pedagogical practices, particularly those adopting inquiry-based learning has been widely recognized by researchers and educators (Krajcik et al. 2008; Urhahne et al. 2010). At the same time, the characteristics of teachers, together with the characteristics of the innovation and features of environmental context, account for the outcome of diffusion of an innovation (Rogers 2003). In the early stages of innovation diffusion, teachers gain knowledge of the innovation and synthesize information that helps them

make decision and plan for possible adaption. At these stages, the reflections are for their later implementation/actions, which is called preflection as defined by Jones and Bjelland (2004).

The stage, by which a person adopts an innovation, and whereby diffusion is accomplished, include awareness of the need for an innovation, decision to adopt (or reject) the innovation, initial use of the innovation to test it, and continued use of the innovation. There are five main factors that influence adoption of an innovation, and each of these factors is at play to a different extent in the five adopter categories.

Relative Advantage **-** The degree to which an innovation is seen as better than the idea, programme, or product it replaces.

Compatibility **-** How consistent the innovation is with the values, experiences, and needs of the potential adopters.

Complexity **-** How difficult the innovation is to understand and/or use.

Triability **-**The extent to which the innovation can be tested or experimented with before a commitment to adopt is made.

Observability **-** The extent to which the innovation provides tangible results.

Effect of Engagement teaching Strategy on Performance in Biology

Student engagement has three dimensions which are behavioral, emotional, and cognitive. Behavioral engagement refers to student's participation in academic and extracurricular activities. Emotional engagement refers to student's positive and negative reaction to peers, teachers and school while cognitive engagement talks about student's thoughtfulness and willingness to master difficult skills (Fredericks, et al., 2004). In biology education, selected teaching methods should support learning biology, learning to do biological science and learning about biological science (Spörhase et al 2012). Several biological topics require approaches promoting experimental problem-solving and process-based skills (Keselman 2003; Ehmer et al 2008). The focus is on science investigation processes and the goal is to reach valuable learning results, and students therefore need crucial science content knowledge as well as autonomous learning (Hof et al 2011). This, however, seems to create difficulties for the so-called working memory, which again impairs the self-regulation competencies (Kirschner 2006). Therefore, it is important to implement teaching methods including both autonomous learning and instructional activities, and to vary the level of openness of experimental tasks. The implementation of problem-based active learning models have positive effects on students' academic achievements and their attitudes to science courses (Akıno˘glu, 2007), while implementation of problem-based learning and group investigation encourages students to think critically through planning, arguing, stating questions and problems, and providing solutions to environmental problems (Asyari, 2016). The productive engagement is an important means by which students develop feelings about their peers, professors, and institutions that give them a sense of connectedness, affiliation, and belonging, while simultaneously offering rich opportunities for learning and development (Bensimon, 2009).

Methods

Comparative survey design was adopted for the study. The study was conducted in the United States of America. The population of the study comprised all secondary school students of biology. Simple random sampling technique was used to select 150 female and 150 male biology students making a total of 300 respondents that constituted the sample size for the study. The Instrument used in this study for data collection was a questionnaire titled: "Creative and Engagement Teaching Strategies on the Concept Diffusion Questionnaire (CETSCDQ)". Face and content validation of the instrument was carried out by an expert in test, measurement and evaluation from United States of America to ensure that the instrument has the accuracy, appropriateness and completeness for the study. The reliability coefficient obtained was 0.80 and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical techniques such as independent t-test analysis. The test for significance was done at 0.05 alpha levels.

Results

Research Question One

The research question one sought to find out the difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategies. (see table 1 below).

TABLE 1: Descriptive statistics of the difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategy.

Variable	N	$\overline{X}$	Mean Diff.
Creative	150	18.85	
			1.77*
Engagement	150	17.09	

***Remarkable Difference**

Table 1 presents the descriptive statistics of the difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategy. The result proved that there is remarkable difference (1.77) between the mean level of academic advancement of secondary school students taught with creative strategy (18.85) and that of those taught with engagement strategy (17.09). The result therefore means that there is remarkable difference in the academic advancement of students studying Biology in United States of America taught with creative and engagement strategy, as creative strategy is more prominent.

Research Question Two

The research question two sought to find out the effect of teaching strategies on the academic advancement of male and female students studying biology in United States of America. Descriptive statistics was performed on the data (see table 2 below).

TABLE 2: Descriptive statistics of the effect of teaching strategies on the academic advancement of male and female students studying biology in United States of America

Gender	N	Mean	SD	Mean diff.
Male	150	17.09	1.17	
				1.76*
Female	150	18.85	0.83	
TOTAL	**300**	**17.97**	**1.34**	

***Remarkable mean difference**
Source: Field survey

Table 2 presents the descriptive statistics of the effect of teaching strategies on the academic advancement of male and female students studying biology in United States of America The result proved that there is remarkable difference (1.76) between the mean level of the academic advancement of male students (17.09) and that of the female students (18.85). The result therefore means that there is remarkable effect of teaching strategies on the academic advancement of male and female students studying biology in United States of America, as female biology students were identified with higher academic advancement.

Hypotheses Testing

Hypothesis One

The hypothesis states that there is no significant difference in academic advancement between secondary school students studying biology in United States of America when taught with creative or engagement strategy. Independent t-test analysis was used to analyze the data in order to determine the effects of teaching strategies on the academic advancement of male and female students studying biology in United States of America (see table 3).

TABLE 3: Independent t-test analysis of the difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategy.

Variable	N	$\overline{X}$	SD	t
Creative	150	18.85	0.83	
				15.01*
Management	150	17.09	1.12	

***Significant at 0.05 level; df = 298; N= 300; critical t-value 1.96**

Table 3 presents the obtained t-test-value as 15.01. This value was tested for significance by comparing it with the critical t-value (0.139) at 0.05 level with 298 degree of freedom. The obtained t-value (15.01) was greater than the critical t-value (1.96). Hence, the result was significant. The result means that there is significant difference in academic advancement of secondary school students studying biology in United States of America when taught with creative or engagement strategy.

Hypothesis Two

The hypothesis states that there is no significant effect of teaching strategies on the academic advancement of male and female secondary school students studying biology in United States of America. In order to test the hypothesis, analysis of variance was performed.

TABLE 4: Analysis of variance of the effect of teaching strategies on the academic advancement of male and female secondary school students studying biology in United States of America

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	398.968[a]	3	132.989	279.782	.000
Intercept	96822.964	1	96822.964	203695.187	.000
TREATMENT	222.084	1	222.084	467.218	.000
GENDER	157.017	1	157.017	330.331	.000
TREATMENT * GENDER	9.631	1	9.631	20.262	.000
Error	140.698	296	.475		
Total	97380.000	300			
Corrected Total	539.667	299			

a. R Squared = .739 (Adjusted R Squared = .737)

P = .0.000; df = 298; N = 300; P > .05 the result not significant

The above table 4 presents the calculated F-value as (20.262) and P-value of 0.000. The P-value of (0.000) being compared with the probability level of .05 was found lower and so proved that the corresponding calculated F-value was significant. This result therefore means that there is remarkable effect of teaching strategies on the academic advancement of male and female secondary school students studying biology in United States of America.

Conclusion

Incorporating creative teaching activities is a positive addition to the curriculum. In doing so, higher education will continue to keep abreast of the needs of graduating students in a complex and rapidly changing professional environment. The study concluded that the role of teachers in implementing innovative pedagogical practices, particularly those adopting inquiry-based learning has been widely recognized by researchers and educators. The right mix of creativity along with curriculum helps students to be innovative and also encourages them to learn new things. Students can grow up as good communicators in addition to improving their emotional and social skills.

Recommendations

The following recommendations were drawn from the study.

1. Biology teachers should always use appropriate teaching strategies such as creative and engagement teaching strategies in order to have them improve academic advancement of secondary school students in biology.

2. The implementation of problem-based active learning models should be incorporated in order to foster positive effects on students' academic achievements as well as their attitudes to science courses.

3. Biology students should be encouraged to use the 3R (read-recite-review) or SQ3R (Survey! Question! Read! Recite! Review!) reading methods in the study of diffusion because there are supported by research.

4. Finally students should be helped to discover the value of evidence-based reasoning and higher-order cognitive skills, and be taught to become innovative problem solvers.

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