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Innovación en educación matemática de básica superior durante el confinamiento por COVID-19

Innovation in higher basic mathematics education during confinement by COVID-19

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ABSTRACT

The objective of the research is to analyze innovation in higher basic mathematics education during confinement by COVID-19 in Ecuador. Methodologically, it was descriptive exploratory in nature with a non-experimental quantitative approach. Eight (8) were the teachers who met the population inclusion criteria. The results were based on exploring the areas related to: inclusive mathematics, teaching update, student training and educational innovation. As a conclusion, the innovation in higher basic

mathematics education during confinement by COVID-19 in Ecuador, should focus on ICT-mediated learning through student-centered methodologies such as problem-based learning, with which the teachers have the possibility of designing strategies in accordance with the needs of the social environment where the student lives, as well as, developing projects that involve mathematical operations by using the resources available for this purpose.

Descriptors: Information technology; activity learning; computer assisted instruction; epidemiology. (Words taken from the UNESCO Thesaurus).

INTRODUCTION

The society of the third millennium in which we lived is characterized by accelerated changes in the field of science and technology, such as: knowledge, tools and the evolution of the way to communicate mathematics; for this reason, both learning and teaching must be focused on the development of the necessary skills in this area so that the student may be capable to solve everyday problems, while strengthening logical and creative thinking (Travieso-Valdés & Ortíz-Cárdenas, 2018).

In addition to the above, education does not currently perceive mathematics as an isolated discipline, but rather interconnected that enables the generation of learning in other subjects, projecting the generation of pedagogical actions in order to promote complex and integrative learning of competences (Calvo-Cereijo, 2019). Thus, education is promoted where the students have the possibility of innovating from the didactic resources that they have.

Today, part of these resources are shaped by ICT (Grisales-Aguirre, 2018), which implies transcending traditional teaching towards supporting didactic strategies based on technology. In consequence, the students assume a main role in learning, developing an investigative task that allows them to improve a series of favorable skills for their integral growth, such as teamwork, autonomy and motivation to achieve, (Ausín, et al, 2016). In this sense, the educational system of Ecuador has been implementing transformations in its curriculum, one of them is the incorporation of ICT in the learning

of mathematics, specifically, in the "higher basic education" stage as indicated:

> OI.4.8. Collect, organize and interpret own and external materials in scientific, artistic and cultural creation, working as a team to solve problems, using logical reasoning, diverse sources and ICT in multiple contexts by considering the impact of human activity. (Ministry of Education of Ecuador, 2016).

In connection with this idea, innovation is projected as part of the teaching-learning process with emphasis on the use of ICT, which is on the par with the current situation experienced due to the confinement by COVID-19, where the Ecuadorian State has assumed telework as an option to comply with the obligations of the public administration without being exempt education at all levels. Because of this, the virtual classroom becomes an element that contributes to the prevention of the disease.

The forced process of assuming virtual education by COVID-19, allows the teacher to face the challenge of planning for promoting learning in mathematics from virtuality, which implies adapting what is proposed in the curriculum to an unexpected situation that the educational plan provides due to COVID -19 (Creamer, 2020). From that point of view, innovative strategies should be applied in order to promote meaningful knowledge in students, especially, in mathematics.

This allows the teachers to generate capacities for creation and innovation, in order to adapt to the new virtual context where they must work, being necessary to know about the approach of strategies and didactic resources, which effectively contribute to learning through ICT mediation (Jiménez-Galán, 2017). The opposite would be improvising without a pedagogical foundation, that is, creating an imbalance that does not favor optimal learning.

Likewise, it is necessary to take into account the possibility to have students with neurobiological conditions that may negatively affect the learning of mathematics, an option to be taken into account by the teachers when designing the strategies to implement (De-La -Peña-Álvarez & Bernabéu-Brotóns, 2018). Addressing this situation, it makes possible to minimize the school dropouts due to the difficulty with mathematics

understanding (Muñoz-Camacho, et al, 2018). In this way, taking into account factors that may influence the risk of such desertion, it allows projecting the pedagogical adequacy to have an educational setting where the chance of failure would be reduced. This becomes a task to be promoted by the teacher, using innovation as a strategic part to form an assertive approach to learning (Pascua-Cantarero, 2016).

In this respect, the design of virtual learning environments as a didactic resource must be thought for the multiplicity of conditions and interests of the students, it cannot be linear and uniform because there is a risk of excluding (Vega-Vega, Niño-Duarte & Cárdenas , 2015); in this sense, the concept of studnets' integration with their peers cannot be lost, since it enables cooperative work and interpersonal communication to generate socialization from education (Rodríguez Pautt, 2014).

On the other hand, (Mendoza, Burbano & Valdivieso, 2019) highlight the role of the teachers in mathematics teaching, since they state that their skills must be associated with the virual environment, considering their experiences and specific knowledge in order to generate an integration that allows the configuration of a quality education in accordance with the challenges posed. In this way, it would be possible to reconcile knowledge with the educational policies of Ecuador, where inclusive, innovative learning is required in relation to the country's challenges for its socio-economic transformation in the coming years (Calvo, 2015).

In relation to the above, the (National Institute for Educational Evaluation, 2018) emphasizes the investment that the State of Ecuador has been making to counter school dropout and improve the quality of education, so the current situation due to the COVID pandemic -19, has forced to assume the virtuality as an alternative for face-to-face meetings, it should not be done to the detriment of the quality indicators, but, it is necessary to raise them to constitute the adverse situation as a learning for the growth of Ecuadorian society (Estrada, Monferrer & Moliner, 2016).

Therefore, ICT as an educational innovation affects the generation of significant learning in mathematics (Carranza-Alcántar, 2017), being necessary to count on the guidelines

of the Ministry of Education in Ecuador, added to the design of strategies in accordance with an inclusive learning in relevance to global social challenges (García-Navarro, Massani-Enríquez & Bermúdez-López, 2016). In relation to these particular matters, the objective is: to analyze innovation in higher basic mathematics education during confinement by COVID-19 in Ecuador.

METHOD

The research was descriptive exploratory in nature with a non-experimental quantitative approach (Hernández, Fernández & Baptista, 2014). It was an observational work; besides, the STROBE guidelines scheme was implemented in order to provide methodical depth to the study carried out (Cartes -Velasquez & Moraga, 2016). Therefore, the following procedures were followed:

Population and study sample

The population was made up of 45 teachers from ‘San Francisco de Sales’ Fiscomisional Educational Unit, located in the province of Manabí-Ecuador. The sample was made up of 8 teachers who met the following inclusion criteria: being an active teacher in the school, being a teacher of higher basic mathematics and being willing to participate in the research through the creation of the online survey.

Regarding the technique, the online survey (Google form) was applied, thus, the population sample provided pertinent information to the research topic. Likewise, a pilot test of the instrument was carried out in order to establish its reliability. Once the data was obtained, it was calculated in the SPSS V25 data processor, which yielded a reliability of 0.91 Cronbach coefficient, considering it reliable for its application.

RESULTS

Regarding inclusive mathematics, 56% of the teachers stated that they have planned in order to incorporate inclusive strategies, 17% proposed strategies to tackle intellectual

diversity and 27% have considered strategies to help students with physical disabilities and face the virtual learning modality.

Respect to the Teaching Update, 40% responded that they have participated in training courses, scheduled during the pandemic as part of updating for the new academic period, 23% affirmed that they have adequate training to handle virtuality before the emergency occured and 23% affirmed that their self-training has allowed them to have greater knowledge to face the challenges of the new educational cycle.

In relation to **student training**, 70% of the teachers considered it pertinent to train students in the use of ICT in order to promote better learning, 20% agreed in updating ICT teaching resources for implementing meaningful learning and 10% expressed that it is important for the student to work in their social context on mathematical learning.

Finally, regarding **educational innovation**, 43% considered relevant to innovate in competency-based education, 27% supported the innovation through project-based education and 30% considered problem-based learning as methods that allow students to train from virtuality.

DISCUSSION

Concerning the inclusive mathematics area, the teachers must take into account the physical and intellectual disabilities that the students may have in order to generate innovative and inclusive strategies that allow them to actively participate (Aldana-Bermúdez, et al, 2018). In this sense, it is an opportunity for inclusion during the virtual period of education due to the pandemic; likewise, this situation also allows promoting an education based on the quality of good living (Rodríguez, Aguilar & Apolo, 2018).

However, for counting on an inclusive and quality education, equity must be promoted as the axis of integration, which will avoid the isolation of students; moreover, (Ayala-Asencio, et al, 2019) affirmed that it is necessary to promote intercultural competences in students, which allow having a greater possibility of generating a climate of citizenship based on the strengths to work collaboratively as a team.

Teaching updating is essential to keep up with the challenges to be faced in the teaching of mathematics from an innovative perspective of education (Díaz-Pinzón, 2018); since it confronts traditional teaching and shows the need to incorporate strategies such as simulation, a situation that could favor students' learning. This is exactly why the teachers must have experience in managing programs because through this previous preparation, they can make this educational trend possible (Cistac, Bongianino, Filippi & Kovac, 2009).

Student training is essential for contributing to the generation of learning in accordance with the goals set by educational policies (Zempoalteca-Durán, et al, 2017), promoting the possibility of avoiding school dropout or low academic performance. (López -Mero, et al, 2015) asserted that family support plays a fundamental role in helping the students to achieve academic goals.

In the same way, (Eljuri-Blanco & Villasmil-Yánez, 2018) considered important the generation of an organizational culture that fosters the permanent training of both teachers and students in extracurricular competitions inside the institution, which is necessary, nowadays, to promote the use of ICT for educational purposes. Moreover, this allows developing meaningful learning based on complying with the guidelines set out in the period of confinement by COVID-19, coupled with the need to stimulate mental structures for assertive management of emotions in the students, as this contributes to a better school integration based on the current academic challenges (Salvatierra-Tumbaco, Vallejo-Valdivieso & Moya-Martínez, 2019).

In the area of educational innovation, problem-based learning, competency-based learning, project-based learning are focused on student centrality (Peche-Cruz and Giraldo-Supo, 2019), and the main goal is innovation and research. From this perspective, both teachers and students established a work team with the proposal of reconciling learning together, under the premise of constant reflective inquiry in the search for information, a situation that has the use of ICT as support. However, it is necessary to monitor the application of these methodologies, so they can be misused

and distort in their essence to the detriment of the quality of education (Gutiérrez, Rodríguez and Isea Argüelles, 2019).

In addition, the importance of the role played by the directors of the institutions in supporting the promotion of quality education respect to the new times affected by the confinement is highlighted, since they as educational leaders should join forces to promote transcendence to a society based on values built from learning achieved in the educational system (Lugo & Villasmil Ferrer, 2019). On the other hand, (Montiel-Espinosa, 2016) indicated the need to innovate educationally for enhancing mathematical learning according to the new social scenarios in which the students are involved, therefore, postgraduate courses became appropriate spaces to promote transformations in education professionals.

CONCLUSIONS

Innovation in higher basic mathematics education during confinement by COVID-19 in Ecuador, should focus on ICT- mediated learning through student-centered methodologies such as problem-based learning, with which, the teachers have the possibility of designing strategies in accordance with the needs of the social environment where the students live. In this way, they can develop projects that involve mathematical operations in line with the resources available for that purpose; in addition, a series of competences are promoted such as ecological awareness, intercultural communication, reflection, understanding, and also, investigative inquiry as a means of searching for information that contributes to solving the problem through the development of the project. Likewise, it is stated that:

-Teachers must be updated in virtual competencies that allow them to process learning effectively in students.

-Students must be trained in ICT so that they can empower themselves with virtuality-based teaching strategies and resources.

- Family support is essential for the support and motivation of students in order to adapt

to virtual education.

-The diversities and disabilities of the students must be taken into account when designing learning strategies with the purpose of generating an inclusive and quality education for good living.

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