

Exploring the notion of function through augmented reality

Carlos Aurelio Robles Amador ¹ 

Problem addressed

The notion of function plays a central role in the teaching and learning process of mathematics. Since the function establishes relationships among variables, it is used to model different phenomena, and to comprehend fundamental structures in daily life. Because of its relevance, difficulties with learning of its foundations and its characteristics have been identified among students (Denbel, 2015). The root of the problem can be either at the level of abstraction that is required, or in the different forms in which it is expressed (Hajizah et al., 2021). One of the possible pathways to address the difficulties in understanding this concept is with the aid of technology, specifically by using augmented reality (AR) (Del Cerro Velázquez & Morales Méndez, 2021).

The theory

In mathematics, the term “function” is stated as the relation between two or more variables. Such a relationship can be expressed in different forms—for example, graphically in a plane, numerically in a table, or algebraically in the form of an equation. According to Niss (2020), the different aspects of the notion of function make it difficult to understand.

¹ ca.robles.amador@gmail.com

Instituto Politécnico Nacional CICATA Legaria

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In the context of education in Mexico, students develop the notion of function during middle school and high school. During this process, it is expected that the student will identify variables, interpret the relationship between them, and visualize it in its different forms. During the first contact with the notion, it is relevant to understand the concept, initiating the construction of links with other areas of mathematics, and developing skills to solve problems using it (Del Cerro Velázquez & Morales Méndez, 2021).

One theory that can address the problem from a cognitive perspective is the Theory of registers of semiotic representation (Duval, 2017, 2020). The use of this theory will allow us to identify whether students' difficulties stem from problems in the transition between registers (for example, from algebraic to graphical), from manipulating within the same register, or from a restricted image of the concept of function.

What is researched and what is the progress?

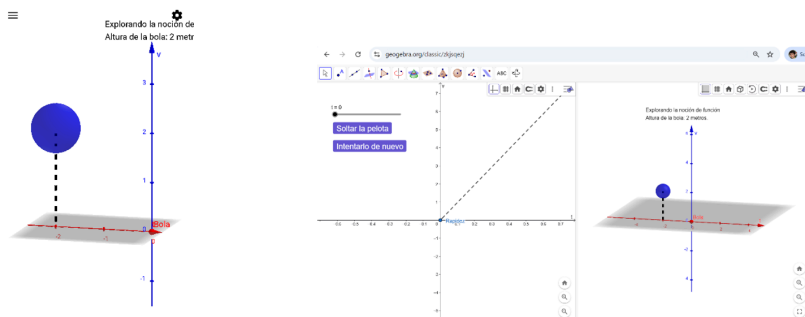
The process of learning a function starts with the linear function. The linear function serves as the first approach to relating two variables and manipulating their different forms (Pierce, 2005).

Because of the different forms in which a function can be expressed, the use of technology, specifically augmented reality (AR), emerges as a useful tool for teaching this concept. AR enhances the user's perception of the real world, offering an environment where users can interact dynamically with different elements and explore mathematical concepts. In addition, AR provides users with a dynamic interface to explore different characteristics in an interactive way, enhancing students' comprehension of the notion of a function (Antonini et al., 2019).

The proposal will use a construction in GeoGebra that the student can manipulate in a mobile device. This research is at the stage of defining the theoretical framework and designing a didactic situation.

Figure 1

GeoGebra construction of the linear functions as seen on a mobile device.



Implications and significance

This study will provide valuable insights for high school students in Mexico regarding the notion of a function. First, it explicitly includes the theory of registers of semiotic representations from Duval (2017, 2020). Second, it focuses on proposing a complete didactic methodology for educators to improve their teaching approaches to this topic using technology.

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References

- Antonini, S., Baccaglini-Frank, A., & Lisarelli, G. (2020). From experiences in a dynamic environment to written narratives on functions. *Digital Experiences in Mathematics Education*, 6(1), 1–29. <https://doi.org/10.1007/s40751-019-00054-3>
- Del Cerro Velázquez, F., & Morales Méndez, G. (2021). Application in augmented reality for learning mathematical functions: A study for the development of spatial intelligence in secondary education students. *Mathematics*, 9(4), Article 369. <https://doi.org/10.3390/math9040369>
- Denbel, D. G. (2015). Functions in the secondary school mathematics curriculum. *Journal of Education and Practice*, 6(36), 77–81.
- Duval, R. (2017). *Understanding the mathematical way of thinking: The register of semiotic representations*. Springer. <https://doi.org/10.1007/978-3-319-56910-9>
- Duval, R. (2020). Registers of semiotic representation. In S. Lerman (Ed.), *Encyclopedia of mathematics education* (2nd ed., pp. 724–727). Springer. https://doi.org/10.1007/978-3-030-15789-0_100033
- Hajizah, M. N., Wijayanti, D. A., & Darhim. (2021). Realistic mathematics education on teaching functions to develop algebraic thinking skills. *Journal of Physics: Conference Series*, 1869(1), Article 012130. <https://doi.org/10.1088/1742-6596/1869/1/012130>
- Niss, M. (2020). Functions learning and teaching. In S. Lerman (Ed.), *Encyclopedia of mathematics education* (2nd ed., pp. 303–306). Springer. https://doi.org/10.1007/978-3-030-15789-0_96
- Pierce, R. (2005). Linear functions and a triple influence of teaching on the development of students' algebraic expectation. In H. L. Chick & J. L. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 4, pp. 81–88). PME.

