Volume 2 | Issue 2 Article 2

2019

Attitudes Towards Teaching Computational Thinking and Computer Science: Insights from Educator Interviews and Focus Groups

Jorge Valenzuela
Old Dominion University

Recommended Citation

Valenzuela, J. (2019). Attitudes Towards Teaching Computational Thinking and Computer Science: Insights from Educator Interviews and Focus Groups. *Journal of Computer Science Integration, 2* (2). https://doi.org/10.26716/jcsi.2019.02.2.2

JCSI Journal of Computer Science Integration

Attitudes Towards Teaching Computational Thinking and Computer Science: Insights from Educator Interviews and Focus Groups

Abstract

In the last three years, integration of both computational thinking (CT) and computer science (CS) into K-12 instruction has become a focus of many schools throughout the Commonwealth of Virginia and the United States. With this new widespread demand, educational leaders and educators are focusing efforts on understanding the core concepts and practices of CT and CS, looking for logical connections for integrating across curriculum, and seeking strategies for implementing a wide variety of educational technology tools (apps and devices). This phenomenological research study was designed to gather depth information from 14 K-16 educators through both semi-structured interviews and two focus groups. Participants were asked open-ended questions about their self-efficacy, confidence, and prior experiences with teaching and learning CS. Moreover, each educator described his or her most significant concern for seeking appropriate professional development for building their CT/CS teaching and learning competencies in meaningful and relevant ways. Overall, nine themes emerged from the data: attitudes about CT/CS, access to industry experts, understanding CT/CS concepts, understanding CT/CS practices, use of relevant technology tools, alignment of CT/CS to current standards, teacher confidence, time to develop their own mastery for CT/CS, and access to appropriate professional development (PD) as the main connector.

Keywords

Computer Science, Computational Thinking, Qualitative Research

DOI

10.26716/jcsi.2019.02.2.2

Corresponding Author

Jorge R.Valenzuela, *Old Dominion University*, Department of STEM Education and Professional Studies, Norfolk, VA. Email: JVale006@odu.edu

As a result of the Computer Science for All initiative (Smith, 2016), many states have started to create policy to support computer science education (Lestch, 2018), beginning with the Commonwealth of Virginia. Llovio (2016) notes that in 2016 Virginia Governor McAuliffe signed legislation mandating that computer science (CS), computational thinking (CT), and coding be incorporated into the Virginia Standards of Learning (SOLs). Since then other states have followed suit and are now beginning to articulate standards for incorporating computer science into K-12 instruction (Zubrzycki, 2016). To support states in their implementation efforts, President Trump made expanding access to learning computer science education a high priority for Secretary of Education DeVos and the Department of Education by allocating grant funding of $200 million per year (The White House, 2017).

In 2016, the Virginia General Assembly unanimously passed House Bill 831 (2016) that elevated Computer Science to a core academic subject spanning kindergarten to 12th grade. Furthermore, the law incorporates computer science and computational thinking, including computer coding (House Bill 831, 2016) into the Virginia Standards of Learning (SOLs) and the state Standards of Quality that determine school and division accreditation. In support of this new policy many educators now require assistance in the form of professional development for making this instructional transition. New training must build teacher capacity to help prepare students for acquiring the appropriate skills and working knowledge of computational thinking, programming, and coding needed for success in mastering the new SOLs and for entry into various STEM fields of study or work they may choose to pursue after the K-12 experience. Krauss and Prottsman (2017) maintain that:

> As educators, we can picture what it takes to teach other science, technology, engineering, and math (STEM) subjects; we all have personal experience with them as learners, and some of us as teachers, and we're all consumers of science news. Computer science can feel less approachable because it's unfamiliar and, on the surface (all that code!), may seem complicated. (p. xiv)

To maximize teacher training and support efforts in Virginia and nationally, this phenomenological research study was undertaken to help determine the professional development needs of educators teaching CT and CS.

Statement of the Problem and Research Questions

The purpose of this study was to assess the preparedness of teachers incorporating fundamental CT and CS practices into classroom instruction in order to develop professional development to support them.

To guide this research, the following research questions were established:

(1) What are the skills gaps of teachers who are incorporating computational thinking and computer science into their instruction?

(2) What are the skills gaps of teachers who are incorporating technology into their computational thinking and computer science instruction?

(3) What type of professional development should teachers receive so that they may begin to successfully implement fundamental computer science concepts and practices into their instruction?

Literature Review

Participant feedback employing the interpretive framework of social constructivism was used to investigate the research questions of this study. The social constructivism paradigm (or social construction) theory of knowledge studies how individuals construct worldly understanding that shapes their view of reality. According to Creswell (2014)

> Social constructivists believe that individuals seek understanding of the world in which they live and work. Individuals develop subjective meanings of their experiences--meanings directed toward certain objects or things. These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas. The goal of the research is to rely as much as possible on the participants' views of the situation being studied. (p. 8)

Grounded theory was selected because it complements the paradigm of the research and is an established educational research model. According to Fassinger, the purpose of a grounded theory approach is to generate theory that is grounded in data regarding participants' perspectives for a particular phenomenon (as cited in Hays & Singh, 2012, p. 48). Charmaz and Mitchell identified six general characteristics of grounded theory:

(1) simultaneous data collection and analysis;

DOI: 10.26716/jcsi.2019.02.2.2

(2) pursuit of emergent themes through early data analysis;

(3) discovery of basic social processes within the data;

(4) inductive construction of abstract categories that explain and synthesize these processes; and

(5) integration of categories into a theoretical framework that specifies causes, conditions, and consequences of the process(es) (as cited in Hays & Singh, 2012, p. 49).

Furthermore, the researcher selected interviews and focus groups as these are exploratory collection tools that are common to grounded theory qualitative studies.

Methods

This qualitative study was reviewed by the College of Education and Professional Studies Human Subjects Review Committee' in Fall 2017 and was determined to be exempt from Institutional Review Board (IRB) review (Education Human Subjects Review Committee Ref 1144627-1).

Data Collection and Fieldwork Strategies

The subjects of the data collections involved three groups: individuals new to teaching CT/CS, individuals already teaching CT/CS, and those conducting research and or providing teacher professional development in areas of computer science and engineering in the Richmond, Virginia Metropolitan area. The researcher sought their input through interviews and focus groups to determine what may be the attitudes, apprehensions, and skill gaps of teachers developing new CT/CS skills. According to Carter, Blinkorn, Evans, and Sbaraini (2011), grounded theory studies begin with open questions, and the researcher presumes that they may know little about the meanings that drive the actions of their participants. The research participants in this study liberally described their feelings and experiences they have had with CS by answering open-ended questions.

According to Charmaz (2006), by carefully selecting participants and by modifying the questions asked in data collection, researchers fill gaps, clarify uncertainties, test their interpretations, and build their emerging theory. As per Blumer (1969), grounded theory studies are generally focused on social processes or actions; they ask about what happens and how people interact. This shows the influence of symbolic interactionism, a social psychological approach focused on the meaning of human actions.

Focus Group Methodology

According to Bond, Hale, MacMillan, McColl, and Thomas (1995), a focus group is a technique involving the use of in-depth group interviews in which participants are selected because they are a purposive, although not necessarily representative, sampling of a specific population, this group being ‘focused’ on a given topic. The use of focus groups in the social sciences is one of the two main ways in which data is collected qualitatively. Moreover, the focus group methodology is also used to develop communication, grounded and narrative theories in qualitative research.

The Semi-structured Interview

Data collection using grounded theory is directed by theoretical sampling, which means that the sampling is based on theoretically relevant constructs. It enables the researcher to select subjects that maximize the potential to discover as many dimensions and conditions related to the phenomenon as possible (Corbin & Strauss, 1998). For this data collection, the researcher utilized a semi-structured interview protocol to elicit the expertise of the subjects through concrete and relevant information. As noted by (Ayres, 2008):

> The semi-structured interview is a qualitative data collection strategy in which the researcher asks informants a series of predetermined but open-ended questions. In this approach, the researcher has more control over the topics of the interview than in unstructured interviews (p. 811-813).

Participants

Participants in the study include 14 educators, one college professor/researcher, the program manager of a Virginia educational non-profit, and the director of a local STEM center. These individuals were identified through their participation in various professional learning organizations. Each participant was targeted for this study because of their expertise in research, experience educating K-12 students, curriculum development, professional development delivery, or knowledge of current teacher preparation in computer science in their respective school, region, and state. Each participant was contacted through e-mail or telephone during the vetting process and all were prepared to participate in either an interview or a focus group.

Interviews and Focus Group Script Guides

Grounded theory studies are generally focused on social processes or actions: they ask about what happens and how people interact. This shows the influence of symbolic interactionism, a social psychological approach focused on the meaning of human actions (Blumer, 1969). Using grounded theory as the basis for collecting and analyzing data for this study, script guides for both the interviews and focus groups were developed after a review of the literature on qualitative research and CT/CS. According to Charmaz (2006), by carefully selecting participants and by modifying the questions asked in data collection, researchers fill gaps, clarify uncertainties, test their interpretations, and build their emerging theory.

The script guides were utilized in six interviews and two focus groups. Minor adjustments were made to some of the questions based on the feedback obtained throughout the process. An example of adjustments made would be the rewording of technical terms (e.g., computational thinking), rephrasing of sentences if the participants had trouble comprehending what was being asked, or when distinguishing whether the question was being directed towards a teacher or trainer.

Conducting the interviews/focus groups. Each of the subjects was made aware that their participation was optional and only with their written consent would transcribing and analyzing of their interview data samples be used for the study. Once dates, times, and locations for the data collections were agreed upon, each participant was provided an invitation via email to attend the data collection session. Two teachers were conferenced telephonically for the interviews and a college professor conferenced via telephone as the commute would not be justifiable for the focus group interview.

Participants were greeted and introduced to one another and then provided the opportunity to informally discuss his/her work, research experience, and their feelings about how they would contribute to this research. This induction created an environment where participants were encouraged to engage in an open discussion format. This fieldwork strategy earned their trust and proved appropriate to elicit detailed views from each of the participants. The objective to interpret the data for the development of targeted PD aimed at meeting both the core CS concepts and practices, including CT, was conveyed to the participants.

Initially, the participants were asked to describe the current teacher preparation program(s) and PD in core CT and CS skills (like coding) throughout Virginia and New York. This question was followed with a series of probing questions aimed to have them explain their experiences with teaching CT/CS, training to teach CT/CS, their use of educational technology for teaching CT/CS, and their thoughts about the proposal for more targeted training as a result of the study. The questions included:

(1) What are the teachers like in entry-level CT/CS workshops and what are their expectations?

(2) What is the most challenging aspect of developing teachers in either or both of the CT/CS basics?

(3) How would you describe the pedagogical content and delivery skills that most (or many) teachers lack (or just yourself) when entering a CT/CS workshop?

(4) Does the effective use of educational technology provide teachers the confidence and self-efficacy needed for implementing CT/CS with students?

(5) Please describe how training (professional development) influences teachers in delivering high-quality instruction in CT/CS in their classrooms? Please explain.

(6) What are some specific CT/CS trainings that you would like to either conduct or engage in, and what content and or strategies should be targeted?

Questions were intentionally modified and repeated for clarity in order to obtain the most honest and thoughtful responses from the participants. As per Seidman (2013):

> The purpose of in-depth interviewing is not to get answers to questions… At the root of in-depth interviewing is an interest in understanding the lived experiences of other people and the meaning they make of that experience.…At the heart of interviewing research is an interest in other individuals' stories because they are of worth. (p. 9)

Analysis

The responses of the participants were either written or recorded using the voice memos application on an iPhone 7. Transcription of the recordings was formatted and saved in rich text format (.rtf) using Microsoft (MS) Word. Furthermore, data collection and data analysis proceeded iteratively and early findings therein informed the researcher that CT as a problem-solving skill is more critical to understanding CS than the use of technology tools. This altered questioning in subsequent interviews and the focus groups until theoretical saturation was felt to be achieved. Moreover, the content of the focus group discussions was also analyzed by theme in addition to the analysis of interactions between the focus group members, and its impact on the content. Where relevant, the interactive aspects are reported in the findings section.

Results

General Attitudes Towards CT/CS Integration in K-12 Instruction

A range of views were expressed regarding CS integration into K-12 instruction. Most of the educators focused on the lack of understanding for CT/CS in general and identified the lack of access to good professional development as its cause. One respondent summed up these key points:

> I would say that I have seen professional development that overwhelmed teachers if it was done poorly. That to me would be a sign of poor professional development is how does the teacher at the end of it versus at the beginning of it. I've seen professional development that has overwhelmed people and left them very anxious, more anxious than when they came in about the task ahead of them. Typically, those are very content heavy and do not include as much opportunity for discussion about ... 'What if I run into this situation?' Or, 'How would I deal with' ... When they take what they expect in their classroom to experience and have a chance to discuss that, and think through strategies to what I might call adapt or customize to their student population (Educator 0001).

While another respondent identified standardized testing as a contributor to the lack of understanding:

> I would say it's that initial doubt that we talked about. That is a difficult part. In fact, it goes back and the root of that goes back to the pressure that so many teachers feel in terms of the standardized test coming (Educator 0002).

However, in reading through each of the transcripts and notes it was discovered that one of the obstacles to successful CT/CS integration in Virginian schools was the lack of rigor in classroom instruction. The data revealed that this is mainly attributed to both poor teacher selection and preparation in the fundamental skills needed for teaching CT/CS. One participant spoke highly of training in some pockets of Virginia but also spoke about the adverse selection of either unqualified or uninterested folks in the CS field. Teacher participants also corroborated this as they stated lacking CT/CS knowledge and having to seek out training opportunities on their own even though it was an expectation for them to integrate CT/CS into their instruction.

Use of Technology for CT/CS Integration in K-12 Instruction

One of the patterns uncovered in the data was participant references to technology tools whenever they were asked to describe their experiences in either utilizing it in the classroom or in preparing teachers to teach CT/CS. Furthermore, technology was addressed in regards to limited access due to constraints in funding, qualified technology teachers, teacher training, teacher competency, confidence, and also in the attitudes and dispositions of teachers towards its integration.

> With respect to use of technology tools, I would say that ALL teachers could use some initial training and periodic updates. Many CTE teachers could use more specific coding, CADding and certain media tools. It might be the sort of thing that would have to be county specific. For instance, ... Public School is moving over to completely Windows based computers, so learning GarageBand or iMovie would be worthless. Also, we have the Adobe suite on all of our computers, so many could use intensive training on Photoshop, Illustrator, etc. (Educator 0004).

One of the researchers in a focus group identified a shortage of technology education teachers and increased focus in testing as playing a role in the ineffective use of technology in schools:

> There's a significant shortage of tech Ed teachers around the nation. Programs have been closing. Maybe this is just anecdotal, but part of the reason for that is the increase in core requirements, particularly mathematics requirements, which in many states comprise three years or sometimes more of study, and if kids aren't able to pass math assessments, they have to go through remediation. All of this stuff cuts into the opportunity for school programs to offer electives (Educator 0005).

The data also revealed that obstacles for both teachers and professional developers in CT/CS is access to the appropriate technology tools and curriculum resources for getting started. One participant expressed that at times he purchases materials out of pocket if funding from grants or other school-based budgets is not available. Many of the educators agreed that they too have had to purchase technology in order to implement projects with students.

Professional Development Required for CT/CS Integration in K-12 Instruction

A pattern focusing on the lack of individuals who understand CT/CS and the need for relevant professional development in that regard was evident in all of the datasets. Moreover, the director of the STEM center explained some of the training they currently offer to improve broader knowledge of CT/CS. Additionally, it was expressed that training needs to be continuous and mandatory so that teachers could develop themselves over time.

> Our most recent work has been with guidance counselors around computer science and helping them to understand what is computer science, the different facets of computer science, what skills students need to have around computer science careers, and talking to experts in the field. So, doing some of that work with them has been helpful. We also provide workshops during our summer program, during our weekend programs, and our after-school programs as well (Educator 0010).

Others expressed the difficulties they have faced in finding the training they need.

> The only reason that I’ve had coding training is because I voluntarily went for some that was offered for summer school. I took it because I wanted some training in something I didn’t know that much about. I have also had training at district wide PDs that went over certain websites and the google drive. We should get training in especially coding

because with something like this is essential in the computer age that we live in. Also, it is easily integrated into science SOLs that I teach (Educator 0003).

The educators who provide professional development also expressed that CT/CS training should be mandatory for the teachers in school buildings who lack basic computing knowledge. Additionally, it was advised that there should be another layer of professional development that is specifically designed and tailored for both building and district level administrators who are tasked with supporting teachers in their classrooms.

Discussion

Initial data suggested that when integrating technology to teach CT/CS, teachers do not need to possess complete mastery over tools or practices that are introduced to learners (adult or child) but would have to be competent in CT as a problem-solving method. Some participants expressed discomfort and a lack of knowledge on how integration of the Computer Science Teachers Association (CSTA) K-12 Computer Science Standards (2017) with existing standards and competencies would be achieved. Some participants expressed that their supervisors informed them they will need to begin aligning standards and competencies due to the recent mandate in Virginia to incorporate CT/CS into the Standards of Learning (SOLs). Participants were informed that the Virginia Department of Education has adopted newly created SOLs for Computer Science that are in alignment to both the CSTA K-12 Computer Science Standards (2017) and the K-12 Computer Science Framework Steering Committee (2016)**.** However, many of the participants were unaware of the new standards, which leads to a bigger question of how can we inform teachers of these new changes?

The participants also expressed the essential role that technology plays in integrating CT/CS into instruction by serving as a scaffold for teaching coding, programming, computational thinking, or databases. The data also revealed that for teachers to feel increasingly comfortable incorporating any technology tool(s) into instruction, they would have to spend some time on the front-end learning and experimenting before working with learners. Similarly, the data identified that teacher trainers need to adopt the same method before engaging educators in workshops and that access to industry experts could help shorten the learning curve for all of the educators.

Several respondents mentioned that teachers have to learn CT/CS on their own or through training that they found themselves. Some of the teacher participants expressed doing some

DOI: 10.26716/jcsi.2019.02.2.2

great work integrating CT/CS with technology tools into their classes recently. Although they had not been formally trained in CT/CS, they had done a significant amount of training both independently and also learning alongside students. Moreover, they were very specific about the types of training and tools they would like to receive in order to be successful with CT/CS integration in K-12 classroom instruction. Some of the training mentioned were in the use of microcontrollers (i.e. Arduino and Raspberry Pi), Scratch and Code.org curriculum, and specific methods for teaching CT to students.

When asked, “How would you describe the pedagogical content and delivery skills that most (or many) teachers lack (or just yourself) when entering a CT/CS workshop?” many of the teacher participants were unsure of what was being asked and needed the question rephrased. The phrase ‘pedagogical content and delivery skills’ was the most difficult for teachers to comprehend and explain. It, therefore, became apparent that they also need training in evidence-based instructional teaching strategies for delivering effective CT/CS instruction in conjunction with CT/CS content knowledge and effective use of technology tools.

During data analysis, nine themes emerged:

1. attitudes about CT/CS,
2. access to industry experts,
3. understanding CT/CS concepts,
4. understanding CT/CS practices,
5. use of relevant technology tools,
6. alignment of CT/CS to current standards,
7. teacher confidence,
8. time to develop mastery for CT/CS, and
9. access to appropriate PD.

The breadth of these findings indicate teachers would have to learn a little each year, in a sustained format, and have access to the appropriate PD. Figure 1 illustrates how professional development is the connector of the categories.

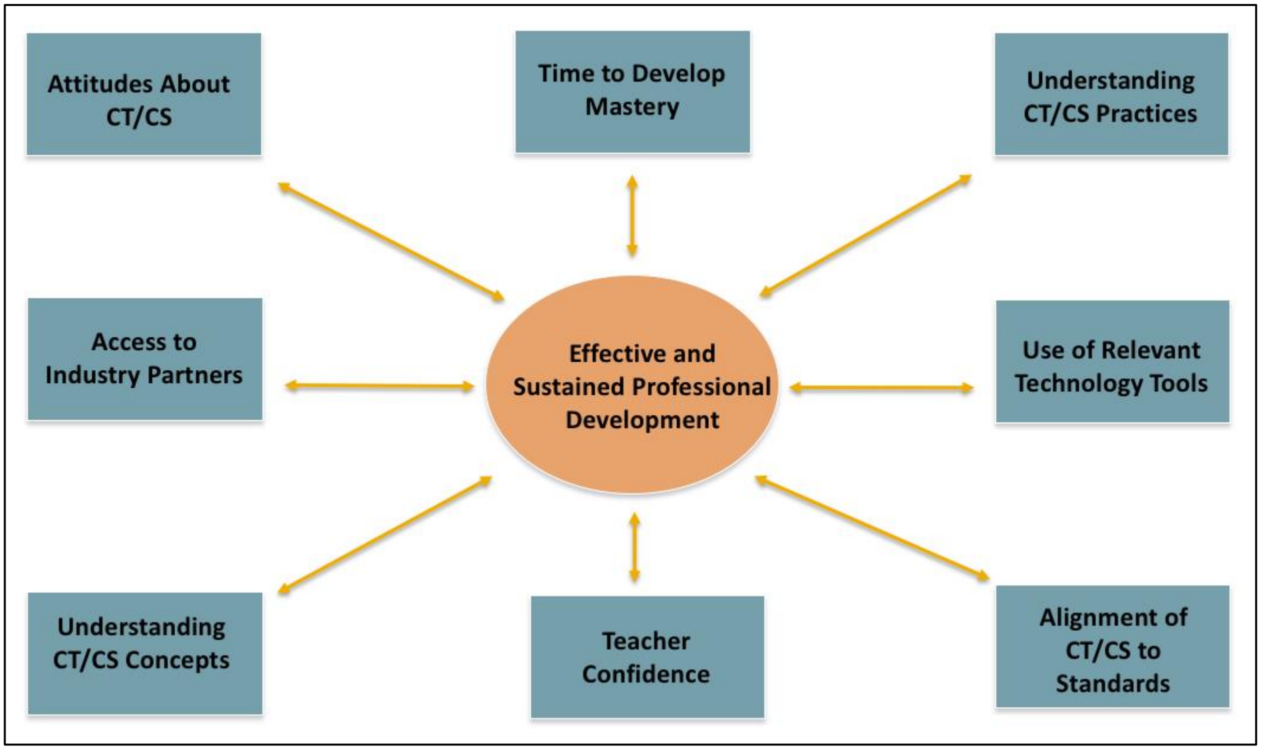

Figure 1. How professional development connects the nine themes.

Limitations

The purpose of qualitative studies is to elicit a range of perspectives, as opposed to being statistically representative. So, it cannot be concluded how common these attitudes and concerns are to all educators or also whether those who participated represent the entire population of interest. However, recruitment methods of participants for this study aimed to provide a wide range of educators possessing multiple perspectives and expertise levels. Both the interview and focus group methods were selected because they reflect the reality of how educators form views about topics they need to teach. A limitation of these methods is that participants may have felt obliged to go along with the views and attitudes expressed by their colleagues or, in the case of interviews, express what they felt I wanted to hear. Taking these limitations into account, knowledge gleaned from the educator responses, and emerging themes from the overall study will aid the development of a questionnaire, which will be used for a large-scale national survey of teachers who are required to teach CT/CS.

Importance of the Findings and Next Steps

It is not surprising that access to appropriate PD is the main connector between all of the emerging themes in the study or that it should be the central focus for both researchers and classroom practitioners aiming to truly make effective CT/CS K-12 integration for all a reality. According to Desimone (2009), educational reform depends on teacher professional development, which leads to improvements in students' learning experiences and achievement. Moreover, all PD is not created equal and if teachers continue to struggle with appropriate pedagogical strategies for lessons following PD, then achieving mastery of the CT/CS content will not positively impact the learning of all their students.

Not receiving the appropriate PD causes frustration and negatively impacts the attitudes of teachers who are tasked with teaching CT/CS. As per Desimone and Phillips (2013), the effectiveness of PD depends on the interaction and confluence of teacher knowledge and beliefs, and the use thereof, to improve the content and the pedagogy of their instruction. Furthermore, Desimone and Garet (2015) explain that there are five key features that make professional development effective—content focus, active learning, coherence, sustained duration, and collective participation.

Keeping in mind the results of the study and that there is substantial evidence that CT/CS will play a major role in the future of K-12 education, there is a need to develop a theory for the preparation of teachers. Evidence-based pedagogical strategies for designing and imparting cross-curricular CT/CS instruction also need to be developed. According to Miller (2014),

> Since it can take as many as 25 years to create a computer scientist, and since computer science skills are becoming increasingly integral for jobs in all industries, this skills gap is on track to emerge as a formidable economic, security, and social justice challenge in the next few years. Teachers, schools, parents, and industry must act on multiple fronts to address student readiness, expand access to computer science curriculum and opportunities, and help foster interest in computer science to ensure that it becomes a core component of every child's education.

Moreover, there is a lack of empirical research on how to provide educators professional development utilizing specific instructional design models to strengthen both the CT/CS content and pedagogical strategies of participating educators. However, there is some validation for this work in previous literature by other researchers in the CS education field. Cooper, Forbes, Fox, Hambrusch, Ko, and Simon (2016) make a case for CS education research that focuses on both the content knowledge and pedagogy of teachers.

Jorge Valenzuela is an adjunct professor at Old Dominion University and the lead coach at Lifelong Learning Defined. Additionally, he is a national faculty of PBLWorks.

DOI: 10.26716/jcsi.2019.02.2.2

References

Ayres, L. (2008). Semi-structured interview. In L. M. Given (Ed.), *The Sage encyclopedia of qualitative research methods* (pp. 811-813). Thousand Oaks, CA: Sage.

Blumer, H. (1969). *Symbolic interactionism: Perspective and method.* Berkeley, CA: University of California Press.

Bond, S., Hale, C., MacMillan, J., McColl, E., & Thomas, L. (1995). Comparison of focus group and individual interview methodology in examining patient satisfaction with nursing care. *Social Sciences in Health, 1*, 206–219.

Carter, S. M., Blinkorn, A., Evans, R.W., & Sbaraini, A. (2011). How to do a grounded theory study: A worked example of a study of dental practices. *BMC Medical Research Methodology, 11*(128), 1-10. https://doi.org/10.1186/1471-2288-11-128

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. London: Sage Publications, Inc.

Cooper, S., Forbes, J., Fox, A., Hambrusch, H., Ko, A., & Simon, B. (2016). *The importance of computing education research* [White paper]. Retrieved from https://cra.org/ccc/wp-content/uploads/sites/2/2015/01/CSEdResearchWhitePaper2016.pdf

Corbin, J., & Strauss, A. (1998). *Basics of qualitative research: Grounded theory procedures and techniques* (2nd ed.). Newbury Park, CA: Sage.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches.* Washington, DC: SAGE Publications, Inc.

Computer Science Teachers Association (CSTA) Standards Task Force. (2017). In CSTA K-12 computer science standards. Retrieved from https://www.doe.k12.de.us/cms/lib/DE01922744/Centricity/Domain/176/CSTA%20Computer%20Science%20Standards%20Revised%202017.pdf

Desimone, L. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher, 38*(3), 181-199. https://doi.org/10.3102/0013189X08331140

Desimone, L., & Garet, M. (2015). Best practices in teachers' professional development in the United States. *Psychology, Society & Education. 7*, 252-263. https://doi.org/10.25115/psye.v7i3.515

Desimone L., & Phillips, K. J. R. (2013). Linking student achievement growth to professional development participation and changes in institution: A longitudinal study of elementary students and teachers in Title I schools. *Teachers College Record, 115*(5), 1-46.

Hays, D. G., & Singh, A. (2012). *Qualitative inquiry in clinical and educational settings.* New York, NY: Guilford Press.

House Bill 831, Virginia Code §§ 22.1-253.13:1 (2016).

K-12 Computer Science Framework Steering Committee. (2016). K-12 Computer Science Framework. Retrieved from https://k12cs.org/wp-content/uploads/2016/09/K%E2%80%9312-Computer-Science-Framework.pdf

Krauss, J., & Prottsman, K. (2017). *Computational thinking and coding for every student: The teacher's getting-started guide.* Thousand Oaks, CA: Corwin.

Lestch, C. (2018). These states embraced computer science education in 2017. Retrieved from https://edscoop.com/these-states-embraced-computer-science-education-in-2017

Llovio, L. (2016). Governor signs legislation to make computer science part of the SOL curriculum. Retrieved from http://www.richmond.com/news/local/education/ /districts/ governor-signs-legislation-to-make-computer-science-part-of-sol/article_36fe1085-9da0-59f5-b3d0-732a5ada5eb1.html

Miller, A. (2014). Computer science: The future of education. Retrieved from https://www.edutopia.org/blog/computer-science-future-of-education-alison-derbenwick-miller

Seidman, I. (2013). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (4th ed.). New York, NY: Teachers College Press.

Smith, M. (2016). Computer science for all: The White House President Barack Obama. Retrieved from https://obamawhitehouse.archives.gov/blog/2016/01/30/computer-science-all

The White House. (2017). Expanding access to high quality STEM and computer science education provides more pathways to good jobs. Retrieved from https://www.whitehouse.gov/the-press-office/2017/09/25/expanding-access-high-quality-stem-and-computer-science-education

Zubrzycki, J. (2016). Washington state rolls out standards for teaching computer science. Retrieved from http://blogs.edweek.org/edweek/curriculum/2016/12/wash_marks_computer_science_ed.html