



HAL
open science

Using the interactive visualization tool SimReal+ to teach mathematics at the university level: An instrumental approach

Said Hadjerrouit

► **To cite this version:**

Said Hadjerrouit. Using the interactive visualization tool SimReal+ to teach mathematics at the university level: An instrumental approach. First conference of International Network for Didactic Research in University Mathematics, Mar 2016, Montpellier, France. hal-01337907

HAL Id: hal-01337907

<https://hal.science/hal-01337907>

Submitted on 27 Jun 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Using the interactive visualization tool Simreal+ to teach mathematics at university level: an instrumental approach

Said Hadjerrouit and Harald Hoven Gautestad

University of Agder, Norway

This work focuses on mathematics education at the university level using the interactive visualization tool SimReal+. To capture the complexity of teaching and learning processes in a digital environment, this work uses the instrumental approach to explore teachers' orchestrations in classroom. In addition, this study proposes a set of criteria to analyse students' perceptions of teachers' use of SimReal+ to orchestrate the learning process. The findings indicate that SimReal+ is globally a useful tool in mathematics education at the university level.

Keywords: Instrumental orchestration, SimReal+, usefulness, visualization.

THE INTERACTIVE VISUALIZATION TOOL SIMREAL+

SimReal+ is an interactive visualization tool for teaching and learning mathematics. SimReal+ uses a graphic calculator, video lectures, video streaming, and interactive simulations to teach mathematics. The basic idea of SimReal+ is that visualizations are powerful mechanisms for learning mathematics and explaining difficult topics. According to Arcavi (2003), visualization is the ability to use and reflect upon pictures, graphs, animations, images, and diagrams on paper or with digital tools with the purpose of communicating information, thinking about and advancing understandings. There is a huge interest in visualization in mathematics education. However, there is little empirical support for the use of visualizations in mathematics education (Macnab, Phillips, and Norris, 2012).

THEORETICAL FRAMEWORK

This work uses the instrumental approach to analyse teachers' use of SimReal+ to orchestrate the students' learning of mathematics. The instrumental approach to mathematics education is rooted in a number of research studies (Drivjers, 2010; Trouche, 2004; Verillon and Rabardel, 1995). These studies highlight the role of instrumental orchestration as external steering of students' instrumental genesis, that is to say the process by which a tool becomes an instrument while students carry out mathematical tasks. Instrumental orchestration is more than a one-way process directed from the teacher to the students. It includes a socio-cultural aspect as the digital tool serves as a medium between teacher and students in teaching and learning processes. Starting from a set of possible orchestrations as defined by Drivjers (2010), new types of orchestrations may emerge as a consequence of digital tool use. This work also uses technical, mathematical, and pedagogical criteria to analyse the usefulness of SimReal+ in mathematics education at the university level.

RESULTS

A total of 13 different orchestrations have been observed, eight in lectures and five in exercises. The results show that traditional teaching with white board/projector and/without SimReal+ is the most used teacher-orchestration (41.8%), followed by Individual Guide-and-explain (10.60%), Individual technical support (7.55%), Individual Discuss-the-screen (6.97%) and technical-demo (6.31%). Regarding the technical usefulness, the findings show that it is difficult to navigate through the menus of SimReal+. This indicates that the orchestration Technical-demo should play a greater role in teaching. From the mathematical point of view, the majority of the students believed that SimReal+ is useful in learning mathematical topics such as differentiation and integration. Students' responses to interviews also indicate that SimReal+ can provide a deeper understanding of differentiation and integration. From the pedagogical point of view, a majority of the students believed that they are more motivated to use SimReal+ due to the varied methods provided by the tool.

CONCLUSION

The findings indicate that SimReal+ is a potentially useful digital tool for teaching and learning mathematics at the university level. Still, SimReal+ needs to be improved to make the user interface more intuitive and easy to use. The large number of participants ($N=500$) may be sufficient to adequately support the generalization of the results. However, new cycles of experimentations and evaluations of SimReal+ in higher education are needed to ensure more validity and reliability of the results.

REFERENCES

- Arcavi, A. (2003). The Role of Visual Representations in the Learning of Mathematics. *Educational Studies in Mathematics*, 52(3), pp. 215-241.
- Drijvers et al. (2010). Integrating Technology into Mathematics Education: Theoretical Perspectives. In C. Hoyles & J.-B. Lagrange (Eds.). *Mathematics and Technology-Rethinking the Terrain*. Berlin: Springer.
- Macnab, J.S., Phillips, L.M., & Norris, S.P. (2012). Visualizations and Visualization in Mathematics Education. In S.P. Norris (Ed.). *Reading for Evidence and Interpreting Visualizations in Mathematics and Science Education*, pp. 103–122. Rotterdam: Sense Publishers.
- Verillon, P., & Rabardel, P. (1995). Cognition and Artifacts: A Contribution to the Study of thought in Relation to Instrumented Activity. *European Journal of Psychology of Education*, 10(1), pp. 77-101.
- Trouche, L. (2004). Managing the Complexity of Human/Machine Interactions in Computerized Learning Environments: Guiding Students' Command Process through Instrumental Orchestrations. *International Journal of Computers for Mathematical learning* 9, pp. 281-307.