

The Implications of Social Constructivism as a Philosophical Theory in the Professional Training of the Mathematics Teacher

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Abstract: *Any nation that desires all-round development needs a proper training of its teachers. This is especially true for the mathematics teacher, with mathematics being a fundamental basis of all universal knowledge, and key to scientific and technological advancements. The theory of social constructivism was one major philosophical principle that promoted meaningful learning in the classroom. Social constructivism theory viewed the process of learning as a result of mental construction, brought about by social interactions. This article explored the theory of social constructivism and its implication in the professional training of the mathematics teacher. Social constructivism framework was shown to have several implications on the professional training of the mathematics teacher, which among others include the promotion of collaborations and social interactions, in any mathematics education programme. It is also important that the teachers be trained to apply the principles of social constructivism to their classrooms when dispensing their duties as facilitators of mathematics knowledge.*

Keywords: Social Constructivism, Philosophy, Professional Training, Mathematics Teacher

1. Introduction

Mathematics is probably the most important science subject in the world today, due to its universal nature and its applicability in all aspects of life, and other fields of knowledge. Ziegler and Loos (2017), described it as the universal science of abstract structures, exploring among others fields of change, quantity, and structure, and characterized by a wide range of computations, problem-solving, and calculations.

The universal nature and applicability of its knowledge is the major constituent that makes mathematics so important, as it is not only fundamental to all major fields of science, technology, and engineering, but also influences the running of simple day-to-day activities (Jayanthi, 2019). In today's contemporary society, knowledge is required by anyone who desires to live effectively, as over time more tasks have continually lent themselves to the mathematics treatment. The importance of this field of knowledge has and will only continue to increase (Pua and Macutay, 2020).

Considering the importance of mathematics, the training of an effective mathematics teacher, who can properly carry out the task of teaching the subject, becomes a matter of necessity. As a result, a variety of studies have been conducted over time, exploring ways to ensure the effective training of the mathematics teacher, and in making mathematics concept learning more meaningful in the classroom situation.

Philosophy is another universal field and is especially relevant in education. Philosophical theories have over time been created, exploring the nature of knowledge, school and schooling, learning, and other relevant constituents of the educational process (Pritchard, 2017).

Constructivism as a philosophical principle/theory was designed to explain the nature of knowledge and how learning occurs. It is a theory, that sees learning as a result of mental construction in the learner. Social constructivism, as a subset of it, emphasizes the role and relevance of society and social interaction in the process of knowledge creation and acquisition by learners (Mercer, 2020).

The theories of constructivism and social constructivism are continually advocated, as principles for improving the learning process in the classroom, to ensure more effective and meaningful learning to occur. Thus, considering the above, this study was designed to explore the philosophical principles of social constructivism, and how they can be applied to make the professional training of the mathematics teacher better and more effective.

Training of the Mathematics Teacher

Teacher training refers to all manner of programs designed to imbibe in an individual not only the necessary proficiency required to carry out teaching responsibilities but also to update and maintain those proficiencies, adapting to new trends and changes. Teacher training can be as a form of professional training geared towards the development of crucial skills, attitudes, and knowledge needed and considered important to create effective and efficient, and competent teachers, in line with the objectives of the society at any point in time (Ntuli, Nyrambi, Agamba, & Ntuli, 2018).

All teacher training programmes can be said to occur at two distinct stages; pre-service teacher training and in-service training. The pre-service teacher training can be said to be the training given to prospective teachers before the commencement of service. In-service training, on the other hand, refers to a form of training given to

individuals already in the teaching profession and usually geared towards continually upgrading their knowledge and skills and adapting to new trends, changes, and innovations (Ogunyinka, Okeke & Adeodyin, 2015).

The goal of training both pre-service and in-service teachers are made explicit in the National Policy on teacher education programs which objectives involve to “*Produce highly skilled, knowledgeable and creative teachers based on explicit performance standards through Pre-service and In-service programs who can raise a generation of students who can compete globally*” (Federal Ministry of Education, 2006). Ogunyinka, Okeke and Adeodyin (2015), state a common organization of teacher training into three stages which include; the initial teacher education, induction (providing training and support for a specified time to a new teacher, during their first time of service, or their first time in a particular school), teacher development or continuing professional development (continued intensive training for practicing teachers).

In Nigeria and most other developing nations, teaching is a vital tool needed for all-around development. This is especially true for the mathematics teacher, as mathematics is probably the most important field of study with it being the basis for science, economy, and technology and it influencing to an extent all aspects of living (Jayanthi, 2019; Pua and Macutay, 2020). The mathematics teacher is thus central in progress and development, and their efficiency thus matters in this regard. Producing highly qualified, competent, and knowledgeable mathematics teachers is one of the main concerns for educational stakeholders. Teachers’ knowledge and skills have been cited as the most significant predictor of students’ success (Adedeji, 2018). The teachers’ knowledge and competency influence the students to a large extent, even determining whether or not they engage in that subject of the field of study.

Alhaji, Yew and Razak (2020) and Darling-Hammond (2016) mentioned a categorization of all teacher knowledge including the mathematics teacher into three strands; content knowledge, pedagogical knowledge, and didactical knowledge. These three categories are otherwise known as the Subject Matter Knowledge (SMK), Pedagogical Knowledge (PK), and Pedagogical Content Knowledge (PCK). In the context of a mathematics teacher, content knowledge refers to the understanding of mathematical concepts, equations, and topics. It refers to the teachers’ capability in mathematics. Pedagogical knowledge on the other hand refers to the teachers’ knowledge of the various principles of general education, including all general aspects of education like theories, psychology, etc. Didactical knowledge on the other hand refers to the knowledge and skill of the teacher to teach mathematics. It refers to the knowledge encompassing all teaching areas connected to mathematics, including the conditions and ways of teaching mathematics. Thus it is important to note that knowing mathematics is not just enough to make one a competent teacher, but also being knowledgeable on how to teach mathematics, as there exists a distinction between

knowing mathematics for oneself and being able to enable others to know it. In conclusion, the three strands of knowledge required by the mathematics teachers are knowing mathematics (knowledge of mathematical content), knowing to teach (knowledge of general pedagogy related to the whole instructional process), and knowing how to teach mathematics (knowledge of the contents of pedagogy related to the teaching and learning of mathematics) (Belecina & Ocampo, 2017).

To teach, the teachers need to have developed an effective knowledge structure, that encompasses not only the subject matter but also the learners, pedagogy, curriculum, and the environment (Otun & Olaoye, 2019). Some of these required knowledge includes; knowledge of the content, the curriculum, pedagogy, learners and learning, contexts of schooling, educational philosophies, goals, and objectives.

Any teacher training activity is programmed towards developing in the individual an updated mastery of the three major strands of teacher knowledge, especially for training programs at the pre-service level. However, Okori and Jerry (2017) and Udonsa (2015), argued, that the teacher education programs in the country have been unable to produce adequately competent and capable mathematics teachers. As a result of the displayed incompetency by teachers especially in the subject matter knowledge in their field of study, many have begun to doubt and question the educational process by which teachers acquire their certificates and qualifications (Anaduaka & Okafor, 2013). Alhaji, Yew & Razak (2020) noted that the content of the curriculum being introduced to pre-service mathematics teachers is often different from the school mathematics curriculum for which the pre-service teacher is being trained to teach. Such, they are bound to experience difficulties in dispensing their duties.

If mathematics teachers are to be adequately prepared to carry out the requirements of their professions, their training should foster and groom all the required knowledge and skills that will be needed in line with the intended objectives and should stimulate the practice of the profession (Ibrahim, Wun & Nordin, 2018). As Barnes, Boyle, Zuilkowski and Bello (2019), state that teachers must be trained to think critically and adapt their instructional methods to a wide variety of situations, and the needs of the students, and the subject matter. An effective mathematics teacher training program needs to embrace curriculum and innovations which addresses and reflects the social, economic, and political atmosphere of modern society while equipping the teachers with the skills needed to adapt to the ever-changing needs and prospects of the students and the society (Mapolelo & Akinsola, 2015; Ahmed et al; 2016).

The Theory of Social Constructivism

Vygotsky proposed the theory of knowledge acquisition, which is now more commonly referred to as social constructivism. This view sees knowledge as a product of social interaction, with words and ideas deriving meaning from those created and negotiated by people in particular

contexts (Kapur, 2018). The main distinction between the social constructivist approach and the more general variant is that this approach does not view an individual's cognitive process as the sole basis for constructing knowledge but views knowledge creation and construction to be actively influenced by social interactions.

Social constructivism while built based on traditional constructivism, lays more emphasis on the relevance of society and culture, as tools actively influencing the process of knowledge construction (Lynch, 2016). Social constructivists view knowledge as a social process, stating that individuals assimilate information and create meaning through their interactions with each other and with the environment. Social constructivism holds that the utilization of social activity in the instructional process is a major tool to enhance meaningful learning.

In social constructivism, knowledge is inherently tied and can never be separated from the social environment in which it is formed (Greenwood, 2020). As an approach to learning, social constructivism lays great emphasis on discussion, interaction, and sharing of knowledge and ideas among students. The social constructivism theory also emphasizes the role played by language and culture in human intellectual development and perceptions. It describes knowledge as being socially created, constructed, and transmitted through language (Akpan et al, 2020).

The social constructivist framework sees knowledge as not only coming apart through intra-psychological activities (within ourselves) but also putting emphasis on inter-psychological activities (among people) (Dagar & Yadav, 2016). In the social constructivist view, knowledge constructs are first formed inter-psychologically (between people), before it is internalized and becomes intra-psychological. In social constructivism, the consensus among individuals is viewed as the ultimate judge of the authenticity of any knowledge. Thus, the status of true knowledge or "truth" is given to those constructs on which the majority of the social group agrees.

Sithara and Faiz (2017), view social constructivism as a highly effective principle to base teaching on, as students tend to benefit more, and even become more motivated when collaboration and social interaction are incorporated into the learning process. Based on the social constructivist perspective, instructional models are likely to be much more effective by stressing the need for collaboration not only among learners but with authorities and practitioners in society (Kelly, 2012). It lays a great deal of emphasis on the interaction among classroom students, along with a personal thinking process. The framework for social constructivism supports approaches such as case studies, research projects, brainstorming, guided discovery, simulations reciprocal teaching, problem-based instruction, peer collaborations, anchored instructions, and other methods that require social interactions in the process of learning. In a social constructivist framework, the teacher is tasked with ensuring all activities are learner-centered and encourage

collaboration among students. It deemphasizes the traditional dictatorship role of teachers in the class in favor of a more comprehensive process, involving the interaction among all components in the teaching-learning process (Detel, 2015). This approach has been noted to help students concretize learning and acquire knowledge better.

The educational implications of the social constructivist view are still numerous. Brau (2016) and Powell and Kalina (2009), outlined some useful principles for the teachers, derived from social constructivism to ensure meaningful learning, which includes; the emphasis should be placed on learning, not performance, learners should be viewed and treated as co-constructors of knowledge, an effective teacher-student relationship should be built based on guidance and not instruction, learners need to be engaged in tasks that ignite their creativity and have worth to them, assessment should be treated as a process of acknowledging and uncovering shared knowledge and understanding.

Implications of the Theory of Social Constructivism to the Professional Training of the Mathematics Teacher

Professional training of the mathematics teacher takes the form of pre-service and in-service that is mathematics teacher as a learner in the classroom and a practicing teacher undergoing in-service training. These two groups can be referred to as 'trainee-teachers'.

Social constructivism emphasizes a learner-centered approach to teaching (Greenwood, 2020). This implies that any training programme for the mathematics teacher be it pre-service or in-service needs to be designed in a manner that allows for and promotes active participation of the mathematics trainee-teacher. It must be activity-based through the utilization of practical approaches, group works, discussions, questioning, student-student, student-teacher interactions and presentations, etc. Also, social constructivist philosopher of mathematics treats knowledge as a process of coming to know through a social process which justify mathematical knowledge. This shows that mathematics educators in the institutions should see themselves as facilitators that help the trainee-teacher engage in activities that can create and recreate mathematical knowledge. The retraining programmes of the in-service mathematics teacher should include working under experts, conferences, workshops and seminars vital to developing individual's subjective mathematical knowledge to an accepted objective mathematical knowledge. This is a very good example of the France and Japan teacher education system which is made up of collaboration with experts.

One major principle of social constructivism is the promotion of collaborative learning, a form of learner-centered approach to teaching (Detel, 2015). Programmes and learning activities for the mathematics teacher in training should thus be designed in a way that encourages interactions among peers and others. The trainee-teacher should be encouraged to share ideas with peers, exchanging and updating knowledge. The trainee

mathematics teacher should also be exposed to the need for and ways they can create a constructivist classroom for their students that boost classroom interactions, towards the end goal of ensuring meaningful and effective teaching and learning. The trainee teacher needs to understand the importance of discouraging competition in favor of collaboration in the constructivist classroom. When training mathematics teachers, all opinions, suggestions, or contributions are to be treated as important by the educators whether correct or not, and the trainee teacher should be made aware of the importance of emulating that act in their classrooms.

The social constructivist approach to teaching and learning deemphasizes the monotony of the teacher's ideas in favor of a more comprehensive approach where the teacher acts only as a guide, not a direct distributor of knowledge (McLeod, 2019). Thus, in the professional training of the mathematics teacher, the mathematics teachers' educator needs to apply that principle when carrying out instruction, while inculcating in the trainee teacher the importance of utilizing that approach, where they only act as a facilitator in their classroom.

Again social constructivism emphasizes the importance of language and culture in knowledge acquisition and construction (Akpan et al, 2020). Mathematics is a linguistic knowledge, conventions and rules which are socially constructed. The professional training of the mathematics teacher by the mathematics educators must take account of the special language of mathematics which is the proof of mathematical knowledge must be explicitly explained. The language of mathematics is both conceptual and symbolic and abstract in nature and it is created socially. Thus, training programmes for mathematics teachers should ensure the understanding and proper assimilation of concepts and terminologies, symbols, equations, procedures, assumptions, etc. Mathematics knowledge should be learned socially during the classroom interaction, in conferences, workshops and seminars.

2. Conclusion

Social constructivism is a major philosophical principle that explains how learning occurs. As a variation of the common cognitive constructivism, it emphasizes the role of society, and social interaction, in knowledge creation, construction, and assimilation in an individual. The constructivism theories have been advocated for a long time, as the basis for improving the process of learning in the classroom. When applied to the professional training of the mathematics teacher, be it pre-service or in-service, the theory holds several important implications, among which training programs should be designed to promote collaboration, while also making the trainee teacher aware of the importance of this so it could be properly applied in their classrooms.

3. Recommendations

Based on the review above, the following recommendations are made;

1. Any mathematics teacher education program or activity should take into account the importance of social interactions and collaborations in its design.
2. Both pre-service and in-service mathematics teachers should be made aware of the importance of applying the principles of social constructivism in the classroom situation.
3. When training mathematics teachers, the teachers in training should be treated as co-constructors of knowledge and should be exposed to the need of applying this in their classrooms.
4. The educational environment for the trainee mathematics teacher should also encourage the discussion and sharing of opinions and contributions, while encouraging curiosity as this is the basis of knowledge creation and construction.
5. Any mathematics teacher training program should consider the importance of language in the instructional process. Taking steps to ensure that the language of instruction is explicitly clear to the individuals.

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