Computational thinking (CT) is a problem-solving skill influenced by concepts fundamental to computer science [6]. CT is considered by many to be a new form of literacy to be incorporated in the K-12 curriculum.

There are two important issues regarding the implementation of CT in education, namely, how should CT be applied from the pedagogical point of view, and what is the appropriate age to introduce CT into the curriculum. Umaschi-Bers [5] argues that CT should be acquired by "doing" i.e. coding, for the purpose of expressing oneself, as well as for understanding the basics of CT, and advocates introducing coding into kindergarten with suitable software in a playful and meaningful way ("playground not playpen"). However, convincing kindergarten teachers to integrate coding into their curriculum, could prove to be a challenge.

This research deals with the perceptions of pre-service kindergarten teachers regarding a coding experience in a course about CT. The goal of the research was to gain an understanding of students' perceptions of the process that they experienced and the possibility of implementing coding into the curriculum of their future kindergartens as a result of this process. The premise of the instructor was that students would consider implementing coding as an activity in their future kindergarten, provided that they experienced it as part of their training in an enjoyable way. The software used for this purpose was ScratchJr.

The students coded and created projects in five half-hour hands-on sessions which were followed by a written reflection submitted after each lesson. At the end of the semester, they were to submit a concluding reflection. These reflections were analyzed by combining quantitative and qualitative procedures for the purpose of performing Grounded Theory analysis [4].

The results indicate that a positive and enjoyable hands-on coding experience with software designed for small children, can improve the sense of technological efficacy of pre-service kindergarten teachers, unleash their creativity and could bring students to consider incorporating the application into their future kindergartens. However there was also a high number of students who enjoyed the learning process, but nevertheless were adamant about the inappropriateness of using the application in kindergarten for various reasons, i.e. the clash with developmental and social needs of the children, as well as time constraints of the kindergarten schedule that would limit the ability to provide the children with a meaningful learning experience.

Keywords: Computational Thinking, ScratchJr, coding, reflections, pre-service.

1 INTRODUCTION

Computational thinking (CT) is a problem-solving skill influenced by concepts fundamental to computer science [6]. The essence of CT "involves breaking down complex problems into more familiar/manageable sub-problems (problem decomposition), using a sequence of steps (algorithms) to solve problems, reviewing how the solution transfers [to] similar problems (abstraction), and finally determining if a computer can help us more efficiently to solve those problems (automation)" [7]. Although CT is a new form of literacy to be incorporated into the K-12 curriculum, pre-service teachers are not trained sufficiently to integrate it into the curriculum [1]. Further, research indicates that pre-service teachers often hold a narrow approach towards embedding CT across the curriculum, many of them connecting it to mathematics [8]. However, CT should by no means be constrained solely to computer science courses or to mathematics, as the fundamental concepts are cross-disciplinary and can be applied to a variety of subjects [7].
There are two important issues regarding the implementation of CT in education, namely, how should CT be applied from the pedagogical point of view, and what is the appropriate age to introduce CT into the curriculum. Umaschi-Bers argues that CT should be acquired by "doing" i.e. coding, for the purpose of expressing oneself, as well as for understanding the basics of CT, and advocates introducing coding into kindergarten with suitable software in a playful and meaningful way ("playground not playpen") [5]. However, convincing teachers, particularly kindergarten teachers to integrate coding into their curriculum, could prove to be a challenge [1, 2].

The goal of this research was to gain an understanding of students' perceptions regarding a coding experience in a course about CT, and the possibility of implementing coding into the curriculum of their future kindergarten as a result of this experience. The premise of the instructor was that students would consider implementing coding as an activity in their future kindergarten provided that they experienced it as part of their training, in an enjoyable way. The software used for this purpose was ScratchJr.

2 METHODOLOGY

The CT course lasted for one semester (14 weeks). There were 43 female pre-service kindergarten teachers in their second year who participated in the course. About half of the students had experience working with kindergarten children or were mothers of young children.

Half of the course was devoted to acquaintance with the general concepts of CT and possible application in an early childhood context. The other half of the course was devoted to coding with ScratchJr, an application designed specifically for young children ranging from 5-8.

The students wrote a reflective learning journal (blog) every week, and at the end of the course were to submit a concluding reflection according to provided guidelines. 41 students submitted the final reflection. The tool used for the reflective learning journal was an online blog which is incorporated into the learning management system (LMS), enabling the instructor to scan the texts on a weekly basis. The fact that the journals were online was convenient for the students, enabling them to review previous posts for the purpose of writing a concluding reflection.

The concluding reflections were analyzed by combining quantitative and qualitative procedures for the purpose of performing Grounded Theory analysis [4]. In the first cycle, the researchers conducted open coding of the texts, subsequently defined the categories emerging from the process. The reflections were then analyzed by relating quotes to the categories as well as by counting recurrent expressions for the purpose of conducting quantitative analysis.

3 RESULTS

The qualitative results gave in depth insights into perceptions of the learning process, suitability of the application for kindergarten children and the possibility of using the application in their future kindergarten.

Students who stated that they would consider using the application in their future kindergartens gave various reasons for doing so:

- The application could help children understand directions
- Children like using technology
- The application is user-friendly
- The application is fun and enjoyable
- The application could help develop children's imagination
- The application could nurture interest in how machines work
- The application could develop high level thinking skills

Students who stated that they would not consider using the application in their kindergartens expressed their reluctance to introducing screens into the kindergarten ("They have enough, if not too much, exposure to screens in their homes") and that it would hinder the development of physical and social skills. In addition they noted that organizing sessions of work with the application would be almost impossible, as children would need mentoring and guidance in order to have a meaningful
learning experience, and this would entail devoting time to coding, instead of dealing with more pressing and important issues.

In their reflections, students wrote about what was useful for mastering the application during the learning process. Working in fixed pairs for the duration of the semester was helpful and enjoyable. Instructional mini-videos created specifically for the course, enabled them to learn to code independently. Students mentioned that the project dealing with the picture book "Cat on the Mat" by Brian Wildsmith enabled them to comprehend how the application could be linked to regular activities, and how it could give an extra dimension to dealing with children's books.

Finally, students wrote about what they had discovered about themselves during the learning process. They stated that coding with ScratchJr improved their sense of efficacy regarding technology as a whole and ScratchJr in particular, and that learning to code with the application unleashed and enhanced their creativity. On a general personal level they felt that their ability to overcome difficulties and to deal with problems improved. They also discovered that they had honed skills necessary for good team work, specifically, tolerance and the ability to cooperate. Many students noted that they discovered how important it was to be patient when facing a process or a challenge, and several students acknowledged that they had to improve in this aspect.

The quantitative results showed that 34 students enjoyed creating projects with the application, while only 3 students did not enjoy the process.

23 students stated that they would consider introducing ScratchJr into their future kindergarten while 11 students deemed the application as unsuitable for kindergarten children, and stressed that they would not use it in the future.

The results indicate a certain extent of correlation between enjoying the learning process and deeming it suitable for use in the kindergarten. Thus, 67.7% of the students who enjoyed the process deemed it suitable for younger students, while 8.8% of the students did not enjoy the process and deemed it unsuitable for kindergarten children. However, there were also a high number of students (23.5%) who enjoyed the learning process, yet deemed the application unsuitable for kindergarten children.

4 CONCLUSIONS

This research deals with the perceptions of pre-service kindergarten teachers regarding a coding experience in a course about CT with an application designed for young children, namely ScratchJr. The goal of the research was to gain an understanding of student's perceptions of the learning process that they had experienced and the possibility of implementing coding with appropriate software into the curriculum of their future kindergartens, as a result of this process.

The learning process had a much wider impact than expected by the instructor. The results show that experiencing coding with software for small children can help alleviate kindergarten trainees' fears of technology and can contribute to their sense of technological efficacy, as well as foster creativity. This is in line with Mishra and Yadav who argue that CT can foster creativity "allowing students to not only be consumers of technology, but also build tools that can have significant impact on society" [3]. This research points out benefits of letting students experience coding with ScratchJr, beyond advancing a sense of mastery of the software.

One of the main goals of the learning process was to convince students to consider applying the software in their future kindergartens. The premise of the instructor was that students would consider implementing coding as an activity in their future kindergartens provided that they experienced it as part of their training in an enjoyable way [2].

The research indicated that there were students who enjoyed the process and were willing, as a result, to consider using the application in their future kindergartens. However there were a high number of students, who, despite enjoying the learning process, perceived the application to be inappropriate for young children. This indicates that integrating ScratchJr into kindergartens might prove to be challenging. In general, exposing young children to activities involving screens is considered to be problematic [5], and this research showed that students also believed that coding with the application could clash with developmental and social needs of the children. Further, students stated that time constraints of the kindergarten schedule would limit the ability to provide the children with a meaningful learning experience. It is possible that if the coding experience had involved
physical objects (e.g. robotic blocks), the attitude of the students towards coding in kindergarten, would have been more favorable [5]. This calls for further research.

The limitations of this research from a quantitative point of view are due to the small number of reflections that were analyzed. In order to determine if indeed there is a correlation between enjoying the learning process and considering using ScratchJr in kindergartens, it is necessary to conduct analysis of a higher number of reflections. The limitation of this research from a qualitative point of view is due to the use of blogs as the only research tool. Conducting in depth interviews in order to gain greater insight into students' perceptions regarding the process and implementation of the application in the future, could have been helpful.

We suggest that in-service kindergarten teachers go through the process experimented by the students as described above, in order to conduct further research that could shed more light on the possibility and optimal conditions for introducing coding into kindergartens with suitable software.

REFERENCES


