Robotics and STEM education for children and primary schools – botSTEM

Ileana M. GRECA

Universidad de Burgos, 09001, Burgos, Spain

Andreas REDFORS, Björn CRONQUIST and Marie FRIDBERG

Kristianstad University, SE-291 88, Kristianstad, Sweden

Abstract. BotSTEM is an ERASMUS+ project aiming to raise the utilisation of inquiry-based collaborative learning and robots-enhanced education. The project outputs are specifically aimed to provide in- and pre-service teachers in Childhood and Primary Education and children aged between 4 and 8, with research-based materials and best practices that use integrated Science Technology Engineering Mathematics (STEM) and robot-based approaches, including code-learning, for enhancing scientific literacy in young children. Initial results from the project will be presented at the conference.

1 Introduction

Recent research have demonstrated that early techno-scientific literacy in children as young as 4 years old could improve their long-term achievement in STEM fields and raise the scientific and technological vocations, especially for girls. botSTEM is an ERASMUS+ project with partners in Spain (coordinators), Sweden, Italy and Cyprus, that aims to address this point, through the development of a new methodology for including STEM integrated programmes into the formal education curricula for childhood and primary schools (4-8 years old), using inquiry teaching and educative robotics and code-learning. The project outputs are specifically aimed to provide in- and pre-service teachers in Childhood and Primary Education and children aged between 4 and 8, with research-based materials and best practices.

2 Framework and Search for good practices

STEM in early childhood education should be preferably holistic, child centred, project and problem based. It is the integration of science, technology, engineering and mathematics fields that creates valuable STEM experiences for children [1, 2]. In particular, inquiry teaching methodology and engineering design help intertwine the different fields in STEM through real world problems. Working with inquiry-based STEM activities provides children with opportunities to practice skills such as reasoning, reflection, questioning, modelling, justifying decisions and communicating. In addition, in botSTEM, we consider that computational thinking (by means of robotics and/or code learning) should be introduced at early childhood, not only because of its prominence in actual technology, but also for its potential to teach logical thinking, problem solving and digital competence. Also, given that girls in general come out as much more negative towards technology and its development, botSTEM pursues to establish gender inclusive teaching and learning activities.

The botSTEM project aims to build a downloadable interactive Toolkit, freely available on the project website addressed to teachers in Europe. The toolkit will include good practices for collaborative inquiry teaching and learning concerning robotics and STEM with methodological guidelines.

3 Results

All partners have looked for successful practices at European-scale in fostering scientific and technological vocations, paying special attentions to STEM and gender perspectives. Robotics in childhood education is not extensive in Europe, especially robotics connected to several or all subjects in STEM.

For the assessment of best practices, that will be the basis of the guidelines for teachers, partners will interview three experts or expert teachers per country. Main criteria for good practices addressing 4 and 8 years-old children are:

- Pedagogical innovative strategies in education with robotics
- Generic and versatile in relation to robotics and robots
- Specific learning goals for several of the four fields S, T, E, M
- Learning goals related to big ideas in science
- Gender inclusive
- Including collaborative work
- Involvement of a wide educational community (parents, stakeholders)
- Extended in time

The overall process has been running smoothly, but the fact that documented examples of teaching and learning practices for integrated STEM [1] utilizing robotics are scarce has made the search difficult. Most of the practices found are extracurricular practices, being developed in non-formal environments and they are especially scarce for the focus age of this project. However, there seems to be integrated STEM activities beginning to appear for older students, in particular secondary school students. It has proven necessary for the consortium to extend the period of searches somewhat in order to collect and analyse a sufficient number of good practices. Other points that emerge from the interviews of experts is that teachers use what is available and easy to buy and use. Hence, activities are not necessarily guided by developed framework methodology and teaching approaches. Results from this selection process will be presented at the conference.

Preliminary teaching sequences for childhood education are currently being designed based on the outcomes of the initial search for good practices. These activities are designed from the guiding theoretical ideas of the project and will be implemented, refined and evaluated in preschools and schools in the partner countries. Example activities are being enacted during 2018 and results from this process will be presented at the conference.

4 Conclusion

The findings of good practice related to integrated STEM teaching and learning has been slim and the consortium has therefore increased efforts in designing new activities. These activities will be implemented, evaluated, redesigned and made ready for final implementation at the local level. Thereafter they will be translated and tested at the European level by the different partners and made available through the interactive web-site of the project.

Acknowledgements

We acknowledge support from ERASMUS+ 2017-1-ES01-KA201-038204.

References

[1] Toma, R. B. & Greca, I. M. (2017). The effect of integrative STEM instruction on elementary students' attitudes toward Science. …

[2] Kermani, H. & Aldemir, J. (2015). Preparing children for success: Integrating science, math, and technology in early childhood classroom. *Early Child Development and Care*. 185(9), 1504-1527