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Picalab Musi-Matemáticas Sonoras Interactivas. Design, implementation and evaluation of a software package and didactic guides for mathematical education based on musical metaphors for primary education in Chile

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Abstract

The Picalab Project proposes the design, development, and study of an integrated mathematics-music software solution to leverage learning of mathematics in a classroom context, by use of music as metaphors for mathematical curricular contents. Software modules were developed, based on Brousseau's Theory of Didactical Situations framework, and aimed at the 3rd, 4th and 5th grades of Chilean primary education level.

The modules can be used by students all by themselves, but the teacher is considered a primary and key player in the implementation of this solution. Primary proof of concept and usability tests seem to point to music, as representation of curricular mathematical contents acts as scaffolding of learning, anchors new information in the socio-cultural context of learning, can be part of situated knowledge, and offers a new perspective for learning mathematics at schools, giving pupils opportunities to develop their own mental representations

Keywords

mathematical learning, didactic software, music

Aims

The objective of the Picalab project is to design MMSI (Musical Mathematical Sound Interactive) modules, consisting of a software application paired with a didactic guide, which would allow a school teacher to present mathematical concepts or concepts, leveraged on a musical or sound based experience. Great consideration was given to the fact that Math teachers do not necessarily have sufficient training in music, and could therefore be averted by the apprehension of having to address musical concepts they do not master during their lessons with the MMSI. To this end, a didactic guide was specifically written to show the teacher how to best take advantage of the interest that students naturally have in music and sound, to create a significant contextualization for otherwise abstract or difficult mathematical concepts

Methods

The production of MMSI consists of a three stage, iterative process: 1) Proposals for a non-functional prototype; 2) Selection and prototype implementation; and 3) Class evaluation and feedback.

Outcomes

Preliminary results show that students become highly motivated with this approach. Students show a very good attitude towards the modules, and remain in activities for the whole extent of the class. Most remarkable, is the fact that they can engage in active discussions about topics that, in a typical lecture format, they do not. They engage in formulating hypothesis regarding the "behavior" of different multiples, and then

proceed to validate or reject them by means of the module itself. They consistently arrive at conclusions such as "a common multiple of two numbers is necessarily the product of these numbers", and shortly discover that this is not necessarily the least common multiple. The fact that these abstract or non-contextualized math topics are now presented in a musical context is apparently a key factor. This is currently being tested for later publication

Conclusions

revealed a very important motivation and positive attitude towards the use of each music-mathematic module presented, particularly in those with a more game-like form. The music component, most evident in the exploratory (no guided) first phase of use of each module, is attractive to practically all students, even those that do not consider themselves "music experts". Equally important, this interest and motivation is also present towards the mathematical concepts involved. The fact that these are presented in a musical context seems to enhance interest and scaffold comprehension in them.These preliminary results seem to indicate that this interdisciplinary approach is worthy of further research, which we expect to broaden as we gather more and definitive data in the quantitative and qualitative final assessment

Acknowledgements

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