Exploring the role Communities of Practice and online technologies can play to support engagement with STEM

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Abstract

There has been considerable interest in advancing Science, Technology, Engineering, and Mathematics (STEM) education for some time now. All current thinking, international best practice, and many commissioned reports highlight the importance of these subjects to facilitate the development of a knowledge-based society. In this position paper we present the overall aim of our research, which is to explore the role Communities of Practice (COP) and online technologies can play to support engagement with STEM topics. We also present how we aim to explore the use of the online tools and technologies to support and strengthen communication and collaboration between members in a COP. The research proposed here will incorporate a participatory design approach and group evaluations, for this we will collaborate closely with several secondary schools (formal setting), along with other groups, (e.g. Coderdojo – informal setting) where design and user studies will be conducted continuously over the course of this research project.

Author Keywords

Communities of Practice, STEM, Teachers, Students, Education, Engagement, Communication, Collaboration

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Research Context

There has been considerable interest in advancing Science, Technology, Engineering, and Mathematics (STEM) education for some time now (Bybee, 2010). All current thinking, international best practice and many commissioned reports (e.g. Allen-Ramdial & Campbell, 2014) illustrate the importance of these subject areas to facilitate the development of a knowledge-based society and to service the increasing need for professionals in areas of employment and industry. For the purpose of this research we chose to focus on second-level education and in particular 14-16 year old students because at this age the students take part in a year called Transition Year, i.e. a unique one year programme that promotes the personal, social, vocational and educational development of students. The year has no set curriculum and the students have more freedom to engage in projects, competitions, work experience, initiatives, etc.

As part of our research we plan to explore Communities of Practice (COP) in the context of education, i.e. teachers and students. Communities of Practice will be at the core of our research as the development of an online COP will be used to increase communication and collaboration between teachers and students in order to support their engagement with STEM. Communities of Practice, as a term and research area, was first introduced by Lave and Wenger (1991) when they discussed it in regards to apprenticeship as a learning model. Wenger then extended this concept, and applied it to other domains, such as, for instance: organisations (Wenger, 1998b). As part of this work Wenger defined COP as a "group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (1991, pp 72-73). A COP is said to have three main structural elements – Domain, Community and Practice. *Domain* refers to the shared domain of interest the community members are engaged in (Corso and Giacobbe, 2005; Probst and Stefano, 2008; Ranmuthugala, et al., 2011; Wiggberg and Daniels, 2011) and commitment to this domain is implied by membership and a shared competence that distinguishes members from other people (Lave and Wenger, 1991; Wenger, 1998, 1998b, 2006). *Community* refers to the joint activities the community members engage in (Lave and Wenger, 1991; Wenger, 1998, 1998b, 2006), i.e. they share information, help each other, engage in group discussions, build relationships etc. Finally, *Practice* refers to the shared repertoire of resources the community members build up, (Lave and Wenger, 1991; Wenger, 1998, 1998b, 2006), i.e. stories, tools, experiences, etc.

To date, the majority of published research considers different definitions of the term COP and how COP are particularly used within organizations. The goal of this research is to understand how a COP can be used in education in order to help to support engagement with STEM and to enhance the student's and teacher's experience of STEM in formal and informal settings. This approach will attempt to fill this research gap in order to support work that seeks to build COP which work towards the future of education.

Current Research

We are conducting an ongoing extensive literature review of Communities of Practice with a particular

focus on how they are formed, how they develop and how they transform over time. As part of our research we are investigating COP in the education sector, i.e. school, teacher and student communities. We have established the key characteristics of a COP, investigating how they align with an existing community, i.e. Coderdojo. In parallel to this, we are carrying out research to determine how teachers communicate and collaborate with each other, what tools they use to do so, and what resources they use, share, etc. We are also looking at how students communicate and collaborate with each other inside and outside the classroom, e.g. on group projects. We are using a mixture of qualitative and quantitative research methods to collect data (e.g. surveys, interviews and focus groups). Taking the results and findings from both of these studies, we then plan to implement a series of participatory design workshops with teachers and students. These will be used to work towards designing a suite of online communication/ collaboration tools which will support engagement between both sets of participants inside and outside the classroom, with a particular focus on STEM. (See Figure 1 for a diagram of our research plan.)

Research Goal and Questions
The general goal of our research is to investigate how communities of practice and the use of online technologies can support teachers and students engagement with STEM topics. The research questions (RQ) are as follows:

Main RQ: How can the use of Communities of Practice and online technologies support teachers and students engagement with STEM topics and enhance their experience in both formal and informal settings?

Secondary RQs:
- *How do teachers communicate and/ or collaborate in formal and informal settings?*
- *What online tools and technologies are essential to the development of a community of practice?*
- *How can we exploit existing online tools and technologies to design a successful community of practice?*
- *How can online tools and technologies support engagement levels in a Community of Practice?*
- *How can an online community of practice support students and teachers engagement with STEM in formal and informal settings?*

Our conjecture is that participation in a community of practice and the use of online technologies will positively affect students and teachers engagement with STEM, to achieve meaningful learning and boost their attitudes toward STEM.

Expected outcomes from attending workshop
From attending the "Hybrid Collaboration – Moving beyond purely co-located or remote collaboration" workshop at ECSCW 2019, we hope to discuss issues related to our research questions and goals. In particular we would like to learn more about what work is currently being done in this area and we would like to hear other researcher's ideas and opinions on the methods we are proposing to use. Furthermore, we hope to network with and learn from other researchers who are working in a similar area about the work they are conducting and the methods they are using.
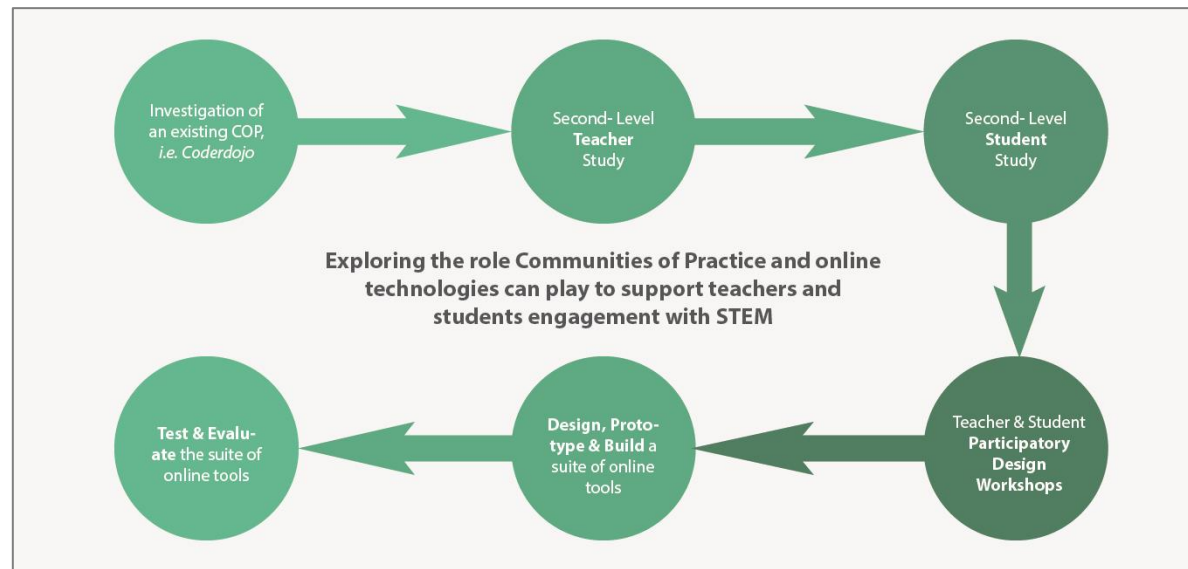
Figure 1: Our Research Plan.

Conclusion

In this position paper we presented our current research. The aim of this project is to evaluate how existing online tools and technologies and COP can support teachers and students engagement with STEM in second-level education. We are currently investigating the landscape of how teachers and students communicate/collaborate with the intention to conduct a series of follow-on participatory design workshops as part of the next research phase.

Acknowledgements

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