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Modeling Constructivism for Efficient Physics Education

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Abstract

The study discussed the possibility of creating a constructivist paradigm for effective physics instruction. The model is necessary since studying physics is becoming increasingly difficult, resulting in low academic achievement in the subject. The article examined two forms of constructivism: social constructivism and cognitive constructivism. The highlights of relationships between constructivist and genuine learning were highlighted. It was stated that constructivist teachers should pay close attention to students' prior knowledge while applying the model to physics instruction. This will decide the mode of instruction used by the teacher. Excellent teaching relies on the teacher's content and pedagogical knowledge. The research concludes that physics teachers should encourage student interactions and value student ideas as the foundation of constructivist learning.

Keywords*: - Constructivist teacher, Conception Constructivism, Social interaction*

INTRODUCTION

Physics learning problems are becoming more prevalent, as evidenced by students' low academic performance in the subject at all levels of school (Folashade and Akinbobola, 2009; Eraikhueme and Ogumogu, 2014; Mekonnen, 2014). Aside from academic success, research investigations demonstrate that physics students struggle to apply theory in practise. In other words, most physics students are unable to use what they have learnt in the classroom to solve a problem in a new setting (Watkins and Mazur, 2013). According to studies, physics students entered the learning scenario with

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preconceived notions about physics ideas, principles, laws, and theories. Many of these beliefs are rooted in culture, religion, and superstitions (Eraikhueme and Ogumogu, 2014), and they have an influence on pupils studying physics. Many physics professors and teachers frequently neglected this issue, resulting in pupils with poor physics grades. Learning is essential in education and should begin with the information that students bring to the learning scenario.

Constructivism stresses the relevance of an individual's knowledge, beliefs, and abilities to the learning experience (Garbett, 2011, p.37). Constructivist ideas have their origins in Piaget and stress on the learner's active nature, interacting with the environment either alone or in groups (Packer & Goicoechea, 2000). Constructivism holds that learners actively generate meaning for themselves (Cornu and Peters, 2005). According to constructivism, humans construct their understanding and knowledge of the world by experiencing things and reflecting on those experiences (Thirteen Ed Online, 2004). Constructivism, as a learning theory, holds that learning is an active process in which knowledge is built via experience and personal interpretation of the environment (Christie 2005). According to Christie, constructivism helps students pursue personal interests and objectives; use and develop learners' talents; build on learners' existing knowledge and experiences; and foster lifelong learning.

Within educational environments, there is both social and cognitive constructivism. Social constructivism is concerned with the knowledge that pupils construct via social interaction. Cognitive constructivism contends that information is not directly transmitted from person to person, but rather is created or found independently. Cognitive constructivists place a strong emphasis on learner-centered and discovery-oriented learning processes. According to Liu and Matthews (2005), the social environment and social interaction serve just as a trigger for individual cognitive conflict during the process (p.388).

SOCIAL AND COGNITIVE CONSTRUCTIVISM

Vygotsky's work inspired social constructivism, which stresses the importance of social context in learning. According to social constructivists, students learn by their interactions with their immediate surroundings. According to this viewpoint, learning is a situation-

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specific and context-bound activity (Eggen and Kauchak, 1999,).

Vygotsky established social constructivism, arguing that learning is a social and collaborative activity in which individuals build meaning via their interactions with one another (Schreiber and Valle, 2013). Through interaction with the teacher and other students, children generated ideas.

Interaction is critical for student learning. According to the Educause Learning Initiative (2005), good learning is inextricably linked to interaction. Learning is an interactive process in which students expand their understanding by combining information, experiences, and activities.

For Powell and Kalina (2010), collaboration and social interaction are incorporated in social constructivism. This theory believes in the social interaction of students in the classroom along with the critical thinking process. Creating a deeper understanding of learning requires cooperative learning. These authors contended that social learning is a part of creating a social constructivist classroom. The theory believes that students have plenty to offer one another by not only working one-on-one with the teacher but also with other students.

Cognitive constructivism, credited to Piaget where learners have a way of viewing learning in their personal way. Students interpret what they hear in the light of their own knowledge and experience. Cognitive constructivism approaches the construction of knowledge from the perspective of the individual. It, therefore, implies that each student learns new information when he/ she connect the prior experience with the new situation on a personal basis.

A state of imbalance or disequilibrium is created when a new situation emerges that challenges what a learner already knew or the way he/she is thinking (Amineh and Asl, 2015). It is a personal cognitive process that may either lead to the assimilation of the new information or its rejection.

According to Kim (2001), individual create meaning through their interactions with each other and with the environment where they live. The author argued that meaningful learning could only take place when students are engaged in social activities. Andrews (2012), social constructivism is concerned with the

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nature of knowledge and how it is created. Social constructivism believes that both the context which learning occurs and the social contexts that the learners bring to the classroom is crucial (Kim, 2001). Social constructivism has a perspective that focuses on the relationship between people and their environment (Kim, 2001). The author believed students learned with their mind and at the same time interacts with the environment as learning is going on, it is, therefore, difficult to separate learning from the environment. Bredo (1994) noted that if the environment and social relationships among groups of students change, apparently the tasks of each student also change. Thus, Kim said learning should not and cannot take place in isolation from the environment.

Powell and Kalina (2011),an active classroom, where teachers and students are communicating optimally, is dependent on using constructivist strategies, tools, and practices. Students' construction of knowledge (Kirschner, Sweller, and Clark, 2006) by themselves is central to the constructivism: this is done through active participation in the learning task. Supporting this is Prawat and Floden (1994) that constructivism is based on the idea that knowledge is actively constructed by the students.

Learning is a social activity. Learning is intimately associated with connection with other human beings, teachers, peers (Hein, 1991). Biggs (1999) argues that constructivism holds the belief that meaning should not be imposed or transmitted by direct instruction, but allows the students generate information created by learning activities. Kim (2005) summarizes what is expected of a teacher in a constructivist classroom very similar to the authentic learning as follow.

- Encourage student's leadership, cooperation, seeking information, and the presentation of the ideas,
- modify their instructional strategies in the process of teaching based on students; thought, experience and or interests
- use printed materials as well as experts to get more information
- encourage free discussions by way of new ideas inviting student questions and answers
- help students to test their ideas
- invite students' ideas, before the student, is presented with the ideas and instructional materials
- encourage students to challenge the concepts and ideas of others
- use cooperative teaching strategies through student interactions and

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respect, sharing ideas and learning tasks
- encourage students to respect and use other people's ideas (p.10).

Kroll (2004) suggests that constructivist classroom students should be able to construct for themselves an articulated vision of learning, teaching, development, and knowledge. According to Huang (2002), constructivism emphasizes the development of learners' ability in solving real-life problems.

The teacher only acts as a facilitator but not the provider of the knowledge in the constructivist classroom. This underscores the similarity between the constructivist class and the authentic learning class. The basis of the authentic learning has been to give the students enough opportunity to control their learning while the teacher plays coaching and scaffolding role.

In an authentic learning environment, teachers' knowledge and textbooks are severely discouraged to allow students direct their learning. The learning task is ill-defined. Brandon and All emphasized that constructivism believes that instead of using the teacher's knowledge and textbooks for solving problems, the student invents solutions and constructs knowledge in the learning process. The students in an authentic learning are guided to learn in a way to apply their learning to everyday life (Aina, 2017). The table below shows correlations between constructivism and an authentic learning (Herrington and Kelvin, 2007; Johnston, 2005; Brooks and Brooks, 1993).

CONCEPTUAL FRAMEWORK

The student learning is the crux of the constructivism theory. In other words, the student is at the center of the constructivist model: every other thing revolves around the students. The teacher comes to the class because of the students; whatever instructional method to be employed the students are considered first. Therefore, the prior student knowledge serves as the springboard on which the learning process starts. Students link any new information with the previous knowledge either individually or while interacting with a peer or the teacher.

Thus, both the construction of knowledge by social interactions and the individual is to enhance students' learning. The teacher instructs based on the students' interactions (contextual learning) and students' preconception. A clear and good instruction that enhance student's learning depends on the teacher's content and the

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pedagogical knowledge. Therefore, through this framework, a model in the figure below is developed for effective students' learning.

APPLYING CONSTRUCTIVIST MODEL TO PHYSICS LEARNING

The teacher is expected to make students actively involved in the classroom because active learning stimulates inquiry (McCarthy and Anderson, 2000). However, research studies show that the traditional lecture approach still dominates teaching in schools (Deslauriers, Schelew, and Wieman, 2011). Scholars argued that the present way of teaching physics must be changed because it is dull and uninteresting to young students. For Rodrigues and Oliveira (2008), this method does not meet the actual requirements of society and the new trends of physics curricula.

Crouch, Watkins, Fagen and Mazur (2007) affirmed that traditionally taught courses do little to improve students' understanding of the central concepts of physics. Research shows that commonly used teaching methods such as the traditional lecture method do not help the students acquire sufficient functional understanding of physics(Bernhard, Lindwall, Engkvist, and Zhu, 2007). Rote learning is a common experience of the students in physics; they learned to forget because it is by memorization (Fagen and Mazur, 2003). According to Aina and Langenhoven (2015),physics students are unable to apply classroom experience outside the classroom because they learned by memorization.

The effective learning of physics starts with the teacher knowing the prior knowledge of the students. The physics teacher should know what experience the students had on the concept to be discussed. This knowledge will determine the teacher approach to the instruction. One of the reasons for mass failure in physics is because many teachers come to class to start lecturing without considering students' entering knowledge. Most students cannot link the new information given by the teacher with what they had preconceived. Thus, confusion sets in and to resolve the confusion many students result into memorization of the new information. Memorization is not a good way of authentic learning.

Students will learn effectively in physics if the teacher gives the students maximum chance for social interaction. Many of these students had something in mind before coming to the class: they were not

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blank slates (tabula rasa) but came in with knowledge. During the interaction, the students would be able to resolve many of the preconceived wrong or right knowledge within themselves through the help of the teacher.

Research studies show that teacher strategies of instruction often hinders physics students from learning effectively (Oladejo, Olosunde, Ojebisi and Isola, 2011; Wanbugu, Chiangeiywo, and Ndirit, 2013). To this effect, physics teacher must have the good content knowledge and sound pedagogical knowledge. Otherwise, the instruction will not be effective. On this background Kim (2005) suggests that a constructivist teacher should modify their instructional strategies in the process of teaching based on students; thought, experience and or interests.

Constructivist class advocates active and interactive classroom as typically obtained in the authentic learning. Therefore, for the students to learn physics well, the teacher should encourage students' participation. A constructivist teacher needs to use cooperative teaching strategies through student interactions, respect sharing of ideas and learning tasks (Kim, 2005).

CONCLUSION

The study created a constructivist paradigm in which students' learning is at the heart of all other learning activities. The author links constructivism with genuine learning, both of which are student-centered learning paradigms. The concept was used in the physics classroom to help students study more effectively. It was emphasised that a physics instructor must constantly consider the students' prior knowledge for effective physics learning. Everything the students learnt and the instructor instructed is based on this past knowledge. The study also contends that the instructor should encourage student interactions and respect student ideas as the foundation of constructivist learning.

RECOMMENDATION

The perceived low academic performance of students in physics as a result of teacher instructional tactics necessitates a more outcome-oriented, student-centered way of teaching. As a result, it is suggested that the constructivist paradigm be completely adopted at all levels of physics study.

REFERENCES

1. Aina, J.K., & Langenhoven, R. (2015). Teaching method in science education: the need for a paradigm shift to peer

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instruction (PI) in Nigerian schools. International Journal of Academic Research and Reflection, 3(6), 6-15.

2. Aina, J.K. (2017). The physics authentic learning experience through the peer instruction. Saarbrucken: LAP Lambert Academic Publisher.
3. Amineh, R.J.,& Asl, H. D. (2015). Review of Constructivism and Social Constructivism. Journal of Social Sciences, Literature and Languages1(1), 9-16. Andrews, T. (2012). What is social constructivism? Ground Theory Review, 11(1), 39-46.
4. Bernhard, J., Lindwall, O., Engkvist, J., & Zhu, X. (2007). Making Physics visible and learnable through interactive lecture demonstrations. Physics Teaching in Engineering Education PTEE. Retrieved from http://www.researchgate.net/publication.
5. Biggs, J. (1999) What the student does: teaching for enhanced learning, Higher Education Research & Development, 18(1), 57-75, DOI: 10.1080/0729436990180105.
6. Christie, A. (2005). Constructivism and its implications for educators. Retrieved from http://alicechristie.com/edtech/learning/constructivism/index.html
7. Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment Physics class. Science, 332(2011), 862–864. http://doi.org/10.1126/science.1201783 Educause Learning Initiative (2005, August). Interaction: Principles and Practice. ELI Summer Session, pp. 1-9.
8. Eggen, P. & Kauchak, D. (1999). Educational psychology: Windows on classrooms(4th ed.). Prentice Hall. Eraikhuemen, L., &Ogumogu, A .E. (2104).An assessment of secondary school Physics teachers conceptual understanding of force and motion in Edo South senatorial district. Academic Research International, 5(1), 253-262.
9. McCarthy, J. P.,& Anderson, L. (2000). Active learning techniques versus traditional teaching styles: Two experiments from history and political science. Innovative Higher Education, 24(4), 279–294. http://doi.org/10.1023/B:IHIE.0000047415.48495.05.

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