Exploratory Study on the Effort Perceived by In-service K-12 Teachers from Subject Areas not Specialising in Computer Science Who Are Complete CS Novices

Paolo Tosato, Monica Banzato

Exploratory Study on the Effort Perceived by In-service K-12 Teachers from Subject Areas not Specialising in Computer Science who are Complete CS Novices

Paolo Tosato, Monica Banzato
Department of Linguistics and Comparative Cultural Studies, Ca' Foscari University, Venice, Italy, ptosato@unive.it, banzato@unive.it

Abstract. Due to the shortage of IT teachers in Italian schools, the teaching of computational thinking is carried out by in-service K-12 teachers from scientific areas not specialised and by novices in computer science (CS). It is crucial to investigate not only the training of teachers in digital skills, but also how their beliefs, attitudes and behaviours can affect, in detail, their implementation in the classroom. From these premises, the present exploratory study investigates the self-efficacy beliefs, intrinsic motivation and perceived effort of a group of 46 teachers who, on a voluntary basis, engaged in a 20-hour workshop on CS teaching. The results show a significant improvement in self-efficacy, despite their perception of strong effort to master the subject.

Keywords. Teacher training, computer science education, self-efficacy, intrinsic motivation, perceived effort

1 Introduction

The educational policies of the last few years have been decisive in promoting the inclusion of computational thinking (hereafter CT) in the school curriculum in several European countries and the rest of the world. The aim is to prepare students for a world strongly influenced by information technology [1, 2], encouraging in the new generations a culture of creation and production rather than the mere consumption of technology.

In Italy, CT has been introduced in primary and secondary schools since 2015 [3]. This educational reform, albeit accompanied by a certain initial enthusiasm, nevertheless presents considerable difficulties for primary and secondary schools (hereafter K-12), among which are: the lack of teachers with sufficient knowledge of the subject as well as complete novices; educational activity in computer science (hereafter CS) carried out by non-specialist teachers or, in some cases, replaced by external IT experts; and insecurities on the part of teachers studying this new subject. A similar situation has been reported in other countries, including: the United States of America (USA) [2], the United Kingdom (UK) [4], Israel [5], and others (see section 2).

The reforms in Italy (as in other countries in the world) have to deal with the lack of CS teachers capable of covering the needs of the entire national school territory. The situation in Italian primary schools, which appears to be the most delicate, has the following peculiarities: 69% of teachers have only a high school diploma; the remaining ones have a higher degree mainly in the science of primary education; and 96.5% are women with an average age of 54.3 years [6]. Nearly all of these teachers are complete novices in CS. Turning to Italian middle schools, we find that there are practically no teachers of CS due to a normative problem: information technology can be taught by engineers or architects; while science is taught by graduates in biological, geological, natural, environmental, agricultural, mathematical and physical sciences (also by some engineers). The average age of teachers in these schools is 53 years, of which 22% are male [6]. The presence of CS teachers in the middle schools is not common (these teachers are specialist subject teachers but not specialised in CS); while CS graduates can teach mathematics, applied mathematics and CS in some high schools. As a result, almost all teachers who are involved in training in CS in middle schools are non-CS scientific area teachers. Even if there were to be a change in the current legislation, it seems a remote possibility that the few graduates in computer science in Italy would be attracted to work as teachers in K-12 schools, both because of the low salary remuneration compared to other school roles, and the high job insecurity in the teaching profession.

Unfortunately, at the moment, there is little research on this precise group of K-12 teachers working in scientific areas not specialised in CS (mainly present in middle schools) or novices at CS (present in primary schools). From research carried out in other countries (USA [2], UK [4], Israel [5]) there are numerous critical issues related to the training of K-12 teachers, also shared in Italy. These include fragmentation and discontinuity of training courses throughout the year, to which is added the heterogeneity of the background of teachers who take training for these courses (both the starting degree and the level of the school where they work). There are CS certification programmes for teachers, recognised by the Italian Ministry of Education, but they have "no tangible relationship with what you need to teach in a computer room" [5]. Unfortunately, there is very little research literature on the beliefs about difficulties, obstacles and perceived efforts that teachers meet in this initial update phase, which requires shifting from information and communication technologies (ICT) to computer science education (see section 2). In Italy, as well, this type of analysis is still an unexplored territory. For this reason, the present exploratory survey aims to investigate the beliefs of self-efficacy, intrinsic motivation and perceived effort required for K-12 teachers involved in CT training courses. In particular, the research questions which we will try to answer are: 1) what are the self-efficacy beliefs of K-12 teachers in-service involved in programming workshop activities?; 2) what perception do K-12 teachers have regarding the intrinsic motivation and effort required and the skills involved in programming activities?; and 3) based on their training-workshop experience, would teachers be able to imagine themselves confidently performing similar classroom activities with their students? The objectives of the research are: (1) to establish the factors that influence the self-efficacy and intrinsic motivation beliefs of K-12 teachers who are studying how to teach programming in the classroom; and (2) to determine the impact of the beliefs of K-12 teachers regarding their ability to teach programming in the classroom.

The exploratory survey was carried out in the course of a 20-hour programming laboratory for 46 K-12 teachers. Teachers' participation in the workshop was free and purely on a voluntary basis (no credits or scores were expected).

2 Related work

The Royal Society [4] has reported that "There are simply not enough teachers with sufficient subject knowledge and understanding to deliver a rigorous Computer Science and Information Technology curriculum in every school at present". In parallel, the European Commission has expressed serious concern that "digital literacy is taught mainly by specialist teachers at secondary level but in approximately 50% of countries it is also taught by other specialist teachers such as mathematics or science teachers" [7]. "Information Technology is not taught by specialist teachers in Ireland, France, Italy, the Netherlands, Sweden, Liechtenstein and Norway – even at secondary level" [4]. Yadav et al. [2] record a similar situation in the United States: "efforts to increase the number of CS teachers have predominantly focused on training teachers from other content areas". There have been several research inquiries that document the experience of computer scientists who teach other scientific subjects in schools. By contrast, there has been little study of the experiences of scientists not specialised in computer science who are asked to teach CS in K-12 schools. Also as pointed out in a number of studies [2, 4, 5], little is known about the difficulties of teachers with no scientific background who must be trained in CS in order to teach it in the classroom. Some studies [8, 2, 9] identify several obstacles which are faced by teachers in CS who teach outside their discipline, such as feeling isolated, teaching in multiple disciplinary areas, class management and insufficient planning time. Veenman [9] identifies 24 crucial problems by means of a meta-analysis work of 83 studies. Among these are difficulties in evaluating student work, a heavy teaching load that leads to reduced planning time, problems in lesson planning, inadequate knowledge of the subject matter and insufficient assistance and support. Other studies report that novice teachers are faced with other challenges such as: loneliness, isolation [10, 2] the lack of adequate IT background and limited resources for professional development [2]. "The researchers argued that these teachers need support during the first years of teaching to increase their content and pedagogical knowledge, self-efficacy and beliefs about what it means to be a successful teacher" [2]. This support should be extended as well to novices and scientists non-specialised in CS K-12 teachers, in both pedagogy and content, taking into account the different educational backgrounds (scientific and not) and the students' education level, as precisely these teachers are facing the first impact of the introduction of CS in K-12. Unfortunately, there is a lack of research documenting what is needed to respond to the needs of these teachers. For this reason, the objective of this exploratory study is to begin an investigation of the critical difficulties faced by K-12 teachers of CS with regard to their self-efficacy beliefs and their perceived effort. "The efficacy beliefs of teachers are related to their instructional practices and their students' achievement" [11].

3 Methods and instruments: self-efficacy, intrinsic motivation and perceived effort

Based on the research questions and objectives presented in section 1, the exploratory survey analysed the results of self-efficacy, intrinsic motivation and perceived effort, according to the following independent variables: gender, age, length of service, diploma or degree, level of education in which the teacher works, subject of teaching, and previous experience of teaching CS courses. The aim was to verify if these matters have a statistically significant impact on the dependent variables. For this reason, a programming workshop was organised, which was preceded and followed by the administration of: 1) pre-test and post-test questionnaires on the beliefs of self-efficacy and intrinsic motivation; and 2) a brief unstructured interview, post-laboratory, aimed at investigating the perceived effort.

The first questionnaire was based on the New General Self-Efficacy scale [12]. This instrument is dedicated to understanding the self-confidence of teachers regarding their learning of CS and their competence to master specific academic domains concerning programming in CS. Pajares [13] found that there was a "strong relationship between teachers' educational beliefs and their planning, instructional decisions, and classroom practices". The self-efficacy questionnaire was based on 8 items on a 5-step Likert scale: from 1, on the "completely disagree" pole, to 5, on the "completely in agreement" pole. The questionnaire investigated the following aspects: the level of self-efficacy in activities of teaching and learning about the subject; expectation of success in the CS workshop; mastery of the computer skills required; work commitment required; teachers' abilities in relation to the programming activities; the achievement of the educational objectives; andthe security of managing the evaluation of teaching activities with students.

The teachers' intrinsic motivation, based on a 5-step Likert scale (as with the previous questionnaire), was measured by a selection of 11 items from the Intrinsic Motivation Inventory (IMI) [14]. The original questionnaire consists of seven subscales. For this research, three subscales were selected: a) "interest" to teach programming: this refers to teachers' general intrinsic motivation; b) "perceived competence" to teach programming: this is theorised to be a positive predictor of intrinsic motivation; c) "perceived effort" required to teach programming: this is a separate variable which seeks to reveal teachers' needs. This instrument required teachers to imagine themselves teaching programming activities to students.

The third tool employed unstructured interviews aimed at exploring in depth teachers' perceptions of effort: 1) effort required for updating in CS and degree of satisfaction; 2) required effort for personal study of CS; 3) self-assessment of progress in one's CS competence level based on the teacher's experience; 4.1) if the teacher has already taught students programming, what are the perceived difficulties of educational activities in the subject?; and 4.2) if the teacher has not yet taught students programming, what are the expectations and when does he or she plan to start teaching? The study was conducted during a 20-hour teacher update workshop that aimed to explore and test elementary programming concepts with the following tools: Lego WeDo, Scratch and Rospino.

4 Research results

A total of 46 teachers, comprising 17 primary school teachers and 29 lower secondary school teachers, enrolled in this pilot study. The teachers were aged from 35 to 63 years (mean age 47 years). The teachers from scientific areas (mathematics, science and technology) were 34, while the teachers from humanities areas (Italian, history, religion, music, foreign language) were 12; the majority had never experienced programming laboratories (30 teachers), while 16 had participated in at least one laboratory on this topic. According to gender, the participants comprised 12 males and 34 females, while according to their academic degree, the majority of teachers were college graduates (32 participants) compared to high school graduated teachers (12 participants).

4.1 Results regarding changes in self-efficacy

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 46 teachers; this revealed that the change (Pre: M = 3.65, SD = 0.54, range from 2.14 to 5.00; Post: M = 4.16, SD = 0.56, range from 2.71 to 5.00) was statistically significant ($t(45) = -5.14$, $p < 0.01$). Subsequently, in order to answer the research questions, the data collected from the questionnaires were more deeply analysed to understand if the increment of self-efficacy was uniform in the group of participants or particularly relevant in a specific category of teachers. For this reason, some independent variables were identified (gender, age, years of service, educational qualification, programming experience, subject taught), and based on these variables, the impact of the laboratory on teachers' self-efficacy was assessed.

Groups by Gender. Grouping data by gender importantly indicated how the change in the sense of self-efficacy was statistically significant in female teachers ($t(33) = -4.93$, $p < 0.01$), moving from a mean of 3.61 to a mean of 4.17. By contrast, the change in the sense of self-efficacy was not statistically significant in male teachers ($p > 0.05$), moving from a mean of 3.76 to a mean of 4.12.

Groups by Age. To analyse the change in self-efficacy, 4 groups were created: from 30 to 39 years old, from 40 to 49 years old, from 50 to 59 years old and from 60 to 69 years old. The most numerous groups were those aged 40-49 years (24 teachers) and those aged 50-59 years (13 teachers). In these groups the increment of self-efficacy was greater than the other groups and was also statistically significant. A deeper analysis of these two groups (40-49 and 50-59 years old), found out that the increase in self-efficacy was particularly relevant and statistically significant in teachers who taught science subjects, were college graduated and were women.

Groups by Years of Service. To analyse the change in self-efficacy, 5 groups were created: from 0 to 9 years, from 10 to 19 years, from 20 to 29 years, from 30 to 39 years and from 40 to 49 years. Confirming the results obtained by grouping data by age, teachers with 10-19 years of service obtained the more significant increase in self-efficacy, from a statistical point of view, moving from a mean of 3.74 to a mean of 4.24, $t(23) = -3.39$, $p < 0.01$.

Groups by Educational Qualification. Grouping data according to teachers' degrees, it was possible to notice how the increase in self-efficacy was statistically significant both in college graduated teachers ($p < 0.01$) and in high school graduated teachers ($p < 0.01$). A deeper analysis of these groups revealed that the increase in self-efficacy was more significant in women and in teachers who taught science subjects.

Groups by Programming Experience. Grouping data according to programming experience, it was possible to notice how the increase in self-efficacy was statistically significant both in teachers with experience ($p < 0.01$) and in teachers with no experience ($p < 0.01$). A deeper analysis of these groups revealed that the increase of self-efficacy was more significant, from a statistical point of view, in female, college graduated teachers and in teachers who taught science subjects, according to the findings of the previous section.
Groups by Subject. Grouping data according to the subject taught, it was possible to notice how the increase in self-efficacy was statistically significant both in teachers who taught humanities ($p < 0.01$) and teachers who taught science subjects ($p < 0.01$). As noted in previous sections, the increase in self-efficacy was greater and statistically significant in female and college graduated teachers.

4.2 Results regarding changes in intrinsic motivation

To verify whether the educational activities had produced an improvement in intrinsic motivation, a t-test for dependent samples was performed on data from 46 teachers; this revealed that the change (Pre: $M = 4.04$, $SD = 0.41$, range from 3.00 to 5.00; Post: $M = 4.13$, $SD = 0.49$, range from 3.00 to 5.00) was not statistically significant ($t(45) = -1.72$, $p > 0.05$). In order to answer the research questions, the data collected from the questionnaires were more deeply analysed, grouping by different variables. This made it possible to compare the results regarding intrinsic motivation with the results of self-efficacy and to understand if the change in intrinsic motivation was particularly relevant in a specific group of teachers.
Groups by Age. Using the same groups identified for self-efficacy (section 4.1), the change in teachers' motivation was analysed. In these groups, the change of motivation was not statistically significant, but it is interesting to highlight that in teachers aged 30-39 and 60-69 years the motivation decreased, while in teachers aged 40-49 and 50-59 years it increased, moving from a mean of 4.07 to a mean of 4.18 (40-49 years old) and from a mean of 3.95 to a mean of 4.14 (50-59 years old). A deeper analysis revealed that the increase in intrinsic motivation was greater and statistically significant in teachers aged 40-49 with programming experience, moving from a mean of 4.26 to a mean of 4.60, $p < 0.05$. Nothing statistically significant can be said grouping teachers aged 40-49 years by gender or educational qualification, even if the increase in motivation was particularly important in female teachers (from a mean of 4.05 to a mean of 4.18, $p = 0.077$)
Groups by Programming Experience. Grouping data according to programming experience, the increase in motivation was statistically significant only in teachers with experience ($p < 0.05$). Nothing statistically significant can be said grouping teachers with experience and without experience by gender. Instead, by grouping data according to their degree, there was a significant increase in motivation in college graduated teachers with experience, moving from a mean of 4.09 to a mean of 4.36, $p = 0.066$.
Groups by Subject. Grouping data according to the subject taught, there was no statistically significant change in motivation, even if the change in teachers who taught science subjects was greater (from a mean of 4.08 to a mean of 4.21) than teachers who taught humanities (from a mean of 3.91 to a mean of 3.93). Nothing statistically

significant can be said grouping teachers by gender or educational qualification. Instead, it is important to highlight the increase of motivation in teachers who taught science subjects with programming experience (from a mean of 4.13 to a mean of 4.38, p = 0.072), partly supporting the findings of the previous section.

4.3 Results regarding changes in perceived effort

To verify whether the educational activities had produced an improvement in perceived effort, a Wilcoxon test was performed on data from 46 teachers; this revealed that the change (Pre: Median = 4.00, Q1 = 3.50, Q3 = 4.50; Post: Median = 4.00, Q1 = 3.50, Q3 = 4.13) was not statistically significant (z = -0.94, p = 0.347). It is important to underline that the higher mean values indicate a lower perceived effort, therefore a better teacher response. As with self-efficacy (section 4.1) and intrinsic motivation (section 4.2), a deeper analysis for perceived effort was also performed, grouping data by different factors.

Groups by Age. Using the same groups identified for self-efficacy (section 4.1) and intrinsic motivation (section 4.2), the change in teachers' effort was analysed. In any groups the change of effort was not statistically significant, but it is interesting to highlight that in teachers aged 40-49 and 50-59 years the perceived effort increased less than teachers aged 30-39 and 60-69 years. The values are respectively: teachers aged 30-39 years: from 4.00 to 3.67; teachers aged 40-49 years: from 4.04 to 3.98; teachers aged 50-59 years: from 4.00 to 3.96; teachers aged 60-69 years: from 3.83 to 3.67. Grouping data according to the years of service, the perceived effort increases, or remains the same, in all groups, except in teachers aged 40-49 and 50-59 years having 10-19 years of service. Although the change in effort is not statistically significant, in teachers aged 40-49 years with 10-19 years of service the perceived effort decreases from 4.00 to 4.04, while in teachers aged 50-59 years with 10-19 years of service the perceived effort decreases from 3.83 to 4.08. A similar result is obtained grouping data by programming experience.

Groups by Programming Experience. Grouping data according to the programming experience, there is not a statistically significant change in perceived effort, although in teachers without experience the effort increases (from 3.92 to 3.75), while in teachers with experience the perceived effort decreases (from 4.19 to 4.22). A deeper analysis highlights that the reduction in perceived effort among teachers with experience is particularly relevant in college graduated teachers (from 4.05 to 4.25), while among high school graduated teachers the perceived effort increases both in teachers with experience and without experience in programming.

Groups by Subject. Grouping data according to the subject taught, there is no statistically significant change in perceived effort. Grouping data by subject and programming experience, perceived effort increases in all groups, except among teachers who teach science subjects and have experience in programming (from 4.23 to 4.27). The change is not statistically significant, but it confirms what was highlighted in the previous section, where teachers were grouped according to programming experience.

5. Interview on motivation and perceived effort

The transcribed interviews were codified and on the basis of a subsequent re-elaboration some categories were extrapolated to provide the conceptual structure that allowed us to select the results reported here. Whereas, in general, we have found a shared accord in the opinions of the teachers, we report the answers as cumulative percentages. From the analysis of the unstructured interviews, to which 96% voluntarily responded, it emerged that many teachers (80%) expressed a determined intention to master the subject and a willingness to continue learning, despite the difficulties that they were encountering. Nevertheless, 73% expressed uneasiness about the training on offer to them. Although characterised by many valid and interesting offers, they found it difficult to form a satisfactory overall picture of what was available to them. Another crucial point is that teachers asked for their commitment to training in this new discipline to be recognised by the schools. They believe that in the future they will be asked to teach their specialised subject and CS at the same time, and will have to keep up-to-date with developments in both of them. The teachers interviewed manifested a good ability: to analyse the commitment required (80%); to reflect on their self-assessment of progress in the discipline (70%); but they considered that they did not yet possess appropriate criteria for assessing the subject; to maintain a proactive attitude, advancing proposals and alternative solutions to existing training (80%); and to show willingness to assume the responsibilities for teaching CS at school (80%). Far fewer teachers expressed their strong disagreement with the current training (7%) or did not wish to continue because the subject was too difficult and complex (9%). Most teachers wondered how many years it would take to master the discipline. Ninety-one per cent expressed concern that they did not feel as expert in CS as in their own disciplines, which they had been teaching for years, and 36% believed that the students knew more than they did. The proposals advanced by 80%, mentioned above, were all oriented to informal learning and to classroom practice, such as: having opportunities to share and discuss problems and learning solutions with colleagues in CS who, unfortunately, are not present in their school; to observe a CS colleague when teaching programming lessons to students; and to start their own programming lessons in co-teaching with a more experienced colleague. They expressed a desire: to analyse the various alternative ways of teaching CS (68%); to review their choices and solutions with colleagues in the subject (73%); and to discuss with expert colleagues the management strategies needed to face any difficulties (80%). The percentage of teachers who were aware of their strengths and weaknesses in the CS area was also high (95%). Many had shown the ability to predict the difficulties they might encounter in the implementation of CS with students in the classroom (66%), even if only a few (25%) were able to think positively about the possibility of failure and to recognise the typical causes of their own mistakes, due to lack of experience. Most of the novices in CS (93%) believed that they would not begin teaching programming in less than a year; while those who already taught it stressed that they did not feel expert in the subject and were proceeding very cautiously with small workshops with pupils. It was therefore too early for them to analyse the educational difficulties.

6. Conclusions and limitations of the research

From the results of the questionnaire, we can deduce that the course in programming completed by the researchers led to an increase in their sense of self-efficacy. To answer the first research question, we can state that the most significant improvement is in female teachers who were college graduated and taught science subjects. These groups of teachers also reported increased motivation and no worsening of perceived effort, which remained almost the same in pre- and post-tests (these improvements were particularly notable among teachers with programming experience). The groups that appeared to be the weakest were the younger and older teachers: this appeared to be a consequence of inexperience in the young and lack of energy in the old. However, we must not forget the problematic context that creates the difficulties and obstacles these teachers have to face (section 5). To answer the first two research questions, it is important to note that self-efficacy and intrinsic motivation have increased in some groups despite the fact that a high level of perceived effort was required. Moreover, in the interviews they demonstrated a high level of analysis, critical reflection and professional self-assessment in carefully evaluating their present and future actions. From their reflections, we conclude that immediate intervention measures are needed to support teachers who are facing genuine challenges. This is especially important in this delicate period in which the teaching of CS is being introduced in schools. “It has been demonstrated that students generally learn more from teachers with high self-efficacy than from those whose self-efficacy is low. In fact, teachers’ beliefs in their instructional efficacy is a very strong predictor of academic attainment in young children” [15]. Confirming other evidence reported by other authors [2, 5, 16] in section 2, and answering the third question, these teachers demonstrated that: 1) their perceived effort increases especially because they have difficulty in re-elaborating the subject teaching on their own. The training courses are not intended to be established as an organised system of learning, but they are fragmentary and unrelated to each other; therefore, it is difficult for teachers to draw up a systematic overall picture of CS and its pedagogical aspects; 2) based on their teaching experience, they believe this “adventure” is absolutely new (it does not have anything similar to their past work) and unexpectedly puts into question their professional role (as some teachers have said: “At this moment, the children know more than we do”); and 3) the teachers have analysed their commitment as perceived by the school and believe that it does not have the deserved recognition because colleagues often confuse it with a training in general ICT, rather than with a specific disciplinary area, computer science education.

The principal limits of this exploratory study are: the selection of the group of participants is based on criteria of convenience (volunteer teachers participating in a training course); and is subject to bias. Finally, it should be observed that as these teachers are Italian, the problems identified by them may not be relevant in other contexts. This exploratory study has investigated only some characteristics and criticalities; however, if we take into account the multidimensionality of teacher professionalism and the constant pressure to which it is subjected (in this phase of digital innovation in the schools), it is necessary to expand and deepen the investigation to further dimensions.

Note: 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. Sections 1, 2, 3, 5 and 6 are by M. Banzato. Section 4 is by P. Tosato. Our thanks to Matthew Hoffman.

References

1. National Research Council: Committee for the Workshops on Computational Thinking: Report of a workshop of pedagogical aspects of computational thinking. National Academies Press, Washington, DC (2011)
2. Yadav, Aman, et al.: Expanding computer science education in schools: understanding teacher experiences and challenges. Computer Science Education. 26(4), 235-254 (2016)
3. MIUR: Riforma del sistema nazionale di istruzione e formazione e delega per il riordino delle disposizioni legislative vigenti. (LEGGE 13/07/ 2015, n. 107) (2015)
4. The Royal Society: Shut down or restart? The way forward for computing in UK schools. The Royal Society, London (2012)
5. Gal-Ezer, J., Stephenson, C.: Computer science teacher preparation is critical. ACM Inroads, 1, 61–66 (2010)
6. OECD: Education at a Glance 2016: OECD Indicators. OECD Publishing, Paris, France (2016)
7. Eurydice: Key data on learning and innovation through ICT at school in Europe 2011. EACEA, Brussels, Belgium (2011)
8. Feiman-Nemser, S., Schwille, S., Carver, C., Yusko, B.: A conceptual review of literature on new teacher induction: National partnership of excellence and accountability in teaching. National Partnership of Excellence and Accountability in Teaching, East Lansing, MI (1999)
9. Veenman, S.: Perceived problems of beginning teachers. Review of Educational Research, 54, 143–178 (1984)
10. Corley, E.L.: First-year teachers: Strangers in strange lands. Paper presented at the Mid-Western Educational Research Association, Chicago, IL, 1-43 (1998). Retrieved from: https://files.eric.ed.gov/fulltext/ED424216.pdf
11. Tschannen-Moran, M., Hoy, A.W., Hoy, W.K.: Teacher efficacy: Its meaning and measure. Review of Educational Research, 68(2), 202-248 (1998)
12. Chen, G., Gully, S. M., Eden, D.: Validation of a new general self-efficacy scale. Organizational Research Methods, 4(1), 62-83 (2001)
13. Pajares, F.: Teachers beliefs and educational research: Cleaning up a messy construct. Review of Educational Research, 62, 307–332 (1992)
14. Ryan, R.M., Deci E.L.: Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary Educational Psychology, 25(1), 54-67 (2000)
15. Mulholland, J., Wallace, J.: Teacher induction and elementary science teaching: Enhancing self-efficacy. Teaching and Teacher Education, 17(2), 243-261 (2001)
16. Qian, Y., Hambrusch, S., Yadav, A., Gretter, S.: Who Needs What: Recommendations for Designing Effective Online Professional Development for Computer Science Teachers. Journal of Research on Technology in Education, 1-18 (2018)