Activation of Computer Science Teachers in Slovenia

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Abstract. The paper describes an approach of improving Slovenian Computer Science Education in general secondary school by forming an active and sustainable Computer Science Community of Practice (CS CoP). In project NAPOJ three systems teachers use in teaching programming are combined: CS e-textbook, LMS Moodle and TOMO, automatic assessment system for learning programming. Group of master teachers were selected, who prepared the initial set of in-class resources and material at a half a week workshop. This was followed by the regional workshops for other CS teachers throughout the Slovenia and run by master teachers. Development of CoP was observed and analyzed through various data gathering tools, such as questionnaires, discussions and observations, and preliminary results are highlighted.

Keywords: Community of practice · Programming · Master teachers
Teaching resources · General secondary school

1 Introduction

Computer Science (CS) is taught in Slovenian general secondary school in the first year as a mandatory and in the later three years as an elective subject. Fortunately, the valid curriculum is written very openly, covering all four years and giving teachers quite some freedom in choosing the topics. Through this openness we aimed to improve general secondary school's CS education [1]. The first step was to introduce a new e-textbook [2] and some changes in the national examination process (Matura). There has been quite a lot of concern and anxiety among the teachers about the requirements these changes would bring to their teaching. Through interviews with them, following discussion in Forums, discussion at various teacher's related events, and through personal contacts we found out that teachers as one of their main concerns feel insecurity of how to approach teaching programming. They also had an impression of lacking the teaching resources. As reported in [3–9], a possible answer to such concerns is a Community of practice (CoP). In this paper we report on intervention in

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which we established CoP among the Slovenian CS teachers to increase their teaching confidence and consequently improve student's knowledge of programming.

The paper is organized as follows: first, the general theory behind CoP is highlighted, then our project is presented in more detail and some of our experiences are listed, the paper is then concluded with our thoughts.

2 Communities of Practice

As CS is a relatively new discipline in K-12 education we face many challenges related to the way CS is taught. In many schools teachers feel isolated [6], which combined with a lack of confidence is also reported in [8]. To overcome the feeling of isolation we can introduce CoP. In [9] the following definition is given: "CoP are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". An important part of CoP, besides sharing the interest, is that the members are practitioners sharing experience, stories, tools, and ways of addressing problems. Fincher and Tenenberg [10, 11] created the Disciplinary Commons project, which invites a group of computing educators within the same discipline to meet monthly during an academic year in order to share, reflect upon, and document their teaching. Ni et al. [6] report how this approach has been useful in establishing a community to support high school (HS) CS teachers. One of their most important results was that teachers reported they were able to build a sense of belonging to a community. Participation in community activities helped them to validate their work and build confidence in themselves as HS CS teachers. A successful CoP can be observed within Computing At School (CAS) movement in Great Britain. As reported in [8], CAS has a particular focus on supporting teachers to deliver the new curriculum in the classroom, with confidence and enthusiasm, through building local CoP.

3 NAPOJ Project

NAPOJ (potion) stands for *Design of Teaching Algorithms and Programming and Establishing a Community* (translated from Slovenian). It is a far-reaching idea to establish a community of Slovenian K12 teachers of CS, starting with a general secondary schools (*Gymnasia*).

3.1 Goal

The primary goal was to establish an active and sustainable CS teacher CoP and provide it with the necessary initial material and tools. A slightly narrower aim has been to produce and share resources as well as to document and share knowledge about teaching and student learning in introductory programming courses.

We mostly tried to address the feeling of teachers that they have not enough knowledge to approach introductory programming and to show them that through active participation within CoP they would gain confidence they feel they are lacking.

The first of three steps was to integrate several resources teachers use in teaching programming. The second step was a hands-on workshop for CS master teachers, where an initial set of in-class material was prepared. In the third step master teachers ran their local workshops for all CS teachers, covering whole Slovenia. With regional workshops, we wanted to give master teachers the opportunity not only to adjust the workshops to the needs of the local communities but also to establish stronger contacts.

3.2 Framework

The target group were all Slovenian Gymnasia CS teachers. The model of Master Teachers was followed. Master Teachers (cf. [8]) are teachers with expertise in CS as well as with skills necessary to impart this to other teachers. This model focuses on local, face-to-face, peer-to-peer delivery. Master Teachers run regional professional development sessions and offer support to their local community of teachers. This way on one side we lower the cost, but even more importantly enable face-to-face and peer-to-peer delivery to all teachers. In our case, candidates for master teachers were selected individually and 14 of them became CS master teachers.

One of the project's goals was to prepare the learning and CoP environment by integrating three systems. The main platform used for resources and interaction among teachers is a Moodle LMS, where the resources are stored following the chapters in the e-textbook [2]. The Moodle LMS also includes forums and other activities, where teachers can collaborate by interacting, exchanging experience and discussing CS education. The LMS platform is complemented by the CS e-textbook and TOMO, an automatic assessment system environment for learning programming [12].

3.3 Some Evaluation and Results

We were observing the development of the community behaviour from the very beginning. Several surveys for teachers (for master teachers as well as for attendants of regional workshops) were conducted through online questionnaires and discussions. The master teachers' activity was also measured via their online participation. For each milestone the data were collected as follows:

1. **Face-to-face meeting with candidates for master teachers** (*June 2016*): (i) Online questionnaire and discussion after the meeting, and (ii) Activity (in integrated online system).
2. **Online meeting with candidates for master teachers** (*June 2016*): (i) Online questionnaire before the meeting, (ii) Discussion after the meeting, and (iii) Activity.
3. **Workshop for master teachers** (*August 2016*): (i) Online questionnaire before the workshop, (ii) Programming assignment and online questionnaire about the assignment, (iii) Observation, (iv) Discussion after the workshop, and (v) Activity.
4. **Regional workshops for teachers** (*November 2016 – January 2017*): (i) Online questionnaire before the workshop, (ii) after the workshop, and (iii) Activity.

We observed that the participants (master teachers as well as participants in regional workshops) had done most of the activities Wenger mentions in [9, 13] as the

building blocks of a successful CoP. Those activities were problem solving, requests for information, seeking experience, reusing assets, coordination, and strategy, building an argument, growing confidence, discussing developments, documenting projects, visits, mapping knowledge and identifying gaps. During this half-year period, most of the myths about CoP mentioned in [9], were also encountered. In a forthcoming paper, we will discuss how we coped with those myths.

3.4 Questionnaires and Observations

All three of the questionnaires used before the milestones had similar sections: besides the demographic questions, also questions about the content of CS course, attitude towards CS and teacher's self-evaluation. The differences were only in the section, which was intended for the specific milestone. We got data from all 14 Master Teachers and from 27 teachers who attended regional workshops. They represent a good sample of Slovenian teachers as we have 53 Gymnasia with approximately 70 teachers of CS.

The data gathered covers broader aspects as those reported in this paper and had to be analyzed further. To observe our main goal – establishment of an active CoP – an important part of the questionnaires were the questions about the teacher's motivation in programming and their self-confidence. We asked them if they like to code (95.2% said yes), and if they thought they are good coders. Interestingly, the opinion between master teachers and teachers at regional workshop was exactly the opposite, although they all completed short programming test without a problem. Master teachers thought they were quite good coders (7.7% very good, 30.8% good and 61.5% in the middle), while other teachers were more pessimistic (18.2% good, 54.5% in the middle, 18.2% bad and 9.1% very bad).

After the first meeting, we asked questions about the community in general, whether it would succeed to establish an active one and what should be done at their local school to improve the CS course. We were positively surprised about the optimism of all teachers regarding the development of community and the resources. However, they were still worried about the students' motivation for programming.

During the workshop, different aspects of socializing were observed, where the most important and efficient way of mutual introducing and forming groups was a team building section.

Finally yet importantly, we asked them what they liked about the master teachers idea, and one teacher explicitly said, "I like the fact that the resources are made by the teachers who actually teach in class."

4 Conclusion

We are planning to gather the remaining data, while improving and widening the community. We cannot overlook the teachers missing self-confidence, which needs to be addressed properly. Furthermore, there is still a room for improvement in gathering the data and further activation of community, but we were very pleased with optimism and enthusiasm teachers showed and the amount of resources they already shared.

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