



A Short Paper about Fundamental Pedagogical Concepts of Constructivism Theory in Relation to TPACK Framework

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Abstract

The influence of constructivism as a pedagogical theory is mainly concentrated on adult education. Its main concepts stem from significant conclusions coming from other theories related to pedagogical and philosophical school practice. The key point is that knowledge is the desired learning outcome that can be accomplished through active learning participation which is closely related to construct. Also, some basic ideas of constructivism rely on idea-based interactions and ideas produced by learners. Certain aspects of the above-mentioned theory in learning and teaching seem to be very helpful for learners to develop their ideas and achieve learning outcomes. The basic aim of this paper is to examine the influence of Constructivism on adult education by utilising Technological Pedagogical Content Knowledge Framework's (TPACK) dimensions in learning and teaching everyday practice. A mixed method analysis was conducted which contains a theoretical analysis, and experimentation through a quiz game. Our experimental approach through the quiz game was to study Newtonian physics and specifically the Law of Gravitation and the 2nd Law of Motion, finding that the mass terms cancel, and ending up making a prediction that all objects fall at the same rate. The experiment would then involve verifying the prediction and explaining any deviations from the prediction in terms of the intuitive idea of air resistance. The findings showed that students after answering the quizzes of the quiz game, were able to discuss their results using logical argument as opposed to when they did the experiment before the theory and their discussion was little more than guesswork. Thus, we could see how students performed on each question and use that information to figure out what needs to be readdressed or retaught.

Keywords: Constructivism, Adult Education, Technological Pedagogical Content Knowledge Framework

1. Introduction

To understand constructivism emphasis should be given on the fact that knowledge is directly related to idea-based interactions and ideas produced by learners. Furthermore, constructivism contributes to a better understanding of how knowledge could be achieved through construct. Certain aspects of the above-mentioned theory in learning and teaching seem to be very helpful for learners to develop their ideas and achieve learning goals and results. Through this process of producing new ideas, critiquing and revising their ideas, learners begin to develop critical thinking and getting a real understanding of the learning concepts of a course. In case, the learners had not previously developed these ideas, they really need to learn “*how to learn*” by actively participating to a constructivist environment in order to develop critical thinking. Under assumptions based on simply passing the teaching content, a teacher perspective could be just presenting the teaching content to students. On the other hand, the constructive teacher who wants to implement the constructivism principles should emphasize on transmitting to learners’ the learning material clearly and next to give directions for practice using the necessary information stemming from the presented learning content. The teaching role should be facilitating with main aim to help learners express, critique and modify their ideas in order to achieve learning. To achieve that, student interaction is very important in these learning processes. So, rather than just observing students’ talk which distracts them from learning activities, teacher should emphasize on helping them to bring up critique and modify their own ideas.

2. Constructivism and Technological Pedagogical Content Knowledge Framework

2.1 Constructivism

Constructivism relies on knowledge achieved based on experience. However, Dewey, Vygotsky and Piaget claimed that the good teacher carefully considers learners’ ideas that stem from previous learning experience closely related to other external factors related to sociocultural environment, in order to incentivize them understand previous existing knowledge and continue their learning journey by constructing new knowledge artifacts and gaining new learning experience (Hsiu-Mei Huang, 2002, p.27-37; Hosseini, 2015).

Vygotsky’s theory was called “social constructivism” because extra emphasis was given on the *social dimension of learning content* and the *cultural* and *social* characteristics of learners and teachers (Vygotsky, 1978; Honebein 1996; Hosseini, 2015).

2.2 Technological Pedagogical Content Knowledge Framework

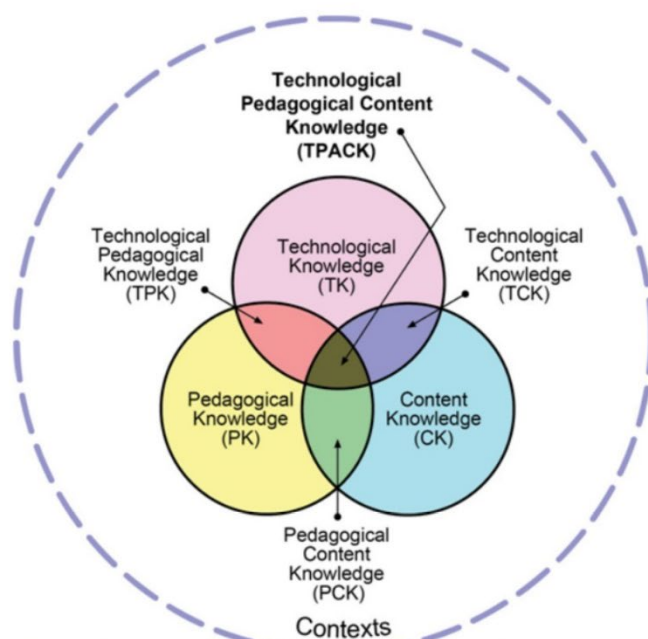
Technologies are tools related to cognition that seem helpful for learners in their effort to identify the critical thinking they start to develop and transform it into learning progress (Jonassen, 2000; Koh, 2013; Koh et al., 2014; Voogt et al., 2016; Goradia, 2018; Triantafyllou 2014; Triantafyllou 2019a; Triantafyllou 2019b; Triantafyllou, 2021; Triantafyllou 2022a; Triantafyllou 2022b; Triantafyllou 2022c; Triantafyllou 2022d; Triantafyllou 2022e; Triantafyllou 2023a; Triantafyllou 2023b).

Professors of educational technology in schools and universities commonly use the Technological Pedagogical Content Knowledge (TPACK) framework (Kohler, 2012; Koh 2013; Hosseini, 2015) (see Figure 1). TPACK framework origins come from the work of Professor Lee Shulman (1986,1987) regarding pedagogical content knowledge, which

describes that effective instructors combine efficiently the content knowledge and pedagogical knowledge.

Punya Mishra and Matthew J, Koehler (2006) have added a third dimension to Shulman's framework that refers to the technological knowledge. They mention that technology tools are separate from both content and traditional pedagogy and emphasize that digital technology learning tools require instructors that consider seriously the new content and pedagogy combinations while they use these tools in their everyday instruction (Kessler et al., 2017).

Figure 1. Technological Pedagogical Content Knowledge Framework



3. Method

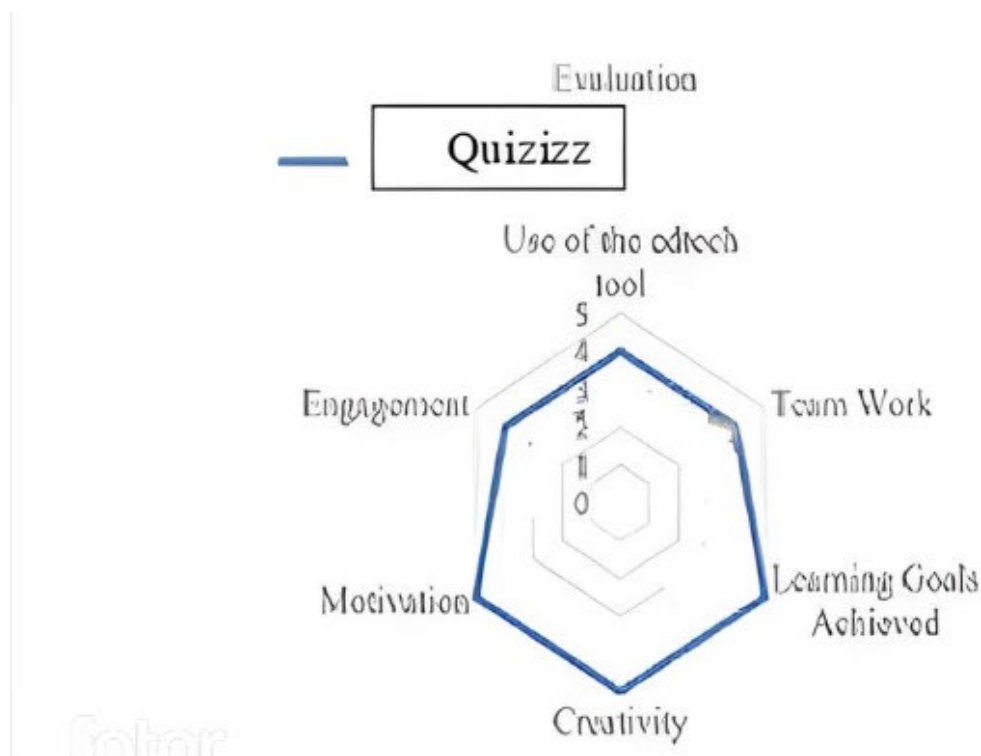
A mixed method analysis was conducted which contains a theoretical analysis, and experimentation through a quiz game. Our approach could be described as “open-ended”, with multiple answers according to learners' different levels of knowledge (Schoenfeld, 1988). Our approach was to study Newtonian physics and specifically the Law of Gravitation and the 2nd Law of Motion, finding that the mass terms cancel, and ending up making a prediction that all objects fall at the same rate. The experiment would then involve verifying the prediction and explaining any deviations from the prediction in terms of the intuitive idea of air resistance.

To stop teaching from being monotonous and boring, we tried to turn it into a game in order to engage students and lead to better learning outcomes. Gamification is the use of game mechanics in non-game situations. It involves the use of video game elements, such as leaderboards, levels and badges in non-game activities aimed at improving the user experience and increasing user engagement. Quizizz was used to create quizzes for students and help them grasp concepts through gamification technology ("Quizizz", n.d.).

The methodology used to conduct our study was the construction of a questionnaire given to students to answer it. The completion of the questionnaire was anonymous and optional. The type of questions we selected to include in the questionnaire was the structured questions. The final questionnaire sent in response contained Likert-type questions. Next, with the use

of a spreadsheet, a comparative analysis was conducted for the Quizizz edtech tool across six basic aspects concerning students' learning progress: (i) knowledge of use of the edtech tool, (ii) teamwork, (iii) accomplishment of learning goals, (iv) creativity, (v) motivation and (vi) engagement. Within each of six aspects, specific points were awarded. Scoring criteria consist the basic metrics that are being measured by the scoring group of students. The points were: 0 points, (zero result), 1 point (Weak result), 2 points (Average result), 3 points (Good result), 4 points (Very Good result) and 5 points (Excellent result). A scoring system is a crucial component of game mechanics, and gives a mechanism whereby students are rewarded with specific points whenever they complete successfully a task in the game. Scoring for assessment is concentrated mainly on patterns indicating weaknesses and strengths in students. Scoring criteria provide evidence for performance that has been achieved at each achievement level for a performance indicator. Scoring criteria have the purpose to help students gain specific knowledge and skills they must show to gain proficiency. Specifically, the basic aim is to achieve learning progress by providing specific feedback, leading to increased student knowledge ownership and better levels of learning. The measurement was selected due to the fact that it encompasses the assignment of scores to individuals so that they represent some basic characteristics (knowledge of use of the edtech tool, teamwork, accomplishment of learning goals, creativity, motivation and engagement) of the individuals. The plot of the final results is presented in the following graph (Figure 2).

Figure 2. Evaluation stage



4. Results

Students after answering the quizzes, were able to discuss their findings using logical argument as opposed to when they did the experiment before the theory and their discussion was little more than guesswork. Thus, we could see how students performed on each question and use that information to figure out what needs to be readdressed or retaught.

Additionally, some basic conclusions stemming from constructivism utilisation in education, focus on new knowledge which is built according to previously existing knowledge. Constructivism changes the role of the teacher in an effort to help him/her encourage learners to construct new knowledge rather than reproduce already gained knowledge. The constructivist teacher can urge students to participate in inquiry-based and problem-solving learning activities with which students start to develop and test new ideas, draw conclusions and construct their learning in a collaborative learning environment. Constructivism changes the learner role from passive to active participant in the learning process.

The principles of constructivism offer the background that will help teachers to design learner-centered and inquiry-based learning environments which will help to develop learners' critical thinking and learning through experience.

5. Conclusion

The basic conclusion is that only through shared interaction and discussion of the basic learning ideas learners begin to critique their ideas and come to their own conclusions. It is very important as teachers, to focus on learners' ideas and idea-based interactions, rather than only on our own teaching strategies as teachers. And it's important to help learners express, critique, and modify their ideas. Only under these circumstances, we will be looking at research that explores learners' ideas and research on instruction focused on learners and their ideas.

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