Narrative learning in coding activities: gender differences in middle school
Apprendimento narrativo in attività di coding: differenze di genere nella scuola di primo grado

Paolo Tosato
Università Ca' Foscari, Venezia
ptosato@unive.it
Monica Banzato
Università Ca' Foscari, Venezia
banzato@unive.it

ABSTRACT
The recent introduction in Italy of Computational Thinking at the primary and secondary levels by the Educational Reform Act (October 2015) raises two critical issues: first, women are underrepresented in the computer field (OECD, 2015a; OECD, 2015b); second, girls lose their interest in computer sciences during adolescence (Gras-Velazquez et al., 2009). Therefore, the aim of this study is to investigate gender differences in self-efficacy and engagement through educational narrative methods for learning programming at middle school, a period considered critical in the research literature (Bandura, 1997; Pajares & Schunk, 2001a; Pajares & Schunk, 2001b). This is generally due to a decline in the self-efficacy beliefs of girls in science. Although this is an exploratory study, the implications that emerged show the potential of narrative educational activities to serve as a "cognitive bridge" to engage and improve the self-efficacy of the girls in computational thinking activities.

La comunità scientifica a livello internazionale esprime da tempo preoccupazione sulla questione delle differenze di genere in quanto le donne continuano ad essere sottorappresentate nel settore tecnologico (OCDE 2015). Da diversi ricerche emerge (European Schoolnet, 2013; Bandura, 1977, Pajares, & Schunk, 2001a, b) che le ragazze perdono il loro interesse durante il periodo adolescenziale, momento decisivo nella scelta degli studi superiori, in quanto si registra un declino di self-efficacy e di interesse per l'ambito scientifico. Tale questione risulta cruciale, data la recente Riforma Educativa che prevede l'introduzione del Computational Thinking in tutta la filiera formativa. Pertanto, lo scopo di questo lavoro è di indagare le differenze di genere sulle credenze di self-efficacy e del coinvolgimento percepito in un laboratorio di programmazione, rivolto ad adolescenti tra i 10 e 12 anni, progettato su metodi didattici narrativi. L'obiettivo è di verificare come e quanto tale strategia di apprendimento possa coinvolgere le/gli adolescenti. Sebbene si tratti di uno studio esplorativo, le implicazioni emerse mostrano il potenziale ruolo delle attività narrative come "ponti cognitivi" per coinvolgere e migliorare la self efficacy e il coinvolgimento delle ragazze in attività di programmazione.

KEYWORDS
Gender difference, Self-efficacy, User engagement, Narrative coding, Computational thinking.
Differenze di genere, Self-efficacy, User engagement, apprendimento narrativo, coding, Pensiero Computazionale.

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* For reasons of national assessment of Italian university research, the authors must declare which sections each has written, in spite of the fact that work is entirely the result of continuous and intensive collaboration. "1. Introduction", "2. Related work gender issues", "3. Research methodology", "6. Discussion and limitations of the research" and "7. Conclusions" are by Monica Banzato. Sections "4. Organization of the coding workshop", "5. Research results" are by Paolo Tosato.

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1. Introduction

The introduction of computational thinking and coding in primary and secondary schools is one of the innovations introduced by the document *Buona Scuola* (MIUR, 2014) and the Italian Education Reform (MIUR, 2015). At this educational level, the introduction of computational thinking appears to be:

– An unprecedented opportunity, as for the first time, this subject is introduced into the school curriculum for younger children as has already occurred in some other European countries and the wider world (European Schoolnet, 2014). And,
– A strategic challenge, because (1) Italy continues to record low rates of student enrolment to STEM, compared to other European countries, and (2) the gap between boys and girls in the STEM area has widened to the disadvantage of the latter (OECD, 2015a).

According to research conducted for European Schoolnet (Gras-Velazquez et al., 2009), the majority of Italian teenage girls, aged between 13 and 18 years, declare that they like ICT although they do not intend to continue their studies in computer science; in fact, the dropout rate is more than 61%, with female students preferring to study humanities and social sciences. Further, the Italian National Observatory (Alma Laurea, 2012) has reported that only 1.79% of females in Italian universities enrol in computer engineering, compared with 9.9% of males. Overall, 23.04% of women study sciences, compared to 46.07% of men (data processed by Boschetto et al., 2012).

Given that computational thinking is meant to be fully operational in primary and secondary schools within the next three years, it would seem urgent to support the introduction of these studies with practical steps that take into account the known gender inequalities, with the aim of ensuring that these differences do not widen further. There is a vast literature on gender differences and ICT in general (Agosto, 2001; Cooper, 2006; Hargittai & Hinnant, 2008; Heemskerk et al., 2009); however, as claimed by Grover & Pea (2013), Wing (2011), National Research Council (2011), at the level of international research there is still little investigation of gender differences in relation to computational thinking, nor studies that evaluate how disabled students perform in this area. In fact, "*much remains to be done to help develop them to more lucid theoretical and practical understanding of computational thinking in children*" (Grover & Pea, 2013, p. 42).

For this reason, the exploratory survey presented in this paper aims to investigate differences in self-efficacy and learning engagement among students being taught coding. In particular, the research questions are:

– Are there gender differences in students' beliefs about their own self-efficacy before and after a coding activity?
– Are there gender differences in learning involvement at the cognitive and perceptual levels during coding activities?

The exploratory study was carried out in a workshop on coding that took place in a class at the first level of a lower secondary school. This work was undertaken before the Educational Reform was launched in Italy (July, 2015) and had two purposes: to explore gender differences in the face of this new school subject and to raise awareness of the participation of girls, as well as boys, in computer science.

2. Related work gender issues

The international research literature on computing education continues to confirm a concerning under-representation of women in the IT sector (Klawe et al., 2009) and worrying results about gender impact (OECD, 2015b). In the recent past, computer use and activities related to ICT were seen as a field of "male domination" (Brosnan & Davidson, 1996; Panteli et al., 2001) and this issue remains today, despite slight improvements in gender balance (Pechtelidis et al., 2015). However, recent research (OECD, 2015a) confirms the persistence of the gender gap.

Some studies point out that there is a sufficiency of research papers that compare the different uses made of software by males and females (Soe & Yakura, 2008; Howland & Good, 2015). Software environments are important even if it needs to be emphasized that computational thinking can also be done with pen and paper. In any event, it is necessary to pay close attention to learning processes, focusing closely on the cognitive and affective processes that are triggered by various educational activities and taking care to avoid the implicit and explicit transfer of stereotypical gender patters (Sáinz & Eccles, 2012; Vekiri, 2010).

There are some interesting studies focused precisely on educationally oriented activities, such as the narrative and the game (Baytak & Land, 2011). As has been pointed out by Repenning & Ioannidou (2008), girls experience the traditional teaching of computer science as an unnecessarily complicated way of learning coding, which diminishes their attentiveness to the subject matter. For this reason, the authors propose the use of game design as an educational strategy for exploring informatics, one which engages the interest of both girls and boys. Kelleher & Pausch (2006) demonstrate an increase of girls' interest in learning to program through involving them in the production of visual stories which are to be implemented later through software. In addition, Van Eck (2006) and Carbonaro et al. (2010) argue that video game design might be a way to engage girls in the study of science, mathematics and computing. The results of Denner et al. (2012) also seem to confirm the educational potential of games for both genders.

The collaborative construction processes involved in programming digital artifacts with computers provide further concrete examples of how it is possible to stimulate student interest and commitment (Teague & Roe, 2008; Kafai, 1996). Baytak & Land (2011) have shown that girls create more scripts and use more instructions than boys, even when the functions can be realized more efficiently with a smaller number of commands. By contrast, a recent study by Howland & Good (2015), who used both narratives and games in teaching coding activities, found that girls typically create more complex and well-developed stories as well as creating more sophisticated scripts than boys. Along the same line, Robertson (2012) confirms the ability of girls to develop more complex games; in particular, they appear much more skilled in some aspects of storytelling. Nevertheless, although a good deal of research into workshops for computational thinking confirms the findings of good performances by girls, much remains to be done to investigate motivational aspects of their work (Howland & Good, 2015). The same Robertson (2013) and Howland & Good (2015) found that despite girls' declarations of their involvement in games, they felt themselves less involved than the boys. They concluded by declaring that they were less attracted to continue programming activities than the boys and that they did not expect to pursue computer science studies in the future.

To understand this situation better, we considered it essential to investigate aspects of perceptual and cognitive involvement in the learning of coding (User Engagement Scale, O'Brien & Toms, 2010), together with the concept of self-efficacy (Bandura, 1994). This last measure has been shown in the scientific literature to have a high rate of success in predicting students' future choices. In fact, it is necessary to explore the perceived differences in cognitive capacity and problem-solving ability in girls and boys, and to combine this with affective variables, such as self-confidence, which are often decisive for the selection of future studies and are also a primary source of gender differences with the passing of years ("*… boys and girls report equal confidence during the elementary years but, by middle and high school, boys have grown more confident*" – Pintrich & De Groot, 1990, cite by Pajares & Miller, 1994, p. 196). As the relationship between gender and self-efficacy in the field of computational thinking has not yet been sufficiently explored, this work is intended as a contribution to filling the gap.

3. Research methodology

As highlighted in the introduction, this paper aims to answer two research questions:

- Are there gender differences in students' beliefs regarding self-efficacy after a coding activity compared to before?
- Are there gender differences in learning involvement at the cognitive and perceptual levels during coding activities?

To answer these questions, questionnaires were administered: (a) pre-and-post-test on the sense of self-efficacy; (b) post-test on cognitive and perceptual student involvement.

These questionnaires were preceded by the compilation of data on gender and age, on the possession of a home computer, and on computing experience (e.g., Can you access the Internet at home? Which programs do you use? Do you know how to download and launch a program?).

The questionnaire (pre- and post-test) of self-efficacy was based on the New General Self-Efficacy Scale (NGSE, Chen et al., 2001), which aims to explain the variance in motivation and performance by measuring the self-efficacy of the students. Bandura defines self-efficacy as "*people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances*" (Bandura, 1986, p. 391). In education, self-efficacy has been used for more than four decades (Bandura, 1977). A large number of investigations have amply demonstrated that self-efficacy beliefs are tied to motivational, affective and behavioral results in a variety of domains (Bandura, 1997). Research in this field has shown that students with high self-efficacy are able to persevere longer in their tasks, to demand more significant results from their research, to withstand the anxiety of schoolwork and achieve better results. Students' self-efficacy has been shown to predict achievement in various academic fields, including mathematics, science and writing (Klassen & Usher, 2010; Pajares, 1996; Pajares & Urdan, 2006).

The questionnaire administered to students employed the four-item Likert scale of five steps (ranging along the poll from (5) "completely agree" to (1) "completely disagree"). It investigated four aspects: (i) level of self-efficacy in learning activities and understanding of coding; (ii) expectation of doing well in activities one chooses to pursue; (iii) security of concluding one's chosen activities successfully; (iv) security of achieving excellent results from the activity of coding. The same questionnaire was administered at the conclusion of the workshop (post-test) in order to check the workshop's impact on the self-efficacy of the students.

The second questionnaire, which was administered after the workshop on coding, was based on the User Engagement Scale (O'Brien & Toms, 2010). It employed the eight-item Likert scale of five steps, ranging from (1) "completely agree" to (5) "completely disagree". This questionnaire was intended to measure the level of students' engagement in their coding activity. User Engagement Scale consists of a wide variety of questions, but for our sample formation and the context in which the activity took place, it was decided to limit the items to eight in order to investigate the following aspects:

– Focused attention, to investigate the students' perception of their concentration levels during the coding session;
– Novelty, to explore how the perceived "newness" of coding affects the students' excitement, curiosity, joy and anxiety;
– Involvement, to verify the students' perception of "*need-based cognitive (or belief) state of psychological identification with some object that is based on an individual's salient needs and perception that the object will satisfy those needs*" (kappelman, 1995, p. 66, cited by o'brien & toms, 2010, p. 19);
– Aesthetics, to investigate the degree to which aesthetic impressions related to the software interface influences students' approval;
– Perceived usability, to explore the students' perception of the difficulty of their coding task.

These measurements were aimed at assessing the differences in effort perceived by boys and girls during the workshop.

To assess the coding operations carried out by students using Scratch software in their workshop (see section 4 "Organisation of the coding workshop" section), desktop video-recording software was installed in the computers. This made it possible to analyze in detail the "actions" and "operations" in the order that the students performed them (for example, their construction of commands, cancellations, mistakes, times when they were unable to continue due to errors, and when they decided to change commands).

4. Organisation of the coding workshop

The software employed in the workshop on coding was Scratch, from the Lifelong Kindergarten Group at MIT Media Lab (https://scratch.mit.edu/about/). Scratch is a visual programming language with high interaction and sharing of assets, a high sensory and affective involvement (Resnick et al., 2009), and a larger than average range of media functionality (e.g., the ability to insert audio, images and text).

The workshop was carried out at a comprehensive school in the Veneto region of Italy. It involved 20 students from a first-year class in a lower secondary school. In accordance with the research presented in Section 2 above ("Related work gender issues"), laboratory activities were organized to pass through five stages:

First stage. This aimed to capture the students' attention by beginning their activities with Aesop's fable "The Fox and the Crow". The narration served as a departure point for students to identify characters and actions that would later be realized in Scratch.

Second stage. Students were encouraged to divide themselves into groups of three members each: in the end, there were three groups of girls and four of boys. Each group received Lego WeDo kits provided by the researchers. Students were asked to build a fox with a maximum of 10 pieces.

Third stage. The Scratch program was introduced, pre-installed in laptop computers provided by the researchers. The task was visual storytelling. After explaining the software interface, the students were asked to create a background ("stage") for the fable and to draw the protagonists ("sprites") of the story (the fox, the crow and the cheese). At this stage, the students were left free to express their creativity in the forms and colors for the background and the sprites. The creation of sprites provided an opportunity for a first brief explanation of the Scratch controls; the students were given the opportunity to gain confidence by familiarizing themselves with the controls and verifying on their own the effects that could be created by using them.

Fourth stage. This was the most complex, and the decisive moment, in which we accompanied the students in their planning of the story with Scratch. This phase of the workshop is described in Table 1.

Fifth stage. In the final stage of the workshop, after the realization of the program associated with each character in the story, the robots built by each group were connected to gyroscopes which, in turn, were connected to their computers. This allowed the groups to guide their fox by manipulating the gyroscope. Thanks to their construction of instructions, realized in Scratch, the students managed to move their Lego-built fox (second stage) and visualize its movements on the monitor.

Educational goals	Questions asked students	Activities with Scratch
Define the essential elements of a problem	What are the main actors of the story?	The main story entities are represented by sprites, while the secondary elements, it is not necessary to animate, are placed on the Stage
Identify the actions to be associated with each entities of the problem and when it is necessary to activate them	What do the main actors must do of the story? Which of these characters do they move first? When does the cheese must move? What does the fox have to do while the cheese falls?	Control block (when [] key pressed, broadcast [],when I receive [])
Describe the termination condition of a loop (construct iteration)	When does the cheese have to stop? How far does it must come down?	Control block (repeat until []), sensor suite (touching []?)
Use the variables	How does the cheese move down? What is the value of variable y? How to bring the cheese to the starting position each time it starts the program?	Motion commands (x position, y position, change x by [], change y by [], set x to [], set y to [])
Describe the condition to select a block of code to be executed (the construct selection)	When to move the fox right? When to move to left? As a result, which of the sensors value "get up"?	Control block (if []), sensor suite ([tilt] sensor value), operators commands ([] = [])
Distinguish between the input and output of a program	How to make a crow sound? How to clear the cheese eaten by the fox? How to move the cheese from the raven to the fox? How to show that the fox is happy to have taken the cheese? How to move the fox according to the movement of the sensor "tilt"?	Looks block (think [] for [] secs, hide, show), motion commands (change x by [], change y by []), sensor suite ("tilt" sensor value)

Table 1. Educational activities with Scratch

5. Research results

5.1. Participants and computer usage

A total of 20 students from a secondary school class (first level), comprising 11 males and 9 females, enrolled in this pilot study. The study was held during school hours. The students were aged from 10 to 12, and included 2 foreign females (one of them dyslexic) and 4 foreign males. None of them had had any experience programming before this workshop, except one student who stated that he had previously used Scratch. All but one student had a computer at home, which they used daily to surf the Internet. Normally they used such software programs as a word processor, Google search engine and YouTube (to watch their favorite cartoons and films).

5.2. Results regarding changes in self-efficacy

Before analyzing the results, the reliability of the questionnaire was estimated by calculating Cronbach Alfa and obtaining a fair result (= 0.792); this data was confirmed by the corrected item-total correlation, which demonstrated good internal consistency among the questions.

To verify whether the educational activities had produced an improvement in the sense of self-efficacy, a t test for dependent samples was performed on data from 20 students; this revealed that the change (Pre: M = 3.925, SD = 0.597, range 3-4.5; Post: M = 4.538, SD = 0.521, range from 3.25 to 4.75) was statistically significant (t (19) = –3.862, $p < 0.01$).

Subsequently, to verify if there were any differences in the sense of self-efficacy before starting the workshop on coding, on the part of the male students (n = 11, M = 4.068, SD = 0.560, range 3-5) and the females (n = 9, M = 3.750, SD = 0.625, range 3-5), a t-test was performed for independent samples on the pre-test data; this revealed that the difference among the average responses to the questionnaire was not statistically significant (t (18) = 1.200, $p > 0.05$). Figure 1 describes from a graphic point of view the comparison between males and females.

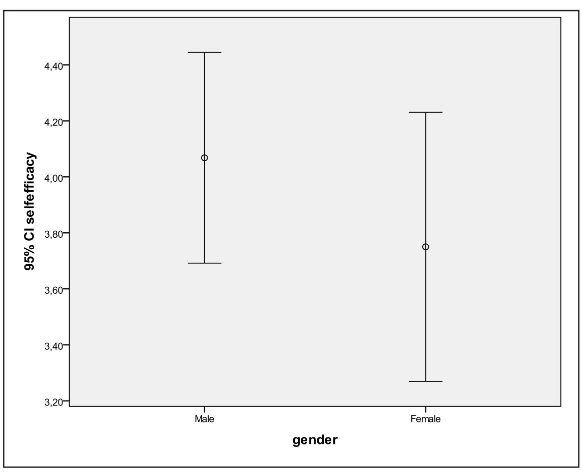

Figure 1. Pre-test: averages and confidence intervals

The same test was performed on the post-test data, again to verify differences in the sense of self-efficacy between males (n = 11, $M = 4.455$, $SD = 0.600$, range 3.25-5) and females (n = 9, $M = 4.639$, $SD = 0.417$, range from 3.75-5). This time the difference between the average response to the questionnaire was not statistically significant ($t\ (18) = -0{,}779$, $p > 0.05$). Figure 2 describes the comparison between males and females.

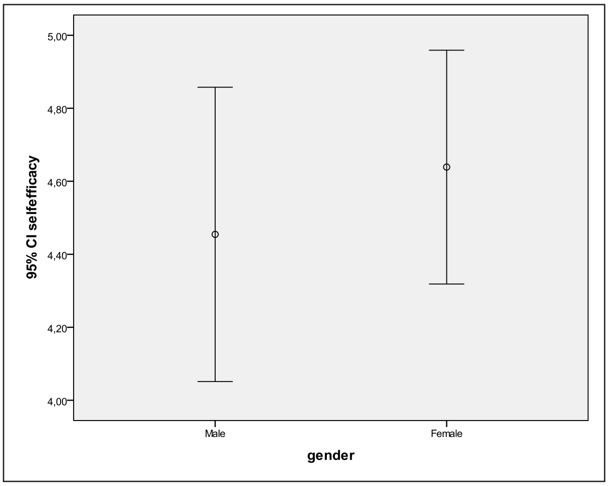

Figure 2. Post-test: averages and their confidence intervals

Although the test does not show differences between males and females, there is an evident improvement in both groups in their sense of self-efficacy, especially in females, with an average of 0.889 points (from 3.750 to 4.639) compared to 0.387 points of males (from 4.068 to 4.455).

The analysis of videos and programs also confirms the results obtained from the questionnaire: both working groups consisting only of males and those consisting only of females have the correct structure in their programs, sometimes making mistakes (corrected independently or with support of researchers), sometimes making appropriate customizations to the software. Probably it is this equality in the results that led the girls to increase their sense of self-efficacy more than boys. Although there are no indicators that confirm this hypothesis, it is plausible to believe that the girls would feel less safe and they had lower expectations of doing well in the activity of coding than their male colleagues, an expectation then denied by the laboratory results. This may have gratified the female students, who could see themselves performing at the same level as their male counterparts.

Through analysis of the video one can also determine that there was greater commitment and greater concentration on the part of the girls in the course of their work than the boys, who were distracted more easily, which was manifested in greater discontinuity of attention. This commitment, coupled with the success in carrying out the activity, may have produced in the female students a higher confidence in their effectiveness.

5.3. Results regarding cognitive and emotional engagement

After the workshop on coding a questionnaire was administered to the children, which was based on User Engagement Scale (O'Brien & Toms, 2010), to measure the degree of student involvement in the activity of coding. The research collected data on the following aspects: focused attention, novelty, involvement, aesthetics, perceived usability. The questions to which the children responded are shown in the following table (Table 2).

Aspects analysed	Items
Focused attention	1. I was so involved in my programming job in Scratch that I ignored everything around me 2. I was so involved in my programming task in Scratch that I lost track of time
Novelty	3. The programming tasks aroused my curiosity 4. I discovered in this activity that I like to programming
Involvement	5. I had a lot of fun doing the programming
Aesthetics	6. I liked the graphics and images used in Scratch
Perceived usability	7. I found it hard to program in Scratch 8. I felt discouraged while using Scratch

Table 2. User Engagement questionnaire

Hypotheses

This study aims to determine whether there is a gender difference in the cognitive involvement of students in coding activities. In order to verify statistically whether there are differences between the medians of the scores obtained in the two populations, the following variables are defined:

- Independent variable: gender (nominal, dichotomous: male, female);
- Dependent variable: user engagement (score of the questionnaire based on user engagement scale: the score of each student is the average of the scores expressed in each item).

If there are differences between the male and female populations, we should be able to reject the following assumption:

> H0: the median of the population from which the sample of males is extracted is equal to the median of the population from which the sample of females is extracted: therefore, there is not a gender difference in cognitive student involvement.

Results

The class in which the experiment took place is from the first level of a lower secondary school; it was composed of 20 students aged between 10 and 12 years.

From this group, two independent samples were created: one of 11 males and the other of 9 females.

Given the very small size of the samples, we decided to use the Mann-Whitney statistical test to analyze the results. This allows comparison of the medians of two independent samples (table 3).

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Engagement	M	11	8.73	96.00
	F	9	12.67	114.00
	Total	20		

Table 3. Comparison of the medians of two independent samples (Mann-Whitney statistical test)

Table 3 indicates which group is judged to have the higher level of engagement; this corresponds to the one with the highest average ranking. In this case, the female sample would appear to demonstrate a greater involvement in the activity of coding.

Test Statistics[b]	
	Engagement
Mann-Whitney U	30.000
Wilcoxon W	96.000
Z	-1.494
Asymp. Sig. (2-tailed)	.135
Exact Sig. [2*(1-tailed Sig.)]	.152[a]
Exact Sig. (2-tailed)	.145
Exact Sig. (1-tailed)	.072
Point Probability	.007
a. Not corrected for ties. b. Grouping Variable: gender	

Table 4. The results of the Mann-Whitney test

Table 4 shows the results of the Mann-Whitney test (U = 30) and the relevant probability (p = 0.145), which corresponds to Exact Sig. (2-tailed). Through this value, following the procedure described by Rosenthal & Rubin (2003), it was possible to calculate the effect size $r_{equivalent}$, amounting to a value of 0.34, interpreted as a moderate effect size (Cohen, 1988).

Data analysis

Taking into consideration the results reported in the previous section, although it seems that girls have a greater cognitive engagement, it is not unlikely that the observed data is the result of a true null hypothesis (H0 given in section 5.3.1 "Hypotheses"): this is why we accept it. The results suggest that most likely the male population (n = 11, median = 4.3, $Q1$ = 4.0, $Q3$ = 4.4) has a median score in the questionnaire concerning user engagement equal to that of the female population (n = 9, median = 4.5, $Q1$ = 4.3, $Q3$ = 4.8); therefore there is no empirical evidence of a gender difference (U = 30, z = –1.494, p > 0.05, r = 0.34). Figure 3 depicts the comparison between males and females from a graphical point of view.

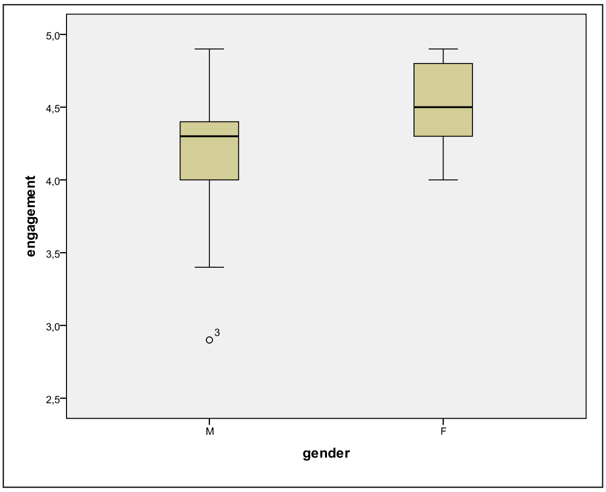

Figure 3. Comparison of males and females

6. Discussion and limitations of the research

The results revealed that there are no significant differences between males and females. This confirms the conclusions of other studies which have examined similar situations. In fact, the girls did not seem to underestimate their capacity to code and, in fact, in the post-test questionnaire, they reported a greater sense of self-efficacy than did the boys. If, as Joët et al. (2011, p. 659) opines, "*Beliefs held become rules for future actions, which may have implications for girls' academic trajectory and, ultimately, the careers they pursue*".

Due to the time constraints of the workshop and the relatively small sample of students, we believe that this conclusion should be stated as potential rather than asserted with a high degree of confidence. Longitudinal studies are needed to confirm this possibility.

From analysis of the girls' answers, it seems that they interpret questions of self-efficacy in an adaptive mode. Comparison of pre- and post-test results (in which females report slightly higher results than males), especially as regards their perceived mastery of skills (also confirmed by the User Engagement Scale results), suggests that these beliefs could help them visualize their capacities in a favorable manner. We were very struck by these positive results and questioned ourselves at length on how to interpret them. We concluded that there were a number of particularly favorable conditions. Firstly, the coding workshop was a novel experience which they had never previously experienced, in or out of school. Secondly, it pertained to a unique genre not associated with any particular subject that they had encountered before, in or out of school. We may infer that the coding workshop belongs to a "new" field, in which males and females work together from the outset. From these facts, we hypothesize that not having previously formed explicit or implicit beliefs about gender stereotypes (from family, friends or teachers), the girls did not have any beliefs that coding is for males and the boys did not have any beliefs that this activity was particular to males.

Another important psychological factor to take into consideration is that of gender differences linked to developmental levels. Several studies show that the differences between males and females begin to emerge in the transition of children from primary to secondary school (Eccles & Midgley, 1989; Wigfield et al., 1991; Wigfield et al., 1996; Pajares & Schunk, 2001a). At this stage "*the girls [are] generally showing a decline in self-efficacy beliefs*" (Pajares & Schunk, 2001b, p. 11). Since our sample of students (11-12 years old) is located exactly at this stage of passage, we consider that this element might have affected the results, even if (and this is another limit) we could not go deeper with further analysis of the effect of this transition on the sense of self-efficacy.

In order to generalize the results of this study, one would need to compare the attitudes and beliefs of students regarding scientific versus humanities studies. This is because the workshop sought to create a bridge between narrative (verbal and visual) and computational thinking. The study of relationships between attitudes should be undertaken in regard to beliefs about academic achievement and cognitive performance, such as the ability to solve more complex problems over time, the ability to transfer and generalize solutions, and the exercise of spatial skills.

The general feedback of the class, which we also addressed in a previous study (Banzato & Tosato, 2017), was very positive, and the students explicitly requested to continue training in the following weeks. We hypothesized, however, that this was mainly caused not only by the novelty (also confirmed by the results of the questionnaire User Engagement Scale) but also from the interruption in the routine of class lessons, the absence of pressure from the evaluation to effect measures of school performance, and the fact that the activity took place in a climate of "experimentation", or as the students proudly put it: "these are adult activities" (Banzato & Tosato, 2017).

We maintain that our exploratory study could serve as the basis for research that was re-imagined, modified and repeated under realistic conditions, that is to say in a number of larger and regular classes, for a longer period of time and with other activities that are counted in the students' final evaluations.

Conclusion

Drawing inspiration from earlier research (reported in section 2 "Related work gender issues"), in the workshop design we tried to contextualize the computational activities through three stages in order to capture students' creativity: verbal narration (listening to a story); construction of a manual artefact (building the fox with Lego WeDo); visual storytelling (designing the story with Scratch programming language). The combination of these three phases was highly motivating; it allowed the students to move gradually from the "narrative thoughts" to the basics of "computational thinking", thereby taking their first steps in the coding process. Our results are supported by the theory of Bandura (1997) and the empirical results of other research, which shows "*perceived mastery experience is a powerful source of self-efficacy across academic domains*" (Usher & Pajares, 2008, cited by Joët et al., 2011, p. 658). As Bandura (1997, p. 81) states, "*the same level of performance success may raise, leave unaffected, or lower perceived self-efficacy depending on how various personal and situational contributions are interpreted and weighted*".

Ultimately, our results are encouraging from a gender perspective. There are many studies that have focused on finding ways to encourage girls to engage with coding (Baytak & Land, 2011; Burge et al., 2013) but few directly compare the relative performance of gender self-efficacy and user engagement. Observing the students' behavior during the workshop, we noticed that in the first phase of coding the girls were more diligent and methodical in writing scripts than boys. The girls followed the explanations of researchers and applied themselves immediately, while some of the boys preferred to seek autonomous solutions for implementing the script, even if this caused them to pause frequently.

After this first stage of contact with the Scratch program, some of the girls tried on their own to program the script and asked the researchers to check their alternatives; in contrast, the boys moved from bench to bench to verify their solutions with the other classmate and only as a last resort sought information from the researchers.

Unlike other exploratory studies (Carbonaro et al., 2010; Kelleher et al., 2007), at the end of the workshop we did not find significant differences in the complexity of the script produced independently by the boys and girls (possibly due to the few hours available), but we did find that the girls made more requests for help and obtained greater gratification from their results.

In accordance with Kelleher et al. (2007) and Howland & Good (2015), we found that utilizing a narrative which is both verbally and visually attractive motivates both boys and girls in their coding activities.

Noting in the data collected on self-efficacy and user-engagement better results for girls, and taking account of the PISA data (OECD, 2013), which records better performance in literacy by girls at both primary and secondary levels, we suspect that the use of narrative by the girls has raised their performance on the cross-domain level. This effect is also pointed out by Howland & Good (2015). Put another way, it is likely that the girls having started from an area in which they felt at ease (the narrative) were led to commit themselves and to engage in an "unknown" area such as programming. When examining the visual narratives of students, we noticed that the girls had created more detailed and aesthetically pleasing drawings and that they had dedicated more time and attention to this aspect of their work. We also noticed, at the end of the workshop, that the girls had produced unnecessarily detailed scripts, while other girls had produced more alternative scripts than the boys. These observations require further research and would certainly be interesting to investigate.

Finally, more research is needed to explore (at this early stage of the introduction of computational thinking in Italian schools) the relationship between teachers' and students' self-efficacy, in order to better understand the influence of the psycho-social environment on academic self-beliefs of children and their effects on the gender issue.

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