THE IMPACT OF A SHORT-TERM TRAINING ON STUDENT AND TEACHER SELF-EFFICACY IN COMPUTATIONAL THINKING, PROGRAMMING AND ENTREPRENEURSHIP

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
COMPUTER EDUCATION AND INSTRUCTIONAL TECHNOLOGY

AUGUST 2019

Approval of the thesis:

THE IMPACT OF A SHORT-TERM TRAINING ON STUDENT AND TEACHER SELF-EFFICACY IN COMPUTATIONAL THINKING, PROGRAMMING AND ENTREPRENEURSHIP

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

THE IMPACT OF A SHORT-TERM TRAINING ON STUDENT AND TEACHER SELF-EFFICACY IN COMPUTATIONAL THINKING, PROGRAMMING AND ENTREPRENEURSHIP

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August 2019, 118 pages

Computational thinking, programming and entrepreneurship are three of the most important domains in 21st century, where the economies are internationalized and primarily based on information technology rather than traditional industry. It is therefore crucial to have individuals with high proficiency and high levels of self-efficacy in these domains, to be able to thrive and advance as a society.

The primary purpose of this study, therefore, was to investigate the possible positive impact of a short-term training on self-efficacy of students and teachers, the dynamic individuals of a society, in computational thinking, programming and entrepreneurship. The study also aimed to investigate whether the short-term training would have a differing impact on students and teachers, in terms of enhancement and sustainability of self-efficacy.

Participants were 38 students and 28 teachers, selected using purposeful sampling, from a pool of 203 students and 129 teachers who applied online to participate in Applied Entrepreneurship and Informatics Training for Youth Project. Data was collected from the groups (students and teachers) three times with the same instruments, as pretest, posttest and 2nd posttest, based on a quasi-experimental research design.

Data was analyzed using paired samples t-test and Independent samples t-test and results indicated that the short-term training significantly increased student and teacher self-efficacy in aforementioned domains and that the training did not have a differing impact on students and teachers in terms of enhancement and sustainability of self-efficacy, as the increase in self-efficacy was not significantly different for the groups and both groups sustained their self-efficacy in these domains indifferently.

Keywords: Computational Thinking, Programming, Entrepreneurship, Self-Efficacy, Teacher Self-Efficacy, Student Self-Efficacy

ÖZ

KISA SÜRELİ BİR EĞİTİMİN ÖĞRENCİ VE ÖĞRETMENLERİN BİLGİ-İŞLEMSEL DÜŞÜNME, PROGRAMLAMA VE GİRİŞİMCİLİK ÖZYETERLİK ALGILARI ÜZERİNDEKİ ETKİSİ

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Ağustos 2019, 118 sayfa

Yerel ekonomilerin gelenekselci endüstriyel zeminden ayırılıp bilişim teknolojisi temeline dayanan bir uluslararası ekonomi haline geldiği 21. Yüzyıl'da, bilgi-işlemsel düşünme, programlama ve girişimcilik en önemli alanlar olarak öne çıkmaktadır. Bu yüzden de ekonomiye dayalı şekilde ilerlemek ve gelişmek isteyen toplumların bu alanlarda becerisi ve özyeterliği yüksek bireylere sahip olması oldukça önemlidir.

Buna bağlı olarak, söz konusu çalışmanın temel amacı, kısa süreli bir eğitimin, toplumun en dinamik bireyleri arasında yer alan öğrenci ve öğretmenlerin bilgi-işlemsel düşünme, programlama ve girişimcilik alanlarında sahip oldukları özyeterlikleri üzerindeki muhtemel olumlu etkisini incelemek olarak belirlendi. Çalışma, ayrıca, bu kısa süreli eğitimin özyeterliği artırması ve bu değişimin kalıcı olması açısından öğrenci ve öğretmenlere farklı şekilde etki edip etmediğini de inceledi.

Bu incelemeleri mümkün kılmak adına, katılımcıların, Gençlerle Uygulamalı Girişimcilik ve Bilişim Eğitimi Projesine katılmak için çevrimiçi olarak başvuru yapan 203 öğrenci ve 129 öğretmen içeren bir havuzdan amaçlı örneklem tekniği ile seçilen 38 öğrenci ve 28 öğretmenden oluştuğu yarı-deneysel yapıdaki bu çalışma

kapsamında, öğrenci ve öğretmenlerden eğitimden önce, eğitimden hemen sonra ve eğitim tamamlandıktan iki ay sonra olmak üzere üç kez veri toplandı.

Veriler, eşleştirilmiş örneklemler t-testi ve bağımsız örneklemler t-testi kullanılarak analiz edildi ve sonuçlar, kısa süreli eğitimin öğrenciler ve öğretmenlerde bilgi-işlemsel düşünme, programlama ve girişimcilik özyeterliklerini istatistiksel olarak anlamlı şekilde artırdığını işaret etti. Ayrıca, bu kısa süreli eğitimin öğrenci ve öğretmenlere farklı şekilde etki etmediği ve bir gruptaki özyeterlik artışının diğer gruptaki artıştan istatistiksel olarak anlamlı şekilde farklı olmadığı ve eğitimin kalıcı olma noktasında iki grup adına istatistiksel olarak anlamlı bir fark göstermediği ortaya kondu.

Anahtar Kelimeler: Bilgi-İşlemsel Düşünme, Programlama, Girişimcilik, Öz-yeterlik

It’s ‘beauty in the struggle, ugliness in the success’.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my supervisor, Prof. Dr. Ömer Delialioğlu, for believing in a bright yet demotivated student when he said that he wants to and he will finish his thesis, after putting it off for almost 2 years. Thank you, Sir, for your guidance, feedback, help and support throughout this journey.

I would like to thank the members of my thesis defense jury, for this study was completed as a much better piece of work, thanks to their invaluable feedback, help and support.

I would like to thank each and every instructor from the Department of CEIT, METU, for their guidance, help and support throughout the course of my master's studies, and for always holding themselves, and us the students, to high standards.

I would like to thank my family; my mother, the most affectionate person I know, my father, the most righteous man I know, and my sisters, 2 successful individuals and wonderful mothers, for always loving and supporting me. Love you guys!

I would like to thank my little nephews and little niece, the most joyous and well-behaved kids that I know, for cheering up everyone and anyone around them and spreading joy all the time. I don't know if you kids will ever read this, but I want you to know that I will always try to be someone you can look up to. Love you kids!

I would like to thank my friends, *"el equipo",* for believing in me as much as I myself do and always motivating me to complete this work. Great to have you guys by my side, a group of accomplished individuals I can always count on! *Gran equipo!*

I would like to thank METU CEC for allowing and assisting me to conduct this study as a part of their project (2018-2-TR01-KA347-060411) which was funded by Turkish National Agency as a part of Erasmus+ Programme.

Finally, I would like to thank *The Iron*, 'the greatest reference point, the all-knowing perspective-giver and the beacon in the pitch black!', for always being there when I need it the most.

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ABBREVIATIONS	
CT	COMPUTATINAL THINKING
PR	PROGRAMMING
EN	ENTREPRENEURSHIP
CTSES	COMPUTATIONAL THINKING SELF-EFFICACY SCALE
PRSES	PROGRAMMING SELF-EFFICACY SCALE
ENSES	ENTREPRENEURSHIP SELF-EFFICACY SCALE
SE	SELF-EFFICACY

CHAPTER 1

INTRODUCTION

1.1. Overview

This chapter mainly communicates the background, purpose and significance of the study, and introduces the research questions, assumptions, limitations and delimitations and definition of terms. First, background of the study is thoroughly discussed. Then, purpose and significance of the study are elaborated on. Last, research questions, assumptions, limitations, delimitations and definition of terms are listed, respectively.

1.2. Background of the Study

Two decades into 21st century and we now live in an internationalized economy which is primarily based on information technology rather than traditional industry. That is why the century we live in is called "Information Age"; an age that has been rapidly transforming the world as we know it and shaping the next generation of values and essentials an individual and a society should have and hold, in order to be able to thrive in it. This is an age that has its residents experience ever-growing advancements and transformations in information technology, and in which the most prevalent elements are knowledge and information.

These changing and advancing conditions in [information technology] and the technological world have transformed learning and teaching environments, as it has many other areas (Anderson 2008, as cited in Voogt et al, 2010; Göksün & Kurt, 2017). This transformation took place in from physical elements such as technological infrastructure of the schools to abstract elements such as student and teacher skills (Göksün & Kurt, 2017).

Students and teachers, as dynamic individuals of a society, are now expected to take part in current collective learning culture, which implies the importance of creating the knowledge rather than passively consuming the existing information (Gretter & Yadav, 2016) and more than that, they are expected to have 21st century competencies and skills (Voogt et al., 2013; Mishra & Kereluik, 2011 as cited in Voogt et al., 2013). Authorities have, therefore, long been talking about the importance of implementing the ways and processes to enhance 21st century competencies, for teaching and learning in Information Age, (Voogt, Erstad, Mishra & Dede, 2011, as cited in Dede et. al., 2013) and the research – primarily educational and computer science research – studies what to implement in the curriculums to teach students and teachers these skills and competencies (Binkley et al., 2012 as cited in Voogt et al., 2013).

This body of research has mainly been focusing on 'what to teach' and 'how to teach' to help students and teachers gain these 21st century skills and help themselves and the society they live in thrive. While "how to teach", and "what to teach" both are an all-time quest for the educational society and research – one that has produced numerous successful and several unfavorable answers – "what to teach" is studied by computer science as well. However, the conditions of the globalized world and the internationalized economy we currently live in play an even bigger role in determining what domains and skills should be taught when the goal for the individuals and the society they live in is to advance within the conditions of Information Age, where, if needs to be repeated, the world is globalized, and national economies are internationalized. Teachers and students around the world are therefore subject to many educational reforms, revisions, and transformations that aim changes and improvements in social, political and economic areas (İncik & Uzun, 2017) of the society they live in.

Research suggest that the means to socially, politically and economically transform a society, through students and teachers, in today's world, are mostly and fundamentally about the domains that have their roots in computer science and entrepreneurship (Gries & Naude, 2008; Alvord, Brown & Letts, 2002). The educational reforms, for that reason, mainly target and revolve around computer science and entrepreneurship, and also 'entrepreneurship built upon computer science'. This is mainly because the research associates change and transformation in social, political and economic areas in a society with entrepreneurship (Alvord, Brown & Letts, 2002) and computer science. Thus, students and teachers are trained and need to be trained to solve today's problems with entrepreneurship based upon computer science (Doboli et. al., 2010) as means to social, political and economic results and developments in the society and for them to have the chance to be successful individuals in 21st century.

These trainings mainly include domains such as computational thinking (CT), programming (PR) and entrepreneurship (EN) (Daimi & Rayess, 2008; Doboli et. al., 2010), as computational thinking and programming are of paramount importance to solve 21st century problems; and so is entrepreneurship, since entrepreneurship helps turn the ideas and solutions into reality and ventures, and transforms those that interact with it (Venkataraman, 2003). Computational thinking, programming and entrepreneurship are therefore listed as three of the most important domains 21st century individuals and societies are expected to have competency in, when and if the goal is to help themselves and the society they live in thrive and advance (Einhorn, 2011).

In the following three sub-sections, these three domains are defined and elaborated on about their importance in 21st century and what aspects of them provided a base for the emergence of this study. The two sub-sections that follow then talk about how these three domains are also interrelated, while being impactful separate/particular domains as of their own, and also self-efficacy, the concept which is investigated in this study, as a part of these three domains.

1.2.1. Computational Thinking

Computational thinking, referred as the process of utilizing algorithms and analytical concepts and procedures to formulate, analyze and deal with problems (Bocconi et. al., 2016), has long been a top priority in computer science education (Shell et. al., 2014). Wing (2011), who helped the term and concept of computational thinking gain importance and popularity in academic research, notes that computer science has produced fascinating technology that has transformed and has been transforming our lives with thorough economic and social impact, at an astonishing pace. It is hard to not to agree with this when we consider the fact that the way we do many things have changed and have been changing due to the ever-increasing, newly introduced, computer science-based software elements and platforms. For Wing (2011), however, what computer science produced and has been producing was not just useful hardware artifacts or software outputs, but also a rational structure for thinking, which is called 'computational thinking' (Wing, 2011), which was primarily considered as a "skill" in the sense that it is 'an ability to do something'. However, the research later started to discuss it as a "domain", in the sense that it involves skills such as problem decomposition, algorithmic thinking, and abstraction. Yadav et al. (2017), for example, refer it as a "competence domain" that is crucial to succeed in today's technological world.

The discussions about the definition, interpretation and importance of computational thinking took place in the reports by authorized organizations such as Computer Science Teacher Association (CSTA) and The International Society for Technology in Education (ISTE) as well (Garcia-Penalvo et al., 2016). Besides, many researchers from various disciplines have also discussed the domain, its definition and interpretation (Mannila et al., 2014; Aho, 2012; Barr & Stephenson, 2011). Computational thinking is therefore thought to be not limited to computer science. Wing (2011) believes that everyone can gain from thinking computationally and argues that computational thinking will turn into an essential skill that is utilized by each person by the mid-21st century, just as reading, writing and arithmetic right now is (Wing, 2011, p. 7). Mostly agreeing with this and keeping this in mind, scholars and administrators from the educational society have therefore been conducting projects to incorporate computational thinking into classroom activities (E.g. Barr, Harrison & Conery, 2011) at K-12 level.

Of course, the incorporation of computational thinking into pre-college level presented challenges. The most important one of these is to equip prospective and in-service teachers with computational thinking skills (Garcia-Penalvo et al., 2016). Among other important challenges are how to teach it to the students and how to assess it. While the researchers and administrators continue working on overcoming these challenges, the fact that the importance of computational thinking for individuals and consequently for a society has been very well comprehended by all parties included in the discussions has been an influential factor on the emergence of the idea and on the decision to conduct this study.

1.2.2. Programming

Programming, which involves skills such as problem-solving, abstraction, mathematical logic, testing and debugging (Saeli et. al., 2011), has been one of the most important and in-demand proficiencies of the 21^{st} century. Although several definitions from the literature for programming and computational thinking might look similar, these domains are obviously different from each other, in the sense that computational thinking skills are actually considered as a crucial set of prerequisites for programming and programming, on the other hand, requires learning a programming language and using it along with computational thinking skills to write programs the computer will understand and execute. Programming is actually a domain that requires individuals to use their computational thinking skills and the programming languages and software to produce the software outputs Wing (2011) talks about. As these outputs continue to be in-demand, so does programming.

That is why the demands on individuals and communities with high competency in – employment for computer literate engineers is projected to grow 13% from 2016 to 2026 (as cited in Abdunabi et al., 2019) – in “knowledge-based” economies around the world (Korkmaz & Altun, 2014). In fact, the investments the software industry recently receives is rapidly increasing, compared to the investments the hardware industry is drawing, which is seen as a phenomenon that indicates even more increase about the importance of learning programming (Lee & Cheng, 2011, as cited in Korkmaz & Altun, 2014) in 21st century. Moreover, considering all these, computer science departments have been covering many programming courses in their curriculums for decades and programming and programming-related courses have almost completely been integrated into K-12 classrooms as well, in many countries for the last couple decades.

The increase in demand and in incorporation of programming courses into almost all levels of education require the students and teachers to be effectively trained in order to make them proficient in programming, so that this incorporation will become a success; which is an end the research strives for and focuses on. More than that, the research focuses on ways to how to teach programming better, and by extension, how to train students and teachers better. (E.g. Özmen & Altun, 2014; Jegede, 2009; Govender & Govender, 2012; Kinnunen & Simon, 2012). This is a rather challenging process for the researchers, just as learning programming is for students and teachers. Still, the academics managed to come up with various explanations and answers to this challenge. There have been studies that provided predictors for programming success (E.g. Ferrer-Mico, Fernandez & Sanchez, 2012, as cited in Özmen & Altun, 2014; Hwang et al., 2012, as cited in Özmen & Altun, 2014; Jegede, 2009), studies that discussed the mental models to learn programming (E.g. Labelle, 2004) and studies that discussed the factors affecting programming success (E.g. Lau & Yuen, 2011, as cited in Özmen & Altun, 2014).

This body of research states that programming success is affected by various factors such as programming experience, academic achievement, mathematic performance, gender, and self-efficacy (Özmen & Altun, 2014). Like in computational thinking, the fact that programming continues to be an in-demand proficiency in today's knowledge-based economies and that programming experience and self-efficacy are important factors for programming success was one of the decisive pieces that led to the emergence of idea to conduct this study.

1.2.3. Entrepreneurship

The definition and interpretation of entrepreneurship or an entrepreneur differs based on the disciplines it is studied, the time the definition or the interpretation is devised and even the societal conditions of the researchers that develop these definitions and interpretations (Vaziri, Hosseini & Jafari, 2014). The research therefore seems to be lacking a consensus on a singular definition and an interpretation. One thing the research agrees about entrepreneurship, however, is the fact that it has become an academic discipline and has expanded into courses, programs and departments in many educational institutions (Peterman & Kennedy, 2003; Dickson, Solomon & Weaver, 2008; Katz, 2008). This is mainly because many countries have been introducing policy frameworks to set up, encourage and maintain entrepreneurship education and training and consequently enhance entrepreneurial intentions and activities (Pittaway & Cope, 2007; Cheung, 2008, as cited in Dehghanpour, 2013), noticing that entrepreneurship has established itself as the most influential and dynamic 'economic' force over the last couple decades (Kuratko, 2008, as cited in Dehghanpour, 2013). Many governmental organizations have been launching projects to teach entrepreneurship and increase entrepreneurial intentions in individuals. (E.g. Rohde et al., 2005; Klamma et al., 2003, as cited in Daimi & Rayess, 2008). On the other hand, this process has been challenging the traditional role of teachers (Belwal, Balushi & Belwal, 2014) and students in educational settings. Teachers are now expected to encourage entrepreneurship and students are expected to develop and show entrepreneurial intentions. The fact that the traditional role of teachers and students are challenged with entrepreneurship education, yet, little to none is known about how a supposed training – a short-term one – or education affects their entrepreneurship self-efficacy played a crucial role in the emergence of the idea to include entrepreneurship in this study, along with the ultimate reason that it is one of the most, if not the most, influential and crucial domains in 21st century.

Besides, entrepreneurship is actually also shown as one of the most crucial domains a 21st century individual can have competence in, to be successful today, the related literature states (The Partnership for 21st Century Skills, 2015; Koeing, 2011; Lai & Viering, 2012, as cited in İncik & Uzun, 2017). Moreover, learning the skills to think and act entrepreneurially is now seen as a source of competitive advantage in many areas of the life in 21st century (Ireland & Webb, 2007, as cited in Kuratko, 2007). Entrepreneurship and entrepreneurial acts have historically fueled many innovations and advancements in technology (Doboli et. al., 2010) and is expected to continue fueling social, political and economic transformations in the following decades as well. Along with previously stated main factors, this forecast about entrepreneurship played a significant role in deciding to include entrepreneurship in this study.

1.2.4. Relationship Between CT, PR and EN

Please refer to the figure below for the relationship between computational thinking, programming and entrepreneurship, which was constructed based on the comprehensive analysis of the related research and the implications from the related literature.

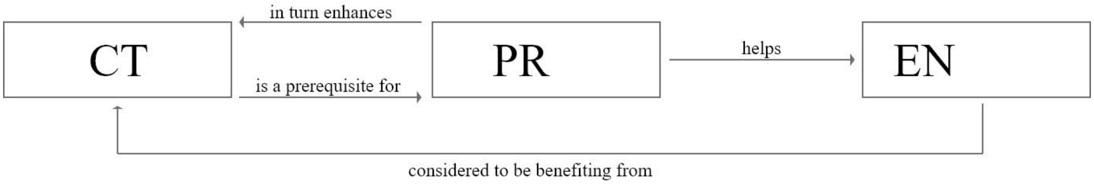

Figure 1.1. The Relationship Between CT, PR and EN

Computational thinking and programming are directly linked as computational thinking is thought to be a crucial prerequisite for programming and as programming enhances computational thinking. That is, a programmer is expected to use computational thinking skills along with programming languages to produce software outputs and this process in turn is expected to further improve the programmer's computational thinking skills. On the other hand, although an entrepreneur does not necessarily have to know how to program to be recognized as an entrepreneur or to be a successful, it is hard to picture and recognize an entrepreneur, in 2019, who lacks computational thinking skills and would not benefit from programming and computational thinking to create a new venture. That's why entrepreneurship can be claimed to be related to computational thinking and programming, two organically related domains. Entrepreneurship research, driven mainly by scholars and researchers from managerial and organizational studies, for instance, offers an interesting case for the use of mathematics in entrepreneurship, in order to develop entrepreneurship theories (Busenitz et. al., 2003, as cited in Levesque, 2004), which implies the relationship between entrepreneurship and computational thinking and consequently programming. That is, entrepreneurship theories are taught to be developed with the help of mathematics; more specifically, with the help of computational thinking and programming. It is therefore not unsound to assume and state that entrepreneurship skills are also related to computational thinking, and programming.

Research, too, supports the idea that these three domains are, in fact, related. Considerable amount of research recognizes computational thinking and programming as closely related skills and study them both to reflect their relationship and how to teach them better (Selby, 2015; Travers, 1996). Selby (2015), for example, proposed a relational model that can be utilized to teach programming and computational thinking together. Orr (2009), similarly, argues that the skills to 'think computationally' can be taught through a training that incorporates programming with algorithms. Einhorn (2011) takes it further by arguing that programming is the best way to learn/teach the skills to think computationally.

On the other hand, Daimi and Rayess (2008) implies the relationship between computational thinking and entrepreneurship by stating that "computational thinking paves the way for entrepreneurial thinking" (p. 2). Also, even though the majority of computer science and software engineering programs do not offer entrepreneurship courses (Daimi & Rayess, 2008), there are programs that relies on frameworks to develop entrepreneurial intentions in students in these programs (Rusu et al., 2006; Kussmaul, 2000), recognizing the fact that programming and software has great potential for entrepreneurship.

The fact that these three domains are interrelated even though they are primarily separate and impactful domains as of their own was a crucial factor for the emergence of the study and for the way it was designed, which included all these three domains together. If the domains were somehow unrelated, it would not make sense for the study to include all three domains, although the instructions were going to be given nonetheless, because the study would lack coherence.

1.2.5. Training vs. CT, PR and EN

The purpose of training is to stimulate behavioral changes and learning in an individual (Skinner, 1953), and this process is expected to generate cognitive, affective, and skill-based results for the learner (Kraiger, Ford, & Salas, 1993). When applied to computational thinking, programming and entrepreneurship domains, the objective of the training is to make learners proficient in using computational thinking, programming and entrepreneurship skills. For that matter, training an individual in programming, for instance, would mean trying to increase one's proficiency in programming skills.

Relevant training and education are proven to enhance an individual's skills and domain knowledge in all of these three domains (Shell et al., 2014; Feldhausen, Weese & Bean, 2018; Bean et al., 2015; Abdunabi et al., 2019; Özmen & Altun, 2014; Yükseltürk & Altiok, 2016; Askar & Davenport, 2009); Breslin, 2017; Dehghanpour, 2013; Izquerdo & Buelens, 2008; Shinnar, Hsu & Powell, 2014). Vast number of studies report that computational thinking skills can be enhanced with training. Similarly, research on programming reveals that relevant programming courses substantially enhance programming skills in individuals. The research also suggests that training has a decisive impact on entrepreneurship skills as well (Tevelde et. al., 2005, as cited in İncik & Uzun,2017). Understanding the role of training in determining and enhancing the proficiency and domain knowledge of individuals was an important factor in deciding to study the role of a short-term training as a part of this study, along with another influential factors, last of which to be stated at the end of the next sub-section.

1.2.6. Self-Efficacy

Another factor that plays a role in individual's proficiency in a given domain or endeavor is self-efficacy (Bandura, 1994). The concept of self-efficacy was first introduced by Bandura (1977), originating from his Social Cognitive Theory. Bandura (1994) defined self-efficacy as self-beliefs about one's own abilities to produce a desired level of performance in a given domain or endeavor (Bandura, 1994).

The use of self-efficacy within the training and educational research has been gradually increasing over the years (Emurian, 2004) and educational research mostly focuses on the relationship between learning, training, and self-efficacy (Bandura, 1997; Schunk, 1995, as cited in Schunk, Pajares, 2002; Pintrich & Schunk, 1995, as cited in Pajares, 2001). The relationship between self-efficacy and training has been studied and is being studied with various domains, including computational thinking, programming and entrepreneurship. In fact, these three domains are some of the domains that have been studied with self-efficacy the most. Considerable amount of research, for example, study the relationship of self-efficacy and 'long-term' training with computational thinking, programming and entrepreneurship (Bandura, 1997; Schunk, 1995, as cited in Schunk, Pajares, 2002; Pintrich & Schunk, 1995, as cited in

Pajares, 2001). These studies suggest that individuals' self-efficacy in computational thinking, programming and entrepreneurship domains are enhanced with the help of long-term training and education (Shell et al., 2014; Feldhausen, Weese & Bean, 2018; Bean et al., 2015; Abdunabi et al., 2019; Özmen & Altun, 2014; Yükseltürk & Altiok, 2016; Askar & Davenport, 2009); Breslin, 2017; Dehghanpour, 2013; Izquerdo & Buelens, 2008; Shinnar, Hsu & Powell, 2014). The relationship between learning, training and self-efficacy, on the other hand, is that training and learnning self-efficacy are both means and tools to enhance learning, while the training is also a key determinant for self-efficacy and self-efficacy is a key factor for performance, which is expected to get better after the learning occurs (Gist, Schwoerer & Rosen, 1989).

Figure 1.2. The Relationship Between Training, Learning, SE and Performance

Self-efficacy is also viewed as a decisive factor for performance and achievement in computational thinking, programming and entrepreneurship domains as well. Higher self-efficacy is proven to result in better performance for students and teachers in these domains. The research has, therefore, focused on identifying and uncovering techniques to enhance individuals' self-efficacy in these domains, while the ultimate way is seen as training and education.

Research suggests that training – mostly long-term – enhances self-efficacy in computational thinking, programing and entrepreneurship and it is an encouraging insight about the topic. However, the research seems to have failed to investigate the impact of a "short-term" training on self-efficacy in these domains, while short-term trainings in these domains are quite common. The encouraging insight about the trainings in these domains and the part the research failed to investigate were definitely motivating factors for this study.

1.2.7. Applied Entrepreneurship and Informatics Training for Youth Project

This study was conducted as a part of Applied Entrepreneurship and Informatics Training for Youth Project, which was collaboratively held by Turkish National Agency, Erasmus+ Programme and METU CEC for the good of the students and teachers. The training was designed and given by METU CEC and was going to include instructions/courses (See Table 3.2*)* that have been mapped to computational thinking, programming and entrepreneurship nonetheless. The researcher, however, had the option to study self-efficacy in only one or two of these domains but chose to study all three because of the aforementioned reasons and motivations. Please note that you can find more info about Applied Entrepreneurship and Informatics Training for Youth Project in Chapter 3: Methodology.

1.2.8. Summary

2019 offers a world where the nations are living in an internationalized economy that is primarily based on information technology. Students and teachers are expected to become ‘21st Century individuals’ and have competency in domains such as computational thinking, programming and entrepreneurship. These three domains are proven to be enhanced with relevant training. That is, relevant training is proven to enhance performance and outcomes of an individual in these domains. Another concept that plays a role in performance in these domains is self-efficacy, which is also proven to be enhanced with training and proven to enhance performance in computational thinking, programming and entrepreneurship.

The curriculums are lacking courses and programs related to these domains and students and teachers are left behind in having a chance to be successful in 21st century conditions. For many, the solution is to implement long-term programs and courses, which are proven to be working, as several studies suggest. However, policymakers and schools do not seem to be completely drawn into these ideas; that of implementing long-term training and educational courses to enhance these skills. Moreover, the time is generally a constraint in many cases; a constraint almost impossible to overcome.

A well-planned, shot-term training can be regarded as an important alternative here, when it is hard to draw schools and policymakers into these radical – yet necessary – changes and when the lack of long-term commitments and time are constraints. That is why many organizations are holding trainings and events to increase individuals' self-efficacy in these domains with the short-term trainings and interventions they design. The impact of these trainings, however, has not been investigated or studied, let alone thoroughly understood or elaborated on.

Last but not least, the current research almost exclusively focuses on a long-term training – generally a semester-long or academic year long courses and programs – and, studies about the impact of a short-term training is limited to none. Besides, these studies have mostly focused on skills enhancements rather than self-efficacy enhancements.

Clearly, there is a need to investigate the possible positive impact of a short-term training on student and teachers self-efficacy in computational thinking, programming and entrepreneurship. Applied Entrepreneurship and Informatics for Youth Project provided the optimal settings and a chance to make this investigation possible and the researcher seized the opportunity and would like to thank the related parties once again.

1.3. Purpose of the Study

The primary purpose of this study is to investigate the possible positive impact of a short-term training on student and teacher self-efficacy in computational thinking, programming and entrepreneurship, by comparing pre and post intervention mean scores of both students and teachers. Furthermore, the study also aims to understand and reveal whether a short-term training would have a different impact on student and teacher self-efficacy in computational thinking, programming and entrepreneurship, by comparing posttest scores of students and teachers, provided that there is no statistically significant difference between pretest scores of these two groups. Lastly, the study also aims to examine whether students and teachers would sustain their self-efficacy in computational thinking, programming and entrepreneurship any differently than one another, provided that their posttest scores are not significantly different.

1.4. Significance of the Study

The fact that it is currently not known how a short-term training would affect student and teacher self-efficacy in computational thinking, programming and entrepreneurship; three crucial 21st century domains, was an important reason for this study. This study will provide insight about the impact of a short-term training on these domains to these originally separate yet related research topics/domains.

Another important reason for this study is that it is also not known whether the same short-term training with same instructors and settings would have a different impact on students and teachers. The study will provide a critical insight about this to educational research, as well as to the those who plans to prepare a similar training in these domains, for students and teachers. The study will also provide insight about sustainability of self-efficacy after a short-term training so that those who might need or want to plan a short-term training for a similar objective has information about the way self-efficacy is retained in these domains Besides, the study will offer an insight about the impact of the short-term training-based programs, workshops and seminars on participants; students and teachers in this case. Moreover, this study will provide information and insight for those who want or need to plan a training – a short-term training for that matter – for students and teachers about computational thinking, programming and entrepreneurship or any related and close topics/domains. Finally, the study will provide information for those who might want to act towards starting to develop a 21st century skilled students and teachers, and consequently 21st century individuals and society.

1.5. Research Questions

Research questions are divided into four parts as,

a. Students,
b. Teachers,
c. Students vs. Teachers: Change/Increase in Mean Scores,
d. Students vs. Teachers: Sustainability of Self-efficacy

to make the analysis and the presentation of results clearer and more coherent. This structure will be used while presenting the results and recalling the research questions.

First, “Students” part focused on examining change in student self-efficacy in computational thinking, programming and individual entrepreneurship, after the short-term training. Second, “Teachers” part focused on examining the change in teacher self-efficacy in computational thinking, programming, and individual entrepreneurship, after the short-term training. Third, “Students vs. Teachers: Change/Increase in Mean Scores” focused on investigating whether the change in self-efficacy for these domains occurred any differently for students and teachers or not.

Last, “Students vs. Teachers: Sustainability of Self-efficacy” focused on investigating whether one of the groups retained their self-efficacy in these domains any different than the other. Please find the research questions below, listed and as categorized under the parts discussed and explained above.

Part 1: Students

1. Is there a significant difference between students' pretest and posttest computational thinking self-efficacy mean scores after the short-term training?
2. Is there a significant difference between students' pretest and posttest programming self-efficacy mean scores after the short-term training?
3. Is there a significant difference between students' pretest and posttest entrepreneurship self-efficacy mean scores after the short-term training?

Part 2: Teachers

4. Is there a significant difference between teachers' pretest and posttest computational thinking self-efficacy mean scores after the short-term training?
5. Is there a significant difference between teachers' pretest and posttest programming self-efficacy mean scores after the short-term training?
6. Is there a significant difference between teachers' pretest and posttest entrepreneurship self-efficacy mean scores after the short-term training?

Part 3: Students vs. Teachers: Change/Increase in Mean Scores

7. Are the changes in students' and teachers' computational thinking self-efficacy mean scores significantly different from each other?
8. Are the changes in students' and teachers' programming self-efficacy mean scores significantly different from each other?
9. Are the changes in students' and teachers' entrepreneurship self-efficacy mean scores significantly different from each other?

Part 4: Students vs. Teachers: Sustainability of Self-Efficacy

10. Do students and teachers sustain their computational thinking self-efficacy scores significantly different from each other?
11. Do students and teachers sustain their programming self-efficacy scores significantly different from each other?
12. Do students and teachers sustain their entrepreneurship self-efficacy scores significantly different from each other?

1.6. Assumptions

The following assumptions are held to be valid for this study:

1. All the items in the scales were answered honestly, sincerely and accurately by the participants.
2. All the data collection and recording were conducted accurately and correctly.
3. Data analysis was conducted correctly and accurately.
4. The research, data collection, data analysis, findings and implications from the study represented the "good research".

1.7. Limitations

1. As the reliability of the scales used in the study, and honesty, sincerity, and accuracy of the participants played a decisive role in findings of the study, the validity of the study is limited to these aspects listed.
2. Another limitation was that the scales of the study were originally tested for reliability and validity (all proven valid and reliable) with participants in different age intervals, mostly with teenagers; however, they were used with teenagers (students) and young adults (teachers) in this study.
3. Even though instructors and content were the same for both groups (students and teachers) in the study, instructors' day-to-day performance may have affected participants' attitude and classroom performance, which may in turn have affected participants' self-efficacy perceptions.

1.8. Delimitations

1. Although the study employed the scales from studies conducted with teenagers and college students and used it with young adults, the mean age for this group (teachers) was around 27.

2. The study employed the scales from studies conducted with teenagers and included a rather young group of participants as the mean age was around 20, overall.

1.9. Definition of Terms

There are variety of definitions in the academic literature and grey literature for the terms listed below. This study accepts the following definitions to be quintessentially the most accurate, based on the comprehensive analysis of the literature.

Self-Efficacy: Individual's belief(s) about his/her abilities and skills to produce certain, desired levels of performance in a given endeavor (Bandura, 1994).

Computational Thinking: Thinking computationally; using logic, algorithms, analytics to solve large problems and/or designing complex systems (Wing, 2006).

Programming: The process/domain that includes problem-solving, abstraction, mathematical logic, testing and debugging skills (Saeli et. al., 2011)

Entrepreneurship: The term/domain that was first introduced by the early French economist Richard Cantillon and defined as "to anticipate an opportunity and to create a venture to capture that opportunity" (Mueller & Thomas, 2001).

1.10. Conclusion

This chapter of the study discussed the three important 21st Century domains (CT, PR, EN) and self-efficacy in these domains, presenting the background of the study, along with the problem statement. The chapter also elaborated on the purpose and significance of the study, and introduced the research questions, limitations, delimitations and definition of terms. Next chapter, Chapter 2 is the review of the literature, in which related literature is presented and discussed along with implications.

CHAPTER 2

LITERATURE REVIEW

2.1. Overview

The main purpose of this study was to understand/investigate the impact of a short-term training on student and teacher self-efficacy in computational thinking, programming and entrepreneurship. The purpose of this literature review, therefore, was to determine what research there was about the ways and the levels that a training – long-term and/or short-term – enhances/impacts student and teacher self-efficacy in computational thinking, programming and entrepreneurship. Please refer to the figure below to see the approach used in the review.

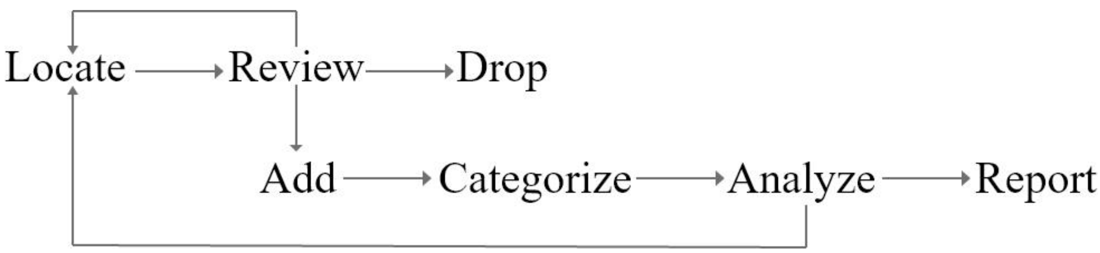

Figure 2.1. Literature Review Approach of the Study

The review was based on a structured approach to locate, review, drop or add, categorize, analyze and report information from the related literature and it included a wide range and variety of sources such as e-databases and e-journals. Relevant studies were primarily located via keyword search and any related study was added to the pool to be reviewed. If the review proved a study irrelevant for the study, the study was dropped and was not added to the pool. The studies and papers in the pool were then thoroughly reviewed again by their abstracts and via a quick read-trough and was categorized. Categorization was done based on their primary topic, which would be the concept of self-efficacy itself and self-efficacy in computational thinking, self-efficacy in programming and self-efficacy in entrepreneurship. In the meantime, initial review helped locate new possibly relevant studies and these studies, too, were included in this process. Each relevant study led to many other studies as their references were reviewed as well, until it was self-evident that the same studies kept showing up. This process continued until after the pool was saturated enough and keyword search did not bring up new additions. The studies were then read and analyzed after an extensive number of relevant articles were available for each topic. It should also be noted that analysis phase helped locate new possibly relevant studies as well, in several occasions.

Therefore, as the primary focus of this study was to provide an insight about how a short-term training would impact student and teacher self-efficacy in computational thinking, programming and entrepreneurship, this literature review did focus on reporting from its predecessors which studied the impact of training on computational thinking self-efficacy, programming self-efficacy and entrepreneurship self-efficacy, as well as from those that studied how to enhance student and teacher self-efficacy in computational thinking, programming and entrepreneurship. This review also focused on identifying and reporting from the research that studied the concept of self-efficacy in educational context, the relationship between the concept of self-efficacy and computational thinking, programming and entrepreneurship and the relationship between self-efficacy and training, since the concept of self-efficacy and a short-term training have formed the base of this study and its design.

The review starts by explaining self-efficacy, its employment in the educational context and research, and then in computational thinking, programming and entrepreneurship research. Along the way, these three domains are also comprehensively elaborated on and explained, after which the literature review is concluded with implications.

2.2. Self-Efficacy

Bandura (1977) introduced the concept of self-efficacy several decades ago, as a part of his Social Cognitive Theory. Bandura (1994) defined it as one's belief(s) about his/her capabilities to produce designated levels of performance in a given endeavor. The concept is thought to be major factor in determining the ways people think and feel about themselves and how they motivate themselves and in positively affecting the results they produce in their endeavors (Bandura, 1994).

Results show that higher levels of self-efficacy and a positive mental model are crucial to acquire and transfer knowledge (Ramalingam, Labelle & Wiedenbeck, 2004). Therefore, the [positive] impact of self-efficacy on outcomes and performance of an individual is widely accepted. That is, as many studies also report, individuals with high self-efficacy are expected to produce better results and outcomes in their endeavors and domains, (Tschannen-Moran, Hoy & Hoy 1998; Zimmerman, 2000); Skaalvik & Skaalvik, 2007). The concept of self-efficacy is also believed to be affecting many areas and aspects of an individual's life, other than the performance in the given endeavor or domain. As Bandura (1994) puts it, a strong sense of efficacy increases one's achievements and improves their well-being in many ways (p. 1). In addition, self-efficacy plays a role in increasing motivation of an individual as a result of the task engagement, the level of which is also mediated by self-efficacy in that task (in that endeavor or domain). Schunk (1995) explains this on a figure (Figure 2.2) as shown below.

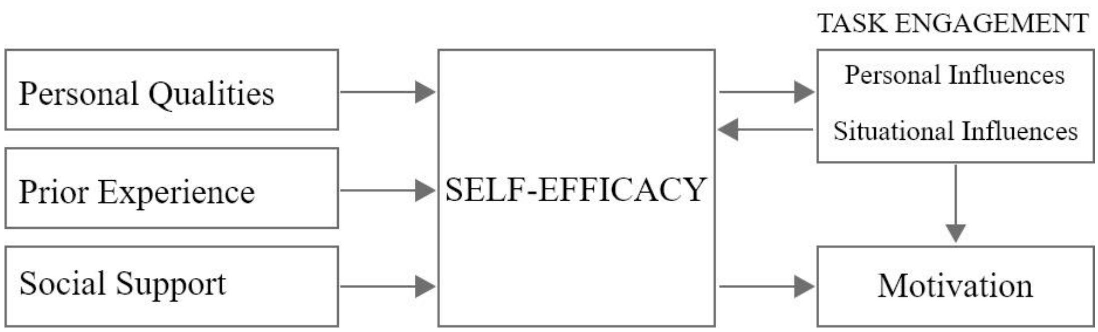

Figure 2.2. The Role of Self-Efficacy in Motivation (Schunk, 1995).

At the beginning of an activity, the individuals may differ in terms of their self-efficacy in that given domain. That is, their belief(s) in their capabilities and abilities to learn and perform a task are at different levels. Students, for example, generally differ in self-efficacy in the educational settings in the extent they are encouraged to develop related skills, their access to resources (materials and facilities) necessary to learn those skills are enhanced and they are taught self-regulatory strategies that facilitates skill acquisition and refinement (Ericsson, Krampe, & Tesch-Romer, 1993, as cited in Schunk, 1995). Teachers, on the other hand, generally differ in self-efficacy in an academic setting, primarily based on their proficiency of the subject and their experience.

An individual’s self-efficacy in a given domain is formed by his personal qualities, prior experience and social environment. When the individual engages with a task related to the given domain, this engagement is expected to turn in to motivation and add up to individual’s self-efficacy, which in turn is expected to turn into motivation to engage in similar and challenging tasks in the given domain. When task engagement in a given domain is planned as a supervised training, training becomes an important influence on self-efficacy and performance at the same time, as training leads to improved performance, and better performance leads to higher self-efficacy in that domain. A higher level of self-efficacy, then, in turn, motivates the learner to engage even more eagerly, show even more effort and persistence when he/she encounters difficulties and consequently perform even better. Therefore, we can talk about a continuous, complementary relation between these three concepts (self-efficacy, training and motivation).

Of course, although self-efficacy is a crucial determinant for performance and achievement, it is, not surprisingly, not the only influence. Background knowledge and prerequisite skills are other influences, for instance. It is also true that no amount of self-efficacy in an endeavor will produce a quality performance when requisite skills and knowledge are lacking (Schunk & Pajares, 2002). As self-efficacy alone will not guarantee a quality performance and higher achievement itself alone, training, too, is not the only influence on self-efficacy. Previous experiences and background knowledge are other factors that play a role in determining one's self-efficacy (Schunk & Pajares, 2002).

2.2.1. Self-Efficacy in Educational Context

In the educational context, self-efficacy is referred as students' and teachers' beliefs in their capabilities to become proficient at new skills and tasks, generally in an academic domain (Pajares & Miller, 1994; Meral, Çolak & Zereyak, 2012). It is justifiably expected that a student with a higher level of self-efficacy [in an academic/education topic/domain] will perform better in an academic domain than a student who does not (Bandura, 1994). Bandura (1994) explains this by stating that students' "beliefs in their capabilities to master academic activities affects their aspirations, their level of interest in academic activities, and their academic accomplishments (p.12). [Academic] self-efficacy is therefore hypothesized to impact learner's choices of tasks, the effort and persistence the learner shows against the challenges and consequently the achievement (Bandura, 1997; Schunk, 1995). Expectedly, learners who have higher self-efficacy for learning and performing a task, participate in the related activities more eagerly, work harder, show more persistence in the face of challenges and produce and achieve more, compared to those who distrust their capacity and competence for learning (Schunk & Pajares, 2002).

The same verdict applies to teachers as well, that is, teachers' own self-efficacy, too, has an impact on their performance, the same way it is for students. However, there is also another aspect of teacher self-efficacy, since, as Bandura explains (1994), teachers with higher levels of self-efficacy about their teaching capabilities are able to "motivate their students and enhance their cognitive development" (p.12), which means that teachers self-efficacy does not only affect their own performance and outcomes but also students' performance and outcomes as well. Thus, while student self-efficacy affects student performance only, teacher self-efficacy has an impact both on teacher’s and student’s performance. Researchers explain this stating that the teachers with high self-efficacy create mastery practices for the students and positively affect student performance, whereas, teachers with low self-efficacy undermine students' cognitive development and their judgements of their own capabilities (Gibson & Dembo, 1984; Cohn & Rossmiller, 1987, as cited in Bandura, 1994), consequently the performance. Educational society has therefore been concerned with improving both student and teacher self-efficacy in the academic context, ever since Bandura (1997) introduced the concept of self-efficacy and after self-efficacy received an ever-growing attention in educational research (Pintrich & Schunk, 1995, as cited in Pajares, 2001).

2.2.2. Student Self-Efficacy

Student self-efficacy has long been accepted as an important factor in determining student performance. As learners, students use information they attain from their performances, experiences, the interaction they have with others and persuasions they receive from them, and their psychological reactions (Meral, Çolak & Zerayak, 2012) to assess their self-efficacy and self-efficacy beliefs they hold about themselves, which in turn, influence the tasks they choose, their effort, persistence, resilience, and achievement and performance (Bandura, 1997; Schunk, 1995). In fact, Ramalingam et al. (2004) and Lishinski et al. (2016) affirmed that self-efficacy is the strongest predictor of student performance in academic settings.

In their study, Ramalingam et al. (2004) found that (a) self-efficacy provides significant clues about student’s future performance, (b) students experience a significant gain in self-efficacy from pre-training to post-training after an introductory programming course and (c) student self-efficacy and student performance are correlated (as cited in Feldhausen et. al., 2018).

Vancouver et al. (2002), on the other hand, argued that high level of self-efficacy may lead to overconfidence in students, which increases the likelihood of committing errors during performance (p. 506), after they studied the relationship between self-efficacy and performance with 104 undergraduate students. Nevertheless, a higher level in student self-efficacy is thought to result in better student performance, research suggests (Meral et al., 2012; Ramalingam et al., 2004). Moreover, not only students with high levels of self-efficacy tend to perform better in given tasks, but also, they tend to be involved in challenging tasks and spend more effort and show more perseverance (Bong, 2004; Pajares, 2001).

2.2.3. Teacher Self-Efficacy

Bandura (1997) refers teacher self-efficacy as teachers' beliefs about their ability to positively influence student performance and outcomes (as cited in Aurah, McConnell, 2014, p. 233). Same as student self-efficacy, teacher self-efficacy has also been accepted as an important factor on teacher performance in academic settings. Since, however, teacher performance has an impact on student performance as well, teacher self-efficacy has an impact primarily on student self-efficacy and consequently on student performance. Please refer to the figure and paragraph below for more details about the relationship between teacher self-efficacy and student performance.

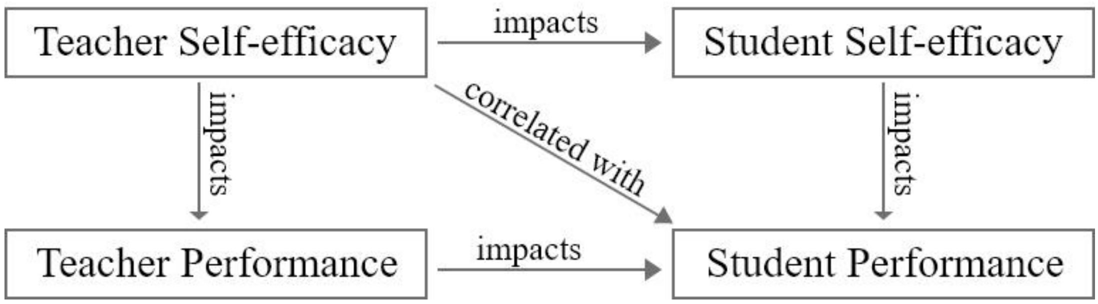

Figure 2.3. The Relationship Between Teacher SE and Student Performance

Considerable number of studies associates teacher self-efficacy with student outcomes such as self-efficacy, motivation and achievement (Anderson, Greene, & Loewen, 1988; Ashton & Webb, 1986; Midgley, Feldlaufer, & Eccles, 1989; Ross, 1992, as cited in Tschannen-Moran, Woolfolk & Hoy, 2007). Findings also suggest that teachers' self-efficacy levels about their domain knowledge and instructional skills are correlated with students' academic performance and achievements (Ashton, Webb, 1986, as cited in Pajares, 2001; Aurah, MacConnell, 2014). Unlike students self-efficacy, therefore, teacher self-efficacy is a key determinant both in teacher and students performance, research suggests.

2.2.4. Self-Efficacy as a Part of This Study

Having a saturated literature of its own, self-efficacy has been studied with variety of domains in educational and academic research. Computational thinking, programming and entrepreneurship are three of those domains that were subjects to many studies about the concept of self-efficacy. For the remaining portion of this literature review, therefore, these domains will separately be elaborated on about the way they were studied with the concept of self-efficacy.

On the other hand, although this review has taken an approach that focused on elaborating on these concepts separately for that it was dictated by the research design and it was the ideal way to provide a clearer understanding of these concepts, this study recognizes that these concepts are, nevertheless, related, as discussed in detail in Introduction chapter. Computational thinking and programming are directly linked as computational thinking is thought to be a crucial prerequisite for programming and as programming enhances computational thinking and although an entrepreneur does not necessarily have to know how to program to be recognized as an entrepreneur or to be a successful one, it is hard to picture and recognize an entrepreneur, in 2019, who lacks computational thinking skills and would not benefit from programming and computational thinking to create a new venture to solve 21st century problems.

Lastly, as stated at the very beginning of this review, the primary purpose of this study was to provide an insight about the impact of a short-term training in student and teacher self-efficacy in computational thinking, programming and entrepreneurship. These three domains and the concepts of computational thinking self-efficacy, programming self-efficacy and, entrepreneurship self-efficacy will therefore be discussed respectively in the following sections, where the findings of the research will be presented and discussed.

2.3. Computational Thinking and Computational Thinking Self-Efficacy

The term "computational thinking" was first used by Papert (1996) who had not provided a clear definition of his own at the time, and it was not until after when Wing (2006) argued that "computational thinking is a skill for everyone, not just for computer scientists", that the term started to gain attention in academic research and in educational society. Fast forward to 2019 and "computational thinking", as a domain, has its own literature, although quite away from being saturated enough, interacting with concepts and topics such as learning, problem-solving, data science, programming, modeling and self-efficacy.

As Bocconi et. al (2016) pointed out, starting with the short paper by Wing (2006), studies and articles concerning computational thinking has continuously increased in numbers, having reached more than 500 papers in the academic and grey literature combined as both the educational society and policy-makers seemed to be understanding the importance of it in an individual's development. Besides, the concept has influenced research in many disciplines, both the sciences and the humanities (Bundy, 2007). Majority of these studies, though, had to deal with "what", "why", and "how" for computational thinking since the term should have been defined, the people should have been convinced why and how computational thinking is valuable (Wing, 2006; Bundy, 2007; Wing, 2008; Aho, 2011).

Wing (2006) defined it as “using abstraction and decomposition when attacking a large, complex task or designing a large, complex system” (p. 33), and furthered this definition by stating that “computational thinking involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science” (Wing, 2006, p. 33). Arguing that there is a need for clearer definitions, Aho (2011) defined computational thinking as “the thought processes involved in formulating the problems, so their solutions can be represented as computational steps and algorithms” (p. 832). He also stated that mathematical abstractions are at the center of computation and computational thinking (Aho, 2011, p. 834). While there were also researchers who argued that computational thinking does not have a clear-cut definition (Hu, 2011), Wing (2011) revisited the topic and wanted to clarify that “Computational thinking is the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer—human or machine—can effectively carry out.” (p. 8), which seemed to be an improved and more coherent definition.

While the studies about the definitional issues of computational thinking is quite frequent, research about the integration of computational thinking in educational context is limited (Wilson & Guzdial, 2010; Voogt et al., 2015). Majority of the studies that have computational thinking in its focal point mostly elaborate on the issues about its definition, understanding, and the ways that enhance computational thinking development (Grover & Pea, 2013) when it may long have been time for the concept to be practically and extensively assessed.

Noticing this, computational thinking research seems to then have turned its attention to being able to assess and enhance computational thinking in individuals. The researchers first focused on developing new frameworks to assess computational thinking and identifying the factors that affect the computational thinking self-efficacy (Hutchison et al., 2006; Brennan & Resnick, 2012). Then, they undertook the missions to develop instrumentation to be able to accurately assess computational thinking

(Korkmaz, Çakır & Özden, 2017; Gülbahar, Kert & Kalelioğlu, 2018). After the studies took a practical approach about computational thinking, the research started to revolve around how to increase student and teacher self-efficacy for computational thinking, for that self-efficacy was proven, by variety of studies, to be an important factor to teach and enhance computational thinking in individuals (Wener, Denner & Campe, 2012; Korkmaz, Çakır & Özden, 2017; Shell, et. al., 2014)

Shell et. al. (2014), for example, reported that students had significantly higher computational thinking self-efficacy scores after the implementation of computational creativity exercises in an introductory course for an entire semester, compared to the students in a different class of the same introductory course. Similarly, Feldhausen, Weese and Bean (2018) stated that, in their longitudinal study which included weekly 3 hours of intervention for 2 summers, they observed statistically significant gains in computational thinking self-efficacy of students by engaging participants in creating computer programs that perform a variety of operations (p. 305).

In another study, Weese and Feldhausen (2016) reported that two novel interventions of 3 months applied to 5th and 9th graders provided strong improvements in student computational thinking self-efficacy. Likewise, Bean et al. (2015) stated that "the intervention strategy of providing pre-service teachers with mastery experiences of using computational thinking embedded within other subject areas was clearly successful in increasing their self-efficacy" (p. 7).

2.4. Programming and Programming Self-Efficacy

Programming has been one of the most crucial proficiencies for the last several decades. As an expertise, it involves skills such as problem-solving, abstraction, mathematical logic, testing and debugging (Saeli et. al., 2011, as cited in Govender et. al., 2014). Given the fact that global demand for computer literate engineers has constantly increased for the last several decades, it was expected that discerning the factors that affect an individual' ability to acquire computer programming skills became crucial (Askar & Davenport, 2009) for the programming research.

The research has therefore focused on explaining why an individual learned to program better than another and several studies suggest that past experiences, individual characteristics and internal factors such as self-efficacy and self-belief of an individual in his/her own competency for programming, possibly play a decisive role in levels the individual will struggle and in his/her ability to overcome those struggles (Askar & Davenport, 2009; Pajares, 1996) faced while learning programming. Several other studies have mentioned the successes and struggles the learners experienced in introductory level programming courses and programs (Govender & Govender, 2012; Kinnunen & Simon, 2012). Programming, as a domain, therefore, has been studied substantially in variety of ways and related concepts in educational research (Askar & Davenport, 2009; Govender et. al., 2014, Davidsson, Larzon & Ljunggren, 2010; Emurian, 2004; Abdunabi, Hbaci & Ku, 2019). One of the most prominent of those concepts has been self-efficacy, which many accepts as an impactful factor for learning to program.

Abdunabi et. al. (2019), for example, reported that IS students who are able to program at a competent level interestingly have medium-level programming self-efficacy, and that valuing programming is related to higher programming self-efficacy and this could be increased by employing extra classroom activities in programming courses. Another interesting finding from the study of Abdunabi et. al. (2019) was that "the time spend to practice programming does not correlate with higher programming self-efficacy" (p. 199), which in fact is in contrast with what Özmen and Altun (2014) found in their study. Özmen and Altun (2014) stated that there is a relation between the time spent practicing programming and programming self-efficacy. However, Ramalingam, Labelle and Wiedenbeck (2004) showed that programming self-efficacy is affected by programming background and that it increases as a student proceeds through an introductory level programming course. While there are also other studies that primarily focus on effectively measuring students' self-efficacy levels for programming (Korkmaz & Altun, 2014), a considerable amount of the research examines the ways to increase student and teacher (of an individual) self-efficacy and its relationship with the programming performance, considering the fact that higher programming self-efficacy is thought to be an important factor when learning to program and improving at it (Govender et. al., 2014; Davidson, Larzon & Ljunggren, 2010; Emurian, 2004; Davenport & Askar, 2009; Abdunabi, Hbaci & Ku, 2019; Jegede, 2009).

Govender et. al. (2014) stated that one way of increasing programming self-efficacy in students would be explicitly teaching "problem-solving" to the students and reported that problem-solving was shown to have benefits in increasing programming self-efficacy. Özyurt and Özyurt (2015) examined student attitude and self-efficacy towards programming and the relationships between them and reported that students had a medium-level programming self-efficacy and it varied statistically significantly by gender, grade and education type. On the other hand, Davidson et. al. (2010) reported that the re-design of an introductory programming course had no positive effect on students' programming self-efficacy, in terms of self-regulation. Still the majority of the research offered encouraging results. From a 14 week, 3-h weekly sessions study, Emurian (2004) reported that programming self-efficacy increased from pre-tutor, which was given at the beginning of the training, to post-tutor, which was done after the training was completed. Similarly, Yukselturk and Altiok (2016) found that programming self-efficacy significantly increased in almost all the complex programming tasks for prospective [ICT] teachers after an academic year long elective course that taught programming with Scratch. Their results also showed that prospective teachers' "negative attitude towards programming decreased significantly" (Yukselturk & Altiok, 2016, p. 1). Likewise, Askar and Davenport (2009), for example, studied the factors that affect programming self-efficacy in university students and reported that university students with higher computer usage rates and experience has a higher level of self-efficacy in programming.

2.5. Entrepreneurship and Entrepreneurship Self-Efficacy

Entrepreneurship, throughout its academic research history, have received a variety of interpretations and definitions offered by many scholars and researchers from multiple disciplines such as anthropology, psychology, sociology, economics, management and technology (Vaziri, Hosseini & Jafari, 2014). The word "entrepreneur" actually has its roots in French and German, as it originates from the French verb "entreprendre" and the German verb "unternehmen", both of which can be translated into English as "undertake" (Vaziri, Hosseini & Jafari, 2014) and the term "entrepreneurship" is introduced for the first time by the early French economist Richard Cantillon, who defines it as self-employment of any sort where the entrepreneur endures uncertainty and risks (Vaziri, Hosseini & Jafari, 2014). Mueller and Thomas (2001), on the other hand, defines entrepreneurship as "to anticipate an opportunity and to create a venture to capture that opportunity" (as cited in İncik & Uzun, 2017).

Entrepreneurship education outrank many other domains in strategic plans of policymakers in Europe and United States of America (Graevenitz, Harhoff & Weber, 2010) and that's why entrepreneurship has had to expand as an academic discipline. As the entrepreneurship has progressed as an academic discipline over the past several decades, so has expanded the courses, seminars and programs about entrepreneurship in universities and professional organizations (Peterman & Kennedy, 2003; Dickson, Solomon & Weaver, 2008; Katz, 2008). The main reason for this expansion was the presumption that entrepreneurship education can help individuals develop entrepreneurial abilities and skills, and consequently intentions to create new ventures. The research then has focused on studying how entrepreneurship education would make a difference and several researchers have provided useful insight about the topic (Mitra & Matlay, 2004; Kuratko, 2005; Neck & Greene, 2010).

While there were studies that suggested entrepreneurial intentions are positively affected by entrepreneurship education (Pittaway & Cope, 2007), the impact of entrepreneurship education in individuals' entrepreneurial intentions remained uncertain in several cases (Souitaris, Zerbataini & Al-Laham, 2007; Walter, Parboteeach, & Walter, 2011). This required a closer look at the effects of entrepreneurship education and the way it interacts with entrepreneurship self-efficacy (Wilson, Kickul & Marlino, 2007)

Zhao, Seibert and Hills (2005), for example, showed that entrepreneurship self-efficacy comprehensively mediates the learning from these entrepreneurship courses and programs. Therefore, it is rational to state that, similar to the relationship between the concept of self-efficacy and computational thinking and also programming, entrepreneurial self-efficacy was also proven to play an important role in developing entrepreneurial intentions in individuals (Boyd & Vozikis, 1994; Piperopoulos & Dimov, 2015) and is seen as a crucial determinant of entrepreneurial characteristics (Krueger, Reill & Carsrud, 2000; Segal et.al., 2005, as cited in Breslin, 2017) as it affects what and how much an individual learns from an entrepreneurship course and program (Zhao et al., 2005).

Different than computational thinking and programming, though, entrepreneurship self-efficacy is also related to personal aspirations of the individual, research suggests. Pihie (2009) found that students with positive entrepreneurial aspirations tend to have significantly more entrepreneurial self-efficacy compared to those who do not (p. 338). For Markham, et. al. (2002), for example, it is the perception of self-efficacy, rather than the objective ability or capabilities that motivates people to exhibit entrepreneurial intentions and behaviors (as cited in Pihie, 2009, p. 338). On the other hand, entrepreneurial self-efficacy is also thought to be affected by circumstantial factors like education, training, and past experiences, unlike other entrepreneurship attributes (Hollenbeck & Hall, 2004).

Concerning the role of education and training or education, several empirical studies support that entrepreneurship education and programs have a positive impact on individuals developing entrepreneurial intentions (Tkachev & Kolvereid, 1999; Fayolle et al., 2006, as cited in Harhoff & Weber ,2010, p. 3). When it comes to how to enhance an individual's entrepreneurship self-efficacy, plenty of researchers and scholars recommended and assessed the employment of training as an intervention (Baughn et al., 2006; Cox, Mueller, & Moss, 2002; Erikson, 2002; Florin et al., 2007, as cited in McGee et al., 2009; Wilson et al., 2007). Wilson et al. (2007), for example, noted that a well-constructed entrepreneurship [training] program should give the student a practical insight of what it takes to start a new venture as well as improve the student's self-confidence level, and consequently entrepreneurial self-efficacy.

Lucas and Cooper (2004), from their study which included a one-week event designed to influence underlying motivations of potential entrepreneurs, reported that the increase of entrepreneurial self-efficacy resulted in the increase of entrepreneurial intentions. Similarly, Breslin (2017) reported that individuals "experienced an increase in [entrepreneurial] self-efficacy, with a knock-on impact on entrepreneurial intentions" (p. 38), after 10 weeks of intervention that had them work their ideas. From a research conducted with 601 participants, Dehghanpour (2013) reported that completion of one entrepreneurship course boosts the possibility of developing entrepreneurial intentions in adults by helping increase their entrepreneurial self-efficacy. Izquerdo and Buelens (2008), likewise, found that entrepreneurial self-efficacy, and consequently the entrepreneurial intentions of students showed significant increase after they were exposed a semester-long entrepreneurship course. Shinnar, Hsu and Powell (2014), supported this with evidence from their study and stated that a semester long entrepreneurship course has significantly increased students entrepreneurial self-efficacy and that entrepreneurial self-efficacy and entrepreneurial intentions are correlated.

2.6. Summary

Higher self-efficacy almost always results in better performance in many domains (Bandura, 1994). Whether this would be valid for students and teachers in computational thinking, programming and entrepreneurship has been an important research topic for the researchers for the last several decades. Therefore, majority of the research available in the literature seems to have focused on the relation between the self-efficacy and the performance for computational thinking, programming and entrepreneurship (Hutchison et al., 2006; Werner, Denner & Campe, 2012; Korkmaz, Çakır & Özden, 2017; Piperopoulos & Dimov, 2015; Boyd & Vozikis, 1994; Askar & Davenport, 2009; Özmen & Altun, 2014; Korkmaz & Altun, 2014). There are studies that report that self-efficacy performance relationship is valid for students and teachers in domains such as computational thinking (Shell, et al., 2014; Feldhausen, Weese & Bean, 2018; Feldhausen & Weese, 2016), programming (Govender et al., 2014, Davidsson, Larzon & Ljunggren, 2010; Emurian, 2004; Abdunani, Hbaci & Ku, 2019) and entrepreneurship (Lucas & Cooper, 2005; Breslin, 2017; Dehghanpour, 2013).

The results are mostly quite encouraging in terms of the importance of training in enhancing self-efficacy. However, the research almost extensively studied only the impact of a "long-term training" – generally a semester or academic year long – on student and teacher self-efficacy in computational thinking, programming and entrepreneurship, but failed to investigate the impact of a short-term one, even though short-term trainings are also common. There are also studies that focused on the type of the training rather than the duration of it, trying to come up with frameworks and ideas to better increase self-efficacy in computational thinking, programming, and individual entrepreneurship (Jegede, 2009; Brennan & Resnick, 2012; Johnson, 1990).

This study, on the other hand, focuses on the impact of a short-term training on student and teacher self-efficacy in computational thinking, programming, and entrepreneurship, considering the fact that the literature has little to no evidence to provide about the self-efficacy enhancement impact of a short-term training on these domains and hypothesizing that a short-term training will have a similar, positive impact on self-efficacy in computational thinking, programming and entrepreneurship, as a long-term one.

Moreover, almost all of the studies available in the literature failed to measure sustainability of self-efficacy in these domains. That is, no study has investigated whether the individuals would sustain their self-efficacy after a certain period of time passes once the training is over. This study, on the other hand, provides insight about the sustainability of self-efficacy by investigating the possible difference between students and teachers in sustaining their self-efficacy. While measuring and reporting the sustainability of self-efficacy separately for each group was deemed unneeded, providing insight about the possible difference between students and teachers in sustaining their self-efficacy thought to be critical for the value it offers for the future research.

2.7. Conclusion

This chapter discussed the related available literature about computational thinking self-efficacy, programming self-efficacy and entrepreneurship self-efficacy and more importantly the role and impact of training on these domains, while presenting findings and pointing out the missing pieces in the related research. The chapter first introduced the review of literature about the concept of self-efficacy and then thoroughly discussed the computational thinking self-efficacy, programming self-efficacy and entrepreneurship self-efficacy domains before presenting a table about the findings from current research and summarizing the chapter with implications. Next chapter, Methodology, communicates the method used in the study; procedures, details about training and participants and instrumentation and presents the research questions.

CHAPTER 3

METHODOLOGY

3.1. Overview

The main purpose of this study is to understand how a short-term training changes and enhances (affects) teachers' and students' self-efficacy in three crucial 21^{st} Century domains:

1. Computational Thinking
2. Programming
3. Entrepreneurship

Therefore, it should be noted that, this study, and the training it includes, neither aim nor claim to increase an individual's self-efficacy or self-efficacy beliefs in any other domain but just in computational thinking, programming and entrepreneurship; although establishing self-efficacy beliefs in an influential domain such as these three domains might end up enhancing an individual's self-efficacy in overall or in a related domain. Another goal of the study was to reveal/understand if a short-term training would have a different impact on teachers' and students' self-efficacy in computational thinking, programming and entrepreneurship when the training is planned the same way and supervised by the same instructors specialized in their subjects.

Finally, the study aimed to reveal if teachers and students would sustain their self-efficacy in these domains any differently. That is, whether one group would sustain their self-efficacy in computational thinking, programming, and entrepreneurship any better than the other group was investigated. Therefore, a 2^{nd} posttest was conducted exactly two months after the first posttest, which was done immediately after the short-term training was concluded. More details to be presented about the research design in the following sub-sections. Beforehand, you may have a look at Table 3.1 and Figure 3.2. This chapter outlines the approach employed to go after the research questions of the study. The chapter provides all the details about the research questions, research design, training, instrumentation, procedures, participants, and data analysis.

3.2. Research Questions

As stated in Introduction chapter as well, research questions were divided into 4 parts as a) Students, b) Teachers, c) Students vs. Teachers: Change in Mean Scores, and d) Students vs. Teachers: Sustainability of Self-efficacy, to make the analysis and the presentation of results clearer and more coherent. The research design, the instruments used to collect the data, the training and procedures employed to carry out the research in this study were guided by the following research questions:

3.2.1. Research Questions – Students

1. Is there a significant difference between students' pretest and posttest computational thinking self-efficacy mean scores after the short-term training?

Null Hypothesis (H_0): The short-term training has no impact on student self-efficacy in computational thinking

2. Is there a significant difference between students' pretest and posttest programming self-efficacy mean scores after the short-term training?

Null Hypothesis (H_0): The short-term training has no impact on student self-efficacy in programming

3. Is there a significant difference between students' pretest and posttest entrepreneurship self-efficacy mean scores after the short-term training?

Null Hypothesis (H_0): The short-term training has no impact on student self-efficacy in entrepreneurship

3.2.2. Research Questions – Teachers

4. Is there a significant difference between teachers' pretest and posttest computational thinking self-efficacy mean scores after the short-term training?

Null Hypothesis (H_0): The short-term training has no impact on teacher self-efficacy in computational thinking

5. Is there a significant difference between teachers' pretest and posttest programming self-efficacy mean scores after the short-term training?

Null Hypothesis (H_0): The short-term training has no impact on teacher self-efficacy in programming

6. Is there a significant difference between teachers' pretest and posttest entrepreneurship self-efficacy mean scores after the short-term training?

Null Hypothesis (H_0): The short-term training has no impact on teacher self-efficacy in entrepreneurship

3.2.3. Research Questions – Students vs. Teachers: Change in Mean Scores

7. Are the changes in students' and teachers' computational thinking self-efficacy mean scores significantly different from each other?

Null Hypothesis (H_0): The short-term training does not impact student and teacher self-efficacy in computational thinking differently.

8. Are the changes in students' and teachers' programming self-efficacy mean scores significantly different from each other?

Null Hypothesis (H_0): The short-term training does not impact student and teacher self-efficacy in programming differently.

9. Are the changes in students' and teachers' entrepreneurship self-efficacy mean scores significantly different from each other?

Null Hypothesis (H_0): The short-term training does not impact student and teacher self-efficacy in entrepreneurship differently.

3.2.4. Research Questions – Students vs. Teachers: Sustainability of SE

10. Do students and teachers sustain their computational thinking self-efficacy scores significantly different from each other?

Null Hypothesis (H_0): The students and teachers do not sustain their computational thinking self-efficacy differently.

11. Do students and teachers sustain their programming self-efficacy scores significantly different from each other?

Null Hypothesis (H_0): The students and teachers do not sustain their programming self-efficacy differently.

12. Do students and teachers sustain their entrepreneurship self-efficacy scores significantly different from each other?

Null Hypothesis (H_0): The students and teachers do not sustain their entrepreneurship self-efficacy differently.

3.3. Research Design

The study relies on a quasi-experimental research design and this is because:

1. The study included 2 pre-defined groups: Students and Teachers
2. The participants of these two groups were selected from two populations, each from a population of their own.
3. The study employed purposeful sampling based on the following criteria:
    a. Students had to be high-schoolers and between 14 and 18
    b. Teachers had to be 30 or younger and min. 1-year of experience
    c. Teacher and students had to be from the same schools
4. Both groups were intervened with the same training once and for all.
5. Dependent variables were measured three times (pretest, posttest, 2nd posttest) and analyzed both "within subjects" and "between subjects"

This quasi-experimental study employs a "one-group pretest-posttest" structure for two separate groups: Students and Teachers and also includes a "2nd post-test" (2 months later) for both groups, administered exactly two months after the first post-test, which was conducted immediately after the training period was over. The table below presents the overall research design of the study.

Table 3.1. Research Design of the Study

Group	Pretest	Treatment	Posttest	2nd Posttest
Students	CTSES PRSES ENSES	Short-term Training	CTSES PRSES ENSES	CTSES PRSES ENSES
Teachers	CTSES PRSES ENSES	Short-term Training	CTSES PRSES ENSES	CTSES PRSES ENSES

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

3.4. Data Collection

As stated several times in the previous chapters and sections, data was collected both from students and teachers three times: Pretest, Posttest, and 2nd-Posttest. Below, on a figure, you can see the approach employed to collect and analyze the data.

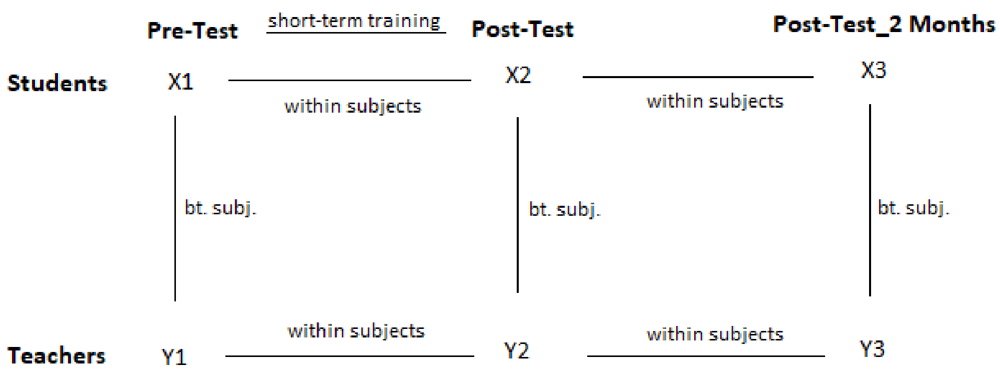

Figure 3.1. Data Collection and Analysis Approach

X1 and Y1 were collected before the training, X2 and Y2 immediately after the training period ended and X3 and Y3 exactly two months after the end of the training. Between X1 – X2 and Y1 – Y2, the change in mean scores of both students and teachers were analyzed using Paired Samples t-test, separately for each group, for each domain: Computational Thinking, Programming and Entrepreneurship. After making sure that the groups' (students & teachers) pretest mean scores were not significantly different from each other, Independent Samples t-test was run on X1-X2 and Y1-Y2 for each of the three domains, to understand whether the training impacted one group's self-efficacy in these domains any different than other's. Lastly, again Independent Samples t-test was used to analyze the data (X3 – Y3) to see whether one group sustained their self-efficacy in these domains any different than the other, after making sure that the groups' posttest mean scores (X2-Y2) were not significantly different from each other. Please find the details about the scales used to collect the data, in "Instrumentation" section below.

3.5. Training

Social Cognitive Theory states that self-efficacy in a domain is formed and enhanced in four ways: (1) mastery experiences, (2) vicarious experiences (observational experiences), (3) persuasion by subjective norms, (4) physiological states (reducing stress) (Wood & Bandura, 1989; Bandura, 1994).

Based on Social Cognitive Theory,

1. a relevant training (mastery experience)
2. done in a social learning environment (observational experience)
3. by instructors with persuasively quality and relevant skills (subjective authority)
4. where the learners are not expected to perform for a high-pressure end (reduced stress)

then could enhance self-efficacy in computational thinking, programming, and entrepreneurship. The training and the instructions/courses it included were therefore designed and planned to meet these criteria, as well as to sufficiently and evenly correspond to each of three domains (CT, PR, EN) so that each domain is covered sufficiently and effectively.

3.5.1. Instructions/Courses

The instructions/courses in the training program were Python, Web Development/Design, Game Design, Design Studio (Digital Design), Entrepreneurship, Intelligent Games Studio.

To match these instructions with the 3 domains the data was collected for, it would look like:

1. Programming: Web Development & Python
2. Computational Thinking: Intelligent Games Studio, Game Design
3. Entrepreneurship: Entrepreneurship Lectures & Digital Design Courses

Table 3.2. Match Between Instructions/Courses and Domains

Domain	Instructions/Courses
Computational Thinking	Intelligent Games Studio - Game Design
Programming	Web Development - Python
Entrepreneurship	Entrepreneurship - Digital Design

Please refer to Table 3.2 above. Intelligent Games Studio and Games Design courses have been mapped to computational thinking because these courses included games and designs that would require students to use problem-solving, analytical thinking, and designing complex systems (in the form of games).

Web Development and Python courses have been mapped to Programming, obviously because they taught two programming languages in HTML5 and Python and required learners to program using JavaScript, CSS, Phyton functions and related syntax. It should be noted here that Web Development and Python courses might have had a mediating impact on computational thinking skills, too, programming is believed to be enhancing computational thinking and computational thinking is thought be a prerequisite for programming. Entrepreneurship and Digital Design courses, on the other hand, have been mapped to entrepreneurship because entrepreneurship courses obviously aimed to teach entrepreneurship to the learners and Digital Design courses aimed to provide learners with the opportunity to develop/design their entrepreneurial projects/ideas.

The courses have been mapped to the domains as explained above and the groups spent 35 hours in the classroom for these courses. The number of hours spent in the classroom for each aforementioned course are as follow: Please see Table 3.3 *Course/Instruction Hours* and Table 3.4 *Amount of Training Corresponding to Each Domain* below, to see the number of hours spent in the classroom for each course and consequently each domain.

Table 3.3. Course/Instruction Hours

Course/Instruction	# of hours in class
Web Development	9 hours
Python	9 hours
Intelligent Games Studio	3 hours
Entrepreneurship	6 hours
Digital Design	4 hours
Game Design	4 hours

Total: 35 hours

Table 3.4. Amount of Training Corresponding to Each Domain

Domain	Amount of Training
Computational Thinking	7 hours + 18 hours from Programming courses
Programming	18 hours
Entrepreneurship	10 hours

Note: Programming courses have been mapped to correspond to computational thinking domain as well because of the relationship between CT and PR. Please see/recall section 1.2.4 for details and explanations.

Both groups received a total of 35 hours of training, made up by nine hours of Web Development and Python each, three hours of Intelligent Games Studio, four hours of digital design and Game Design each, and six hours of Entrepreneurship courses. Therefore, the participants have taken 18 hours of instruction for Programming, seven hours of instruction for Computational Thinking (plus programming instructions) and 10 hours of instruction for Entrepreneurship. You can see the course program for students and teachers in the following tables.

Table 3.5. Students' Course Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
09:00– 09:50	Python	Python	Dig. Des.	Python	Web Dev.
10:00 – 10:50	Python	Python	Dig. Des.	Python	Web Dev.
11:00 – 11:50	Ent.	Python	Dig. Des	Python	Web Dev.
12:00 – 12:50	Int. G. Stu.	Python	Dig. Des.	Game Des.	Web Dev.
			Lunch Break		
14:00 – 14:50	Ent.	Ent.	Web Dev.	Game Des.	Ent.
15:00 – 15:50	Web Dev.	Ent.	Web Dev.	Game Des.	Int. G. Stu
16:00 – 16:50	Web Dev.	Ent.	Web Dev.	Game Des.	Int. G. Stu

Ent.: Entrepreneurship.

Int. G. Stu.: Intelligent Games Studio.

Dig. Des.: Digital Design.

Table 3.6. Teachers' Course Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
09:00 – 09:50	Web Dev.	Dig. Des.	Python	Ent.	Python
10:00 – 10:50	Web Dev.	Dig. Des.	Python	Ent.	Python
11:00 – 11:50	Web Dev.	Dig. Des.	Python	Web Dev.	Ent.
12:00 – 12:50	Web Dev.	Dig. Des.	Python	Web Dev.	Ent.
			Lunch Break		
14:00 – 14:50	Int. G. Stu.	Web Dev.	Game Des.	Python	Game Des.
15:00 – 15:50	Int. G. Stu.	Web Dev.	Game Des.	Python	Ent.
16:00 – 16:50	Int. G. Stu.	Web Dev.	Game Des.	Python	Ent.

Ent.: Entrepreneurship.

Int. G. Stu.: Intelligent Games Studio.

Dig. Des.: Digital Design.

3.5.1.1. Web Development

Web Development classes included introductory level HTML5, CSS and JavaScript in HTML5. Learners were paired for their training project to be delivered at the end of the training. Classrooms included a PC for each learner in the class. Participants developed a personal website at the end of the 18-hours instruction.

HTML: HTML classes included HTML elements, attributes, formatting, CSS, classes and other introductory level HTM topics, all of which was used to teach participants to prepare HTML base and elements for designing a personal website.

CSS: CSS classes included CSS syntax, colors, backgrounds, borders-margin-padding, text, font, links, tables, list and other introductory level topics that needs to be covered to help participants learn to prepare CSS necessary to describe how HTML elements are to be displayed. These instructions again served the same purpose; developing a personal website.

JavaScript in HTML5: This short class included the instructions on how to use JavaScript in HTML5, which are necessary to prepare dynamic and interactive HTML pages in the personal website developed.

3.5.1.2. Python

Python classes included introductory level Python programming. The main topic covered was “functions in Python”. Learners had hands-on experience with text editors and IDEs and prepared basic programs to display text, data-time and make simple mathematical calculations. Like in Web Development class, learners were paired for the practical in-class exercises and were grouped for the project that they completed for the end of the training. The instructions were a zipped version of a 44-hours long instruction the instructor has been teaching for several years as a professional trainer in the field.

Python Syntax: Python Syntax was the first topic to be covered to help participants comprehend the syntax of the language and get familiar with it.

Python Variables: The instructions included how to define and use a variable in Python, as well as assigning a value to a variable, which actually means the first creation/definition of it.

Python Functions: The instructions included creating a function, calling a function, parameter, default parameter value, passing a list as a parameter and return values, as well as function recursion.

3.5.1.3. Intelligent Games Studio

Intelligent Games Studio classes included lecturing, presentation, pairing and group work. The topics covered were the goal of the intelligent games, problem solving, brainstorming, communication, hands-on activities to prepare course materials and presentation skills. Classes were a rapid coverage of six units of the "Intelligent Games" course offered as an elective course in MEB curriculum.

3.5.1.4. Game Design

Same as Intelligent Games, Game Design included a rapid coverage of six units of the "Intelligent Games" course offered as an elective course in MEB curriculum. The courses included theoretical discussions and material design with hands-on experiences. The 4-hour instruction was planned as a zipped version of 40-hour certificate instruction by the same trainer. Classes included lecturing, presentation, pairing and group work.

3.5.1.5. Entrepreneurship

The classes included presentation and lecturing by the instructor, along with question-answer session, to ensure learner participation. The first two hour of the training included topics such as what an entrepreneur is, economic, social, cultural and political entrepreneurship, what makes an entrepreneur and what are his/her characteristics. The next two hours included topics such as entrepreneurship ideas in technology and social media domains, successful projects and examples. At the end of this two hours session, learners were assigned a homework to come up with an entrepreneurship idea for an environmental and daily life problems that they care about and were expected to work in groups of 2-3 people. Finally, the last 2-hours included learners sharing their ideas about the problem they care about and interacting with the accomplished entrepreneurs about their ideas (an idea in the context of social and/or economic entrepreneurship) and these entrepreneurs' past experiences.

Entrepreneurship courses also included lecturing and presentation and mentoring, where accomplished entrepreneurs were invited to the last two hours of instruction to talk to students and teachers in informal settings. The learners, therefore, have developed product and solution ideas for the problems they believe to be important, and that they care about. The learners were also taught about the economic side of entrepreneurship, the ways to officially launch a start-up, the difficulties the entrepreneurs face, the failed ideas and products so that they were able to know about both ways.

3.5.1.6. Digital Design

Digital Design courses were held in METU Design Factory, which offers an environment for interdisciplinary collaboration, where both academics, researchers, teachers and students can work together using the space and production infrastructure provided. The center has rapid-prototyping and product development infrastructure to help people materialize their ideas. Digital Design courses included lecturing, presentation and group work.

3.5.1.7. Classroom Settings

Overall, the instructors were free to use their own style of teaching and were not necessarily asked to strictly follow an instructional model or strategy. However, the interviews conducted with the instructors after the training revealed that all classes included similar patterns and strategies, which were:

1. An instructor giving a lecture
2. Use of presentation about the topic
3. Encouraging and assuring learner participation
4. Group-work
5. In-class activities
6. Take-home activities and homework
7. Group or individual project to be completed at the end of the training/classes.

The classes were held in conventional classroom settings, with tools to make an effective presentation and provide easy communication between the instructor and learners. Both students and teachers were divided into two groups to ensure that learner participation and engagement is easier. Two student groups received instructions in classes of 23 and 22, respectively, and two teacher groups received instructions in classes of 18 and 17, respectively. The classes lasted 50 minutes and started at 09:00 AM in the morning and continued until 17:00 PM in the evening, with recesses of ten minutes and 1-hour lunch break from 13:00 PM to 14:00 PM.

3.6. Participants

Participants were selected from a large pool of applicants who fulfilled an online form to participate in Applied Entrepreneurship and Informatics Training for Youth Project, which was collaboratively held by METU CEC, Turkish National Agency and Erasmus+ Programme. The pool included more than 50 schools from Mamak district of Ankara, Turkey and a total of 203 students and 129 teachers applied online to participate in the project and the study. From this population, 45 students and 35 teachers were selected to participate in the project and consequently the study.

Table 3.7. Applicants Pool vs. Selected Participants

Applicant Group	# of Applicants	# of Selected Participants
Students	203	45
Teachers	129	35

Out of 45 students who participated in the project and the training, 7 were excluded from the data analysis since they were unable to participate in the "2nd post-test" which was conducted 2 months after the project ended. Out of 35 teachers who participated in the project and the training, 2 were primarily excluded from data analysis since they were unable to attend the session in which (first) posttest was handed, and 5 were excluded since they did not participate in the 2nd posttest. Therefore, this study included 38 students and 28 teachers. Below, you can see the demographics for the participants cumulatively.

3.6.1. Demographics of Participants (Age)

Applicants were between the ages of 14 to 18 for students and 23 to 30 for teachers. These age intervals took shape after the requirements set for the application for students and teachers. That is, student applicants were expected to be high school students and teachers were expected to have at least one year of teaching experience and to be younger than 30 to be able to apply and that's why, initially the applicants and then the selected participants were between the aforementioned age intervals. Please find the details about the age of participants in the tables below.

Table 3.8. Participants (Students & Teachers) by Age

Group	N	Mean Age	Std. Dev.	Variance	Min. Age	Max. Age
Students	38	15.13	1.119	1.252	14	18
Teachers	28	27.29	2.070	4.286	23	30
Total	66	20.29	6.255	39.131	14	30

Table 3.9. Students' Age by Frequency

Age	Frequency	Valid Percent	Cumulative Percent
14	15	39.5	39.5
15	8	21.1	60.5
16	11	28.9	89.5
17	3	7.9	97.4
18	1	2.6	100.0
Total	38	100.0	

Table 3.10. Teachers' Age by Frequency

Age	Frequency	Valid Percent	Cumulative Percent
23	2	7.1	7.1
24	2	7.1	14.3
25	1	3.6	17.9
26	4	14.3	32.1
27	3	10.7	42.9
28	8	28.6	71.4
29	4	14.3	85.7
30	4	14.3	100.0
Total	28	100.0	

The study included a total of 66 participants, with 14 being the minimum and 30 being the maximum age, and the mean age for the participants was M=20.29. Therefore, it can be said that it was a rather young group of people that participated in the study, and the project, as it was intended. This was also important in terms of the scales used in the study. The scales were originally tested for validity and reliability with young groups of participants by the researchers who developed or adopted them, and it was therefore critical to have a rather young of participants in this study.

The mean age for students was 15.13, 14 being the minimum and 18 being the maximum age among the students. It can also be seen that students of age 14 made 39.5% of the group and of age 16 made 28.9%. There was only 1 18-year-old in the group. Therefore, the group was predominately formed by high school freshmen, sophomores and juniors, having only 4 seniors in the group.

The mean age for teachers, on the other hand, was 27.29; 23 being the minimum and 30 being the maximum age. It can also be seen that the teachers' age data was rather normally distributed as there was 8 different age and highest percentage of those was 28.6% and the lowest was 3.6%. Therefore, the group was rather pertinent in terms of age and teaching experience.

3.6.2. Demographics of Participants (Gender)

Although study did not aim to investigate anything related to gender, a participant group that includes almost equal number of people from both genders would be ideal for many studies, as it would be for this one. Please see the table below.

Table 3.11. Participants (Students & Teachers) by Gender

Group	# of Females	# of Males	Total (by Group)
Students	20	18	38
Teachers	23	5	28
Total (by Gender)	43	23	66

As it can be seen from the Table 3.11. *Participants (Students & Teachers) by Gender*, students had an almost equal distribution of genders, females making 52.6% of the group and males making 47.4% of it. Therefore, the students group was rather homogenous in terms of gender, making it a pertinent group for this aspect. Unlike students, however, teachers had an inequal distribution of genders as the females made up for 82.1% of the groups, males for 17.9%. This might have happened due to the higher rate of application from female teachers. Aggregately, too, participants were a non-equivalent group in terms of gender as there were 43 female participants and 23 male participants in the study.

3.7. Procedures

This part provides information about the project this study was conducted as a part of, and communicates overall procedures completed to conduct the study.

3.7.1. The Short-Term Training: Applied Entrepreneurship and Informatics Training for Youth Project

Applied Entrepreneurship and Informatics Training for Youth project was conducted with the ultimate goal of producing important gains both for participants and organizer institutions, as well as to lay a base for upcoming similar projects and training programs. The official first-meeting of the project was done on December 19, 2018, in which the organizers, collaborators, participants, instructors attended. The project ended on June 11, 2019. The training part took place at the last week of January 2019.

3.7.1.1. Collaborators

The project was collaboratively conducted by Middle East Technical University (METU), METU Continuing Education Center (METU CEC) and Turkish National Agency, Erasmus+ program and Mamak District - Directorate of National Education.

The project was designed and planned by METU Continuing Education Center and METU applied for the project to be funded by Turkish National Agency, Erasmus+ program, who also helped ensure the collaboration of Mamak District - Directorate of National Education who granted the permission for the potential participants from the district, for their 1-week absence to attend the training and other potential meetings/sessions.

3.7.1.2. Announcements

After the official procedures were completed and it was official that the project would be conducted, Mamak District - Directorate of National Education helped announce the project to the potential participants, students and teachers from the public schools in the district. The project was also announced in official websites and social media accounts of all of the collaborators, process mainly being driven by METU CEC.

3.7.1.3. Application and Registration Process

The applications were accepted online and were open for a long period of time. The applicants fulfilled an online form and when the applications were closed, the applicants pool included more than 50 schools from Mamak district of Ankara, Turkey and a total of 203 students and 129 teachers applied to participate in the project and the study. After the participants were selected from applicants pool, each participant was registered to the project to participate in the training, events and briefings the project included.

3.7.1.4. Project Process

Registered participants were then emailed about project program and schedules via email and was informed about it via their phone numbers. Each participant was also contacted personally via phone by METU CEC and project personnel to inform them about the project, training and processes. The very first day of the training, the participants (both students and teachers) received a briefing about the project, the training, the duration of the project and the training and were given the pre-test after this briefing. The pre-test, like the 2 post-tests that followed it after the training, included a voluntary participation form and 3 scales. Please find the voluntary participation form in the Appendix part.

3.7.1.5. Accommodation of Participants

Although the project took place in the same city (Ankara, Turkey) that the participants lived in, all of the students and several teachers were accommodated into a hotel close to the METU Continuing Education Center (METU CEC) where the project and training took place, so that they did not have to worry about transportation. Rest of the participants preferred not to be accommodated since transportation was convenient for them. Project personnel kept in touch with those who were not accommodated, so that any issues they might experience about transportation were resolved. These arrangements helped ensure that all the participants (45 students and 35 teachers) attended the classes.

3.7.2. Ethics Committee Permission

In the meantime, an application was sent to METU Ethics Committee, after the scales to be used in this study were determined. METU Ethics Committee granted its permission to conduct a study as part of the project. Please find the METU Ethics Committee application form in the Appendix part.

3.7.3. Parental Permission for Students

A Parent Permission Form was prepared to inform and get permission from students' parents. The form was distributed online and via the help of students themselves and a parental permission was acquired for each student participation. Please find Parent Permission Form in APPENDIX C.

3.8. Instrumentation

Data was collected for self-efficacy in computational thinking, programming and entrepreneurship with three separate scales. These three scales, taken from three different studies, were used to collect data from both groups, meaning that both students and teachers were given the same instrument for each of these three domains. The study the scales are derived from are the reliability and validity studies conducted for these scales themselves. The scales were tested with rather young groups of participants, from college seniors to 5^{th} and 6^{th} graders. CTSES and ENSES were developed by the authors while PRSES was adopted from another scale that was originally developed in English. You can find detailed information about the scales in Table 3.12 and Table 3.13.

Table 3.12. Characteristics of Scales Used in the Study - 1

Scale	# of Items	Sampling	Cronbach's Value
CTSES	36	952 Students	0.72 – 0.930
PRSES	9	152 Students	0.928
ENSES	31	555 Students	0.92

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 3.13. Characteristics of Instruments/Scales Used in the Study - 2

Scale	Original Name	Author (Year)	Dev./Adop.
CTSES	Bilgi-işlemsel Düşünme Becerisine Yönelik Özyeterlik Algısı Ölçeği	Gülbahar, Kert & Kalelioğlu (2018)	Developed
PRSES	Programlamaya İlişkin Özyeterlilik Algısı Ölçeği	Altun & Mazman (2012)	Adopted
ENSES	Bireysel Girişimcilik Algı Ölçeği	İncik & Uzun (2017)	Developed

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

3.8.1. Computational Thinking Self-Efficacy Scale (CTSES)

Cited from an article which was published in Turkish Journal of Computer and Mathematics Education in October 16, 2018, the scale is originally named as "Bilgi İşlemsel Düşünme Becerisine Yönelik Özyeterlik Algısı Ölçeği" and will be called as "Computational Thinking Self-Efficacy Scale" for the sake of this study and may occasionally be referred as "Computational Thinking Scale" or "CTSES" as an abbreviation.

The scale was tested for reliability and validity with 952 students between the age 11 and 12, from 17 different schools. While the majority of (75.5%) of the students in the study were at age 11, the genders were rather equally distributed (Gülbahar, Bahadır & Kalelioğlu, 2018).

The scale initially had 39 items and was finalized with 36 items and 5 factors after the validity and reliability study was completed (Gülbahar, Bahadır & Kalelioğlu, 2018).

3.8.2. Programming Self-Efficacy Scale (PRSES)

Cited from an article which was published in Journal of Measurement and Evaluation in Education and Pyschology in 2012, the scale is originally named as "Programlamaya İlişkin Öz Yeterlik Algısı Ölçeği" and it will be called "Programming Self-Efficacy Scale" for the sake of this study and also may occasionally be referred as "Programming Scale" or "PRSES" as an abbreviation.

The scale was originally developed by Ramalingam & Wiedenbeck (1998) and the article the scale was cited for this study is a research conducted to translate/adopt this scale into Turkish.

The scale was translated into Turkish with the help and review of subject-matters and then was tested for reliability and validity with 152 undergrad students who have taken at least 1 programming course in their academic life.

The students who participated in the study were from Computer Engineering, Electrics & Electronics Engineering and Computer Education and Instructional Technology departments. 90.8% of students (138) were between the ages of 18 and 25 and 9.2% of them were between the ages of 26 and 35 (Altun & Mazman, 2012, p.299).

The scale originally had 32 items and 4 factors and was finalized with 9 items and 2 factors after the validity and reliability study was concluded (Altun & Mazman, 2012).

3.8.3. Entrepreneurship Self-Efficacy Scale (ENSES)

Cited from an article which was published in Mustafa Kemal University Journal of Social Science Institute in 2017, the scale was originally called "Bireysel Girişimcilik Algı Ölçeği" and it will be called "[Individual] Entrepreneurship Self-Efficacy Scale" and may occasionally be referred as "Entrepreneurship Scale" or "ENSES" as an abbreviation.

Although the original name of the scale does not include the term "özyeterlik" (direct translation of the term "self-efficacy" in Turkish), the study this scale was developed and tested for validity and reliability aims to reveal individuals' perception of their entrepreneurship skills with a valid and reliable scale. The scale therefore is considered as a valid and reliable scale to measure an individual's self-efficacy beliefs in their entrepreneurship skills.

The scale was tested for reliability and validity with 555 junior undergrad students in Mersin University (İncek & Uzun, 2017, p. 473) and was finalized with 35 items.

Please find these instruments attached in APPENDICES B.

3.8 Data Analysis

After the data is collected and organized, SPSS (Statistical Package for Social Sciences) version 25 was utilized to analyze the data. The level of significance was designated as ".05" by the researcher. While the dependent variable was students' and teachers' self-efficacy scale scores for all 3 domains (CT, PR, EN), the training they received was the independent variable.

As research questions were divided into 4 parts as "Students", "Teachers", and "Students vs. Teachers: Change in Mean Scores" and "Students vs. Teachers: Sustainability of Self-efficacy", the analysis of the data, therefore, was completed part by part and including 4 parts. First, change in students' score was analyzed for Students. Second, change in students' score was analyzed for Teachers. Third, whether there was any difference in change of scores for these 2 groups was analyzed. Last, whether there was any difference in terms of sustainability of self-efficacy for these two groups was analyzed. Please see Table 3.14 about the research questions and the analysis conducted to go after them.

Table 3.14. Research Questions vs. Tests Run

Part	Research Questions	Analysis (Tests Run)
Students	1, 2, 3	Paired Samples T-Test
Teachers	4, 5, 6	Paired Samples T-Test
Change in Mean Scores	7, 8, 9	Ind. Samples T-Test
Sustainability of SE	10, 11, 12	Ind. Samples T-Test

SE: Self-Efficacy

Paired samples t-test was used to analyze the change in scores for both groups, for all 3 scales. Independent samples t-test was used to analyze whether this aforementioned training affected one group's score change any different than the other. For this analysis, the difference of scores from pre-test to post-test was calculated for each participant in both groups. To examine the possible difference between students' and teacher's retention/sustainability of their self-efficacy in computational thinking, programming and entrepreneurship, Independent samples t-test was used. It should also be noted that normality was checked for the data from all the scales, before the aforementioned analyses were conducted, and the data was normally distributed.

3.9. Reliability and Validity

Reliability and validity are crucial parameters to contemplate before the results and findings of a study is interpreted and conclusions are drawn from those findings and results. Reliability can be defined as the extent to which a research instrument consistently provides the same results when it is used in the same situation on repeated occasions (Heale & Twycross, 2015). In other words, reliability refers to the consistency of results in different and repeated occasions in which the same instrument is utilized. Validity, for a quantitative study, on the other hand, can be defined as the extent to which a concept is accurately measured in a quantitative study (Heale & Twycross, 2015). It can also be referred as the meaningfulness, correctness and usefulness of the study (Fraenkel & Wallen, 2006 as cited in Yurdagül, 2018).

Validity and reliability are important concepts that define/determine the quality of a study. This study, therefore, paid attention to the following tests, strategies and procedures that are discussed in the next two sub-sections.

3.9.1. Reliability

The study employed 3 separate scales, which were tested for reliability and validity by the researchers that originally developed them or adapted them into the language the scales are used in. The Cronbach's Alpha Reliability Test results from the original studies are presented in the Table "Characteristics of Instruments/Scales Used in the Study" above. The results for reliability test for these scales in this study, on the other hand, are as follows: Please check the table below.

As seen from the table, Cronbach' Alpha coefficient for all three scales in all three measurements (pretest, posttest, 2nd posttest) was found to be an indication of high reliability ($\alpha > .80$). The tests revealed a consistent coefficient for all three scales in all three measurements, meaning that indication of high reliability could be maintained throughout all measurements. In addition to these results, the researcher sought the opinions of the supervisor of the study and colleagues as well, to ensure the reliability aspect of the study was sound.

Table 3.15. Cronbach's Alpha Reliability Test Results in the Study

Groups	Scales (# of items)	Cronbach's Alpha Reliability Test Result		
		Pretest	Posttest	2nd Posttest
Students	CTSES (36)	.927	.921	.895
	PRSES (9)	.908	.865	.898
	ENSES (31)	.938	.964	.961
Teachers	CTSES (36)	.961	.917	.965
	PRSES (9)	.961	.917	.970
	ENSES (31)	.937	.947	.963

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

3.9.2. Validity

The concept of validity can be evaluated as internal and external validity. Creswell (2012) states that internal validity is related to the inferences that can be drawn about the cause-effect relation between the variables (independent and dependent) of the study. External validity, on the other hand, can be referred as the concept that is primarily relate to the generalization of the results of a study to other (external) settings, occasions, terms and participants.

As Campbell and Stanley (1996) notes, in quantitative research, the researcher is and should be most concerned with the internal and external validity of the (experimental or quasi-experimental) design and the study (as cited in Creswell & Miller, 2000). The researcher of this study therefore took the following measures and employed several techniques to ensure internal validity:

1. It was made sure that all the participants did attend all the courses. The project coordinators were always in contact with the participants. Transportation and accommodation of the participants were all well-organized way before the classes started. Since it was also a 1-week training process, all participants could attend all the classes.
2. Participants who could not attend the posttest and 2nd post-test were excluded from the sample before the data analysis.
3. 1-week training eliminated the maturation effect.
4. The research design ensured that participant characteristics were not controlled.

Since the study relied on Inferential Statistics and parametric tests, paired samples t-test and independent samples t-test namely, and also included between subjects design along with within-subjects design, findings could be generalized to the population. In the meantime, reliability and validity of the study were overseen as explained above.

3.10. Summary

This study employed a quasi-experimental research design to investigate the impact of a short-term training (intervention) on student and teacher self-efficacy in computational thinking, programming and entrepreneurship. The sample of the research primarily included 45 students and 35 teachers; and after the missing cases were removed, data analysis included 38 students and 28 teachers, making it a total of 66 participants who received the same instructions in same settings in different classrooms from the same instructors. Data was collected via 3 scales (CTSES, PRSES, ENSES), corresponding to each domain (CT, PR, EN) investigated in the study. Data was analyzed using inferential statistics tests; paired samples t-test and independent samples t-test namely. The measures taken, and procedures applied ensured that the reliability and validity aspects of the study was in line with of a high quality one.

3.11. Conclusion

This chapter re-listed the research questions, elaborated on the research design, provided details about the training and procedures, introduced and discussed the instrumentation used in the study, and explained how the data was collected and was analyzed. The following chapter, Results, will present the results and findings, based on the research questions.

CHAPTER 4

RESULTS

4.1. Overview

This chapter communicates the results and findings from the study; about the impact of a short-term training on student and teacher self-efficacy in computational thinking, programming and entrepreneurship. Specifically, it will communicate the self-efficacy enhancement impact of the short-term training on students and teachers and if the training impacted students and teachers differently in terms of self-efficacy enhancement and sustainability of self-efficacy.

To produce the results, the data was analyzed relying on inferential statistics and two inferential statistics tests; namely, Paired Samples t-test and Independent Samples t-test. These two tests were utilized to be able to produce findings and results that are drawn from the sample and can be generalized to the population.

As stated in Introduction and Methodology chapters, research questions were handled/evaluated in 4 parts as

a. Students,
b. Teachers,
c. Students vs. Teachers: Change in Mean Score,
d. Students vs. Teachers: Sustainability of Self-efficacy

to make the analysis and the presentation of results clearer and more coherent and the results will be presented with the same approach so that they, too, are clear and coherent for the readers. Please see the table Table 4.1, which reflects this approach.

Table 4.1. Research Questions, Their Sections (Parts) and Investigation

Part/Section	Res. Questions	What is Investigated?
Students	1, 2, 3	Change in students' mean scores in CTSES, PRSES and ENSES
Teachers	4, 5, 6	Change in teachers' mean scores in CTSES, PRSES, ENSES
Change in Mean Scores	7, 8, 9	Diff. of change in mean scores in CTSES, PRSES and ENSES
Sustainability of SE	10, 11, 12	Difference of sustainability in CTSES, PRSES and ENSES

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

SE: Self-efficacy

First, research questions from 1 to 3 will cover the results about the change in student self-efficacy mean scores in Computational Self-Efficacy Scale (CTSES), Programming Self-Efficacy Scale (PRSES) and Entrepreneurship Self-Efficacy Scale (ENSES). Second, research questions from 4 to 6 will cover the results about the change in teacher self-efficacy mean scores in Computational Self-Efficacy Scale (CTSES), Programming Self-Efficacy Scale (PRSES) and Entrepreneurship Self-Efficacy Scale (ENSES). Third, research questions from 7 to 9 will cover the results about the difference of change in mean scores between both groups (students and teachers) for CTSES, PRSES and ENSES. Last, research questions from 10 to 12 will focus on the results about the difference of sustainability of self-efficacy in mean scores between two groups, again for CTSES, PRSES and ENSES. The results are to be presented in the same table for the research questions in the same part/section and are to be discussed separately for each research question respectively, from 1 to 12.

4.2. Part 1: Students

This part communicates the results about the impact of the short-term training on student self-efficacy in CT, PR and EN. First the tables that reflects the findings for this part are listed and then each research question in this part are elaborated on using the tables, to present the results. Data was analyzed using Paired Samples t-test for this part and paired samples statistics, correlations and results for students' CTSES, PRSES and ENSES scores are presented below.

Table 4.2. Paired Samples Statistics for Students' Pretest and Posttest Scores

Scale	Pretest – Posttest	Mean	N	Std. D.	Std. E. Mean
CTSES	Students' Pretest CTSES Scores	85.92	38	13.810	2.240
	Students' Posttest CTSES Scores	103.16	38	7.365	1.195
PRSES	Students' Pretest PRSES Scores	36.00	38	15.617	2.533
	Students' Posttest PRSES Scores	56.68	38	8.734	1.417
ENSES	Students' Pretest ENSES Scores	135.84	38	15.831	2.568
	Students' Posttest ENSES Scores	141.47	38	17.365	2.817

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.3. Paired Samples Correlations for Students' Pretest and Posttest Scores

Scale	Pair	N	Correlation	Sig.
CTSES	Students' Pretest & Students' Posttest	38	.166	.318
PRSES	Students' Pretest & Students' Posttest	38	.365	.024
ENSES	Students' Pretest & Students' Posttest	38	.669	.000

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.4. Analysis of Students' Posttest and Pretest Scores

Pair	Mean Diff.	Std. Dev.	Std. E. Mean	df	Sig.
Posttest CTSES – Pretest CTSES	17.237	14.529	2.357	37	.0000
Posttest PRSES – Pretest PRSES	20.684	14.856	2.410	37	.000
Posttest ENSES – Pretest ENSES	5.632	13.581	2.203	37	.015

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

4.2.1. Results on Students' Pretest and Posttest Computational Thinking Self-Efficacy Mean Scores (Research Question 1)

Paired samples t-test was used to investigate the impact of the short-term training on student self-efficacy in computational thinking. To do this, students' pretest and posttest scores in CTSES were paired and the analysis revealed that students (N=38) had a relatively low level of mean score (M=85.92; SD=13.810) in CTSES (See Table 4.2), when measured with a pretest before the short-term training and their posttest CTSES mean score (M=103.16; SD=7.365) was considerably higher (See Table 4.2) after the short-term training.

Then, a paired samples t-test was run students' pretest CTSES and posttest CTSES scores to see if the increase in mean score was statistically significant. Paired samples t-test showed that there was a statistically significant ($p<0.05$) (See Table 4.4) increase in students' CTSES scores from pretest to posttest (pre-training to post-training). Students' (N=38) mean score for computational thinking self-efficacy was M=85.92 (See Table 4.2) before the training and rose up to M=103.16 (See Table 4.2) and students' mean CTSES score increased more than 17 points (See Table 4.4) after the training. Based on these results, Null Hypothesis (H_0) was rejected.

4.2.2. Results on Students' Pretest and Posttest Programming Self-Efficacy Mean Scores (Research Question 2)

Paired samples t-test was used to investigate the impact of short-term training on student self-efficacy in programming. To do this, students' pretest and posttest scores in PRSES were paired and the analysis revealed that students (N=38) had a middling level of a mean score (M=36.00; SD=2.533) in PRSES (See Table 4.2) when measured in pretest, before the short-term training and a relatively higher level of mean score (M=56.68; SD=1.417) in posttest (See Table 4.2), after the short-term training.

Then, a Paired Samples t-test was run on students' pretest PRSES and posttest PRSES scores to see if the increase in mean score was statistically significant. Paired samples t-test showed that there was a statistically significant ($p<0.05$) (See Table 4.4) increase in students' PRSES scores from pretest to posttest. Students' (N=38) programming self-efficacy mean score was exactly M=36.00 (See Table 4.2) before the training and increased up to M=56.68 (See Table 4.2) after the training, meaning that students' mean PRSES score increased more than 20 points (See Table 4.4) after the training. Based on these results, Null Hypothesis (H_0) was rejected.

4.2.3. Results on Students' Pretest and Posttest Entrepreneurship Self-Efficacy Mean Scores (Research Question 3)

Paired samples t-test was used to investigate the impact of short-term training on student self-efficacy in entrepreneurship. To do this, students' pretest and posttest scores in ENSES were paired and the analysis revealed that students (N=38) had a decent level of a mean score (M=135.84; SD=15.831) (See Table 4.2) in ENSES when measured in pretest, before the short-term training and a higher level of mean score (M=141.47; SD=17.365) (See Table 4.2) in posttest, after the short-term training.

Then, a paired samples t-test was run on students' pretest ENSES and posttest ENSES scores to see if the increase in mean score was statistically significant. Paired samples t-test showed that there was a statistically significant ($p<0.05$) (See Table 4.4) increase in students' ENSES scores from pretest to posttest. Students' (N=38) entrepreneurship self-efficacy mean score was M=135.84 (See Table 4.2) before the training and climbed up to M=141.47(See Table 4.2) after the training. Students' mean ENSES score increased more than 5 points (See Table 4.4) after the training. Based on these results, Null Hypothesis (H_0) was rejected.

4.3. Part 2: Teachers

This part communicates the results about the impact of the short-term training on teacher self-efficacy in CT, PR and EN. Paired Samples statistics, correlations. The results for teachers' CTSES, PRSES and ENSES mean scores are in the tables presented below.

Table 4.5. Paired Samples Statistics for Teachers' Pretest and Posttest Scores

Scale	Pretest – Posttest	Mean	N	Std. Dev.	Std. E. Mean
CTSES	Teachers' Pretest Scores	94.79	28	13.900	2.627
	Teachers' Posttest Scores	106.18	28	4.464	.844
PRSES	Teachers' Pretest Scores	33.68	28	16.348	3.090
	Teachers' Posttest Scores	56.04	28	7.426	1.403
ENSES	Teachers' Pretest Scores	130.07	28	16.841	3.183
	Teachers' Posttest Scores	139.54	28	13.874	2.622

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.6. Paired Samples Correlations for Teachers' Pretest and Posttest Scores

Scale	Pair	N	Correlation	Sig.
CTSES	Teachers' Pretest & Teachers' Posttest	28	.316	.102
PRSES	Teachers' Pretest & Teachers' Posttest	28	.519	.005
ENSES	Teachers' Pretest & Teachers' Posttest	28	.594	.001

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.7. Analysis of Teachers' Posttest and Pretest Scores

Pair	Mean Diff.	Std. Dev.	Std. E. Mean	df	Sig.
Posttest CTSES – Pretest CTSES	11.393	13.189	2.492	27	.000
Posttest PRSES – Pretest PRSES	22.357	14.011	2.648	27	.000
Posttest ENSES – Pretest ENSES	9.464	14.094	2.663	27	.001

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

4.3.1. Results on Teachers' Pretest and Posttest Computational Thinking Self-Efficacy Mean Scores (Research Question 4)

Paired samples t-test was used to investigate the impact of short-term training on teacher self-efficacy in computational thinking. To do this, teacher's pretest and posttest scores in CTSES were paired and the analysis revealed that teachers (N=28) had a relatively low level of a mean score (M=94.79; SD=13.900) (See Table 4.5) in CTSES when measured in pretest, before the short-term training and a higher level of mean score (M=106.18; SD=4.464) (See Table 4.5) in posttest, after the short-term training.

Then, a paired samples t-test was run students' pretest CTSES and posttest CTSES scores to see if the increase in mean score was statistically significant. Paired samples t-test showed that there was a statistically significant ($p<0.05$) (See Table 4.7) increase in teachers' CTSES scores from pretest to posttest (pre-training to post-training). Teachers' (N=28) mean score for computational thinking self-efficacy was M=94.79 (See Table 4.5) before the training and rose up to M=106.18 (See Table 4.5) after the training. Teachers' mean CTSES score increased more than 11 points (See Table 4.7) after the training. Based on these results, Null Hypothesis (H_0) was rejected.

4.3.2. Results on Teachers' Pretest and Posttest Programming Self-Efficacy Mean Scores (Research Question 5)

Paired samples t-test was used to investigate the impact of short-term training on teacher self-efficacy in programming. To do this, teacher's pretest and posttest scores in PRSES were paired and the analysis revealed that teachers (N=28) had a low level of mean score (M=33.68; SD=16.348) (See Table 4.5) in PRSES when measured in pretest, before the short-term training and a much higher level of mean score (M=56.04; SD=7.426) (See Table 4.5) in posttest, after the short-term training.

Then, a paired samples t-test was run students' pretest PRSES and posttest PRSES scores to see if the increase in mean score was statistically significant. Paired samples t-test showed that there was a statistically significant ($p<0.05$) (See Table 4.7) increase in teachers' PRSES scores from pretest to posttest (pre-training to post-training). Teachers' (N=28) mean score for programming self-efficacy was M=33.68 (See Table 4.5) before the training and rose up to M=56.04 (See Table 4.5) after the training, meaning that teachers' mean PRSES score increased more than 22 points (See Table 4.7) after the training. Based on these results, Null Hypothesis (H_0) was rejected.

4.3.3. Results on Teachers' Pretest and Posttest Entrepreneurship Self-Efficacy Mean Scores (Research Question 6)

Paired samples t-test was used to investigate the impact of short-term training on teacher self-efficacy in entrepreneurship. To do this, teacher's pretest and posttest scores in ENSES were paired and the analysis revealed that teachers (N=28) had a decent level of mean score (M=130.07; SD=16.841) (See Table 4.5) in ENSES when measured in pretest, before the short-term training and a higher level of mean score (M=139.54; SD=13.874) (See Table 4.5) in posttest, after the short-term training.

Then, a paired samples t-test was run students' pretest ENSES and posttest ENSES scores to see if the increase in mean score was statistically significant. Paired samples t-test showed that there was a statistically significant ($p<0.05$) (See Table 4.7) increase in teachers' ENSES scores from pretest to posttest (pre-training to post-training). Teachers' (N=28) mean score for entrepreneurship self-efficacy was M=130.07 (See Table 4.5) before the training and rose up to M=139.54 (See Table 4.5) after the training, meaning that teachers' mean ENSES score increased more than 9 points (See Table 4.7) after the training. Based on these results, Null Hypothesis (H_0) was rejected.

4.4. Part 3: Students vs. Teachers: Change in Mean Scores

This part communicates the results about the possible different impact of the short-term training on students and teachers. First, students' and teachers' pretest scores in all three scales (CTSES, PRSES, ENSES) were analyzed using independent samples t-test to make sure that there was not a statistically significant difference between pretest scores of the groups (students and teachers), so that the change in mean scores could be analyzed and compared and the analysis and the comparison could be accurate and reliable.

Whether there is statistically significant difference between students' and teachers' pretest scores in CTSES, PRSES, and ENSES was investigated using independent samples t-test. Results from this analysis (See Table 4.8 and 4.9) indicated that students' and teachers' pretest CTSES scores were significantly different ($p<0.05$) (See Table 4.9), whereas, pretest PRSES and pretest ENSES scores were not significantly different for the groups ($p>0.05$) (See Table 4.9). Therefore, the difference of posttest CTSES – pretest CTSES was not analyzed for the groups.

Then, whether there was a statistically significant difference between these changes in mean scores (increase from pretest to posttest) were analyzed using independent samples t-test, for PRSES and ENSES. The analyses from first independent samples t-test conducted to make sure that groups' pretest scores were not significantly different from each other and the analyses from the second independent samples t-test that could be conducted only for PRSES and ENSES are shown in the tables below.

Table 4.8. Analysis of Pretest Scores of Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest CTSES Scores	Teachers	28	94.79	13.900	2.627
	Students	38	85.92	13.810	2.240
Pretest PRSES Scores	Teachers	28	33.68	16.348	3.090
	Students	38	36.00	15.617	2.533
Pretest ENSES Scores	Teachers	28	130.07	16.841	3.183
	Students	38	135.84	15.831	2.568

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.9. Independent Samples T-Test Results for Pretest Scores of Groups

		Levene's Test		t-test for Equality of Means			
Pretest Scores		F	Sig.	df	Sig.	Mean Diff.	Std. E. Diff.
Students' CTSES vs. Teachers' CTSES	Eq. var. assumed	.054	.816	64	.013	8.865	3.449
	Eq. var. not as.			58.12	.013	8.865	3.452
Students' PRSES vs. Teachers' PRSES	Eq. var. assumed	.020	.889	64	.561	2.321	3.967
	Eq. var. not as.			56.78	.564	2.321	3.995
Students' ENSES vs. Teachers' ENSES	Eq. var. assumed	.571	.453	64	.159	5.771	4.051
	Eq. var. not as.			56.21	.164	5.771	4.090

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.10. Analysis of Posttest – Pretest PRSES Score Difference for Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Difference CTSES (Posttest-Pretest)	Was not analyzed since pretest scores were significantly different for the groups.				
Difference PRSES (Posttest-Pretest)	Teachers	28	22.36	14.011	2.648
	Students	38	20.68	14.856	2.410
Difference ENSES (Posttest-Pretest)	Teachers	28	9.46	14.094	2.663
	Students	38	5.63	13.581	2.203

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.11. Ind. Samples T-Test Results for Diff. of Posttest-Pretest Scores

		Levene's Test		t-test for Equality of Means			
Posttest-Pretest		F	Sig.	df	Sig.	Mean Diff.	Std. Error Difference
Difference CTSES	Was not analyzed since pretest scores were significantly different for the groups.						
Difference PRSES	Equal var. assumed	.263	.610	64	.645	1.673	3.613
	Equal var. not assumed			60.144	.642	1.673	3.580
Difference ENSES	Equal var. assumed	.112	.739	64	.269	3.833	3.437
	Equal var. not assumed			57.087	.272	3.833	3.457

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

4.4.1. Results on Comparison of Change in Students' and Teachers' Computational Thinking Self-Efficacy Mean Scores (Research Question 7)

One prerequisite to be able to investigate the possible difference of impact of the training on student and teacher self-efficacy in computational thinking was that there should not have been a statistically significant difference between the groups' pretest CTSES mean scores. An independent samples t-test was run on the groups' pretest CTSES scores and mean difference of 8.865 (F= .054) between two groups' pretest CTSES scores was statistically significant ($p<0.05$) (See Table 4.9). Students' (N=38) pretest CTSES mean score (M=85.92) (See Table 4.8) was lower than teachers' (N=28) pretest CTSES score (M=94.79) (See Table 4.8). Therefore, the difference of change between mean scores of students and teachers in computational thinking self-efficacy could not be investigated. Null Hypothesis (H_0) could not be investigated and was neither rejected nor failed to be rejected.

4.4.2. Results on Comparison of Change in Students' and Teachers' Programming Self-Efficacy Mean Scores (Research Question 8)

One prerequisite to be able to investigate the possible difference of impact of the training on student and teacher self-efficacy in programming was that there should not have been a statistically significant difference between the groups' pretest PRSES mean scores. Students' (N=38) pretest PRSES mean score (M=36.00) (See Table 4.8) was quite close to teachers' (N=28) pretest PRSES mean score (M=33.68) (See Table 4.8) and an independent samples t-test run on the groups' pretest PRSES scores revealed that the little difference (between the groups' pretest PRSES mean scores was not statistically significant ($p>0.05$) (See Table 4.9) .

Then, another independent samples t-test was run on the difference of posttest PRSES and pretest PRSES scores of both groups. The analysis revealed that the mean difference of 1.673 was not statistically significant ($p>0.05$) (See Table 4.11). Based on these results, Null Hypothesis (H_0) was failed to be rejected.

4.4.3. Results on Comparison of Change in Students' and Teachers' Entrepreneurship Self-Efficacy Mean Scores (Research Question 9)

One prerequisite to be able to investigate the possible difference of impact of the training on student and teacher self-efficacy in entrepreneurship was that there should not have been a statistically significant difference between the groups' pretest ENSES mean scores. An independent samples t-test was run on the groups' pretest ENSES scores and it revealed that students' (N=38) pretest ENSES mean score (M=135.84) (See Table 4.8) was close to teachers' (N=28) pretest ENSES mean score (M=130.07)

(See Table 4.8) and that there was no statistically significant ($p>0.05$) (See Table 4.9) difference between both groups' pretest ENSES scores .

Then, another independent samples t-test was run on the difference of posttest ENSES and pretest ENSES of both groups. The analysis revealed that the mean difference of 3.833 (See Table 4.11) was not statistically significant ($p>0.05$) (See Table 4.11). Based on these results, Null Hypothesis (H_0) was failed to be rejected.

4.5. Part 4: Students vs. Teachers: Sustainability of Self-efficacy

This part communicates the results about possible difference in sustainability of self-efficacy scores between students and teachers. Since there was not any statistically significant difference between posttest scores of students and teachers for any of the scales, sustainability of self-efficacy could be analyzed for all three scales. To proceed with this analysis, though, first, the difference between 2nd posttest – posttest scores in CTSES, PRSES and ENSES were calculated for both groups. Then, these difference of mean scores were analyzed using independent samples t-test.

Table 4.12. Analysis of Posttest Scores of Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest CTSES	Teachers	28	106.18	4.464	.844
Scores	Students	38	103.16	7.365	1.195
Posttest PRSES	Teachers	28	56.04	7.426	1.403
Scores	Students	38	56.68	8.734	1.417
Posttest ENSES	Teachers	28	139.54	13.874	2.622
Scores	Students	38	141.47	17.365	2.817

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.13. Independent Samples T-Test Results for Posttest Scores of Groups

		Levene's Test		t-test for Equality of Means			
Posttest Scores		F	Sig.	df	Sig.	Mean Diff.	Std. Error Difference
Students' CTSES vs.	Eq.var. assumed	5.070	.028	64	.059	3.021	1.571
Teachers' CTSES	Eq. var. not as.			61.980	.043	3.021	1.463
Students' PRSES vs.	Eq.var. assumed	.624	.432	64	.752	.648	2.044
Teachers' PRSES	Eq. var. not as.			62.618	.746	.648	1.994
Students' ENSES vs.	Eq.var. assumed	.031	.861	64	.628	1.938	3.981
Teachers' ENSES	Eq. var. not as.			63.534	.616	1.938	3.848

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

Table 4.14. Analysis of 2nd Posttest – Posttest Score Difference for Groups

	Group	N	Mean	Std. Deviation	Std. E. Mean
Difference CTSES (2nd Posttest-Posttest)	Teachers	28	-2.29	5.981	1.130
	Students	38	-2.00	6.451	1.047
Difference PRSES (2nd Posttest-Posttest)	Teachers	28	-3.64	9.182	1.735
	Students	38	-4.00	9.028	1.465
Difference ENSES (2nd Posttest-Posttest)	Teachers	28	.93	15.456	2.921
	Students	38	-.71	9.555	1.550

Table 4.15. Ind. Samples T-Test Results for Diff. of 2nd Posttest-Posttest Scores

		Levene's Test		t-test for Equality of Means			
		F	Sig.	df	Sig.	Mean Diff.	Std. Error Difference
Difference CTSES (2nd Posttest-Posttest)	Eq. var. assumed	.472	.495	64	.855	.286	1.558
	Eq. var. not as.			60.626	.853	.286	1.540
Difference PRSES (2nd Posttest-Posttest)	Eq. var. assumed	.227	.635	64	.875	.357	2.265
	Eq. var. not as.			57.775	.876	.357	2.271
Difference ENSES (2nd Posttest-Posttest)	Eq. var. assumed	2.352	.130	64	.597	1.639	3.086
	Eq. var. not as.			41.921	.623	1.639	3.307

CTSES: Computational Thinking Self-Efficacy Scale

PRSES: Programming Self-Efficacy Scale

ENSES: Entrepreneurship Self-Efficacy Scale

4.5.1. Results on Comparison Between Students and Teachers for Sustainability of Computational Thinking Self-Efficacy (Research Question 10)

One prerequisite to be able to investigate the possible difference in sustainability of self-efficacy in computational thinking for students and teachers was that there should not have been statistically significant difference between the groups' posttest CTSES mean scores. An independent samples t-test was run on the groups' posttest CTSES scores and it revealed that students' (N=38) posttest CTSES mean score (M=103.16) (See Table 4.12) was close to teachers' (N=28) posttest CTSES mean score (M=106.18) (See Table 4.12) and that there was no statistically significant ($p>0.05$) (See Table 4.13) difference between both groups' posttest CTSES scores.

Then, another independent samples t-test was run on the difference of 2^{nd} posttest CTSES and posttest CTSES scores of both groups. The analysis revealed that the mean difference of .286 (See Table 4.15) was not statistically significant ($p>0.05$) (See Table 4.15). Based on the results, Null Hypothesis (H_0) was failed to be rejected.

4.5.2. Results on Comparison Between Students and Teachers for Sustainability of Programming Self-Efficacy (Research Question 11)

One prerequisite to be able to investigate the possible difference of sustainability of self-efficacy in programming for students and teachers that there should not have been a statistically significant difference between the groups' posttest PRSES mean scores. An independent samples t-test was run on the groups' posttest PRSES scores and it revealed that students' (N=38) posttest PRSES mean score (M=56.68) (See Table 4.12) was almost the same with teachers' (N=28) posttest PRSES mean score (M=56.04) (See Table 4.12) and that there was no statistically significant ($p>0.05$) (See Table 4.13) difference between both groups' posttest PRSES scores.

Then, another independent samples t-test was run on the difference of 2^{nd} posttest PRSES and posttest PRSES scores of both groups. The analysis revealed that the mean difference of .357 was not statistically significant ($p>0.05$) (See Table 4.15). Based on the results, Null Hypothesis (H_0) was failed to be rejected.

4.5.3. Results on Comparison of Sustainability of Entrepreneurship Self-Efficacy Between Students and Teachers (Research Question 12)

One prerequisite to be able to investigate the possible difference of sustainability of self-efficacy in entrepreneurship for students and teachers that there should not have been a statistically significant difference between the groups' posttest ENSES mean scores. An independent samples t-test was run on the groups' posttest ENSES scores and it revealed that students' (N=38) posttest ENSES mean score (M=141.47) (See Table 4.12) was quite close to teachers' (N=28) posttest ENSES mean score (M=139.54) (See Table 4.12) and that there was no statistically significant ($p>0.05$) (See Table 4.13) difference between both groups' posttest ENSES scores.

Then, another independent samples t-test was run on the difference of 2nd posttest ENSES and posttest ENSES scores of both groups. The analysis revealed that the mean difference of 1.639 (See Table 4.15) was not statistically significant ($p>0.05$) (See Table 4.15). Based on the results, Null Hypothesis (H_0) was failed to be rejected.

4.6. Conclusion

This chapter presented the results and findings of the study, as well as details about the data analysis, providing the statistical results in the same tables for all three scales and stating the results one by one for each research question. Next chapter, Discussion, discusses these findings and results along with implications and suggestions for future research.

CHAPTER 5

DISCUSSION

5.1. Overview

This chapter provides a discussion about the findings of the study, as well as conclusions and implications drawn from these findings, after revisiting the purpose of the study. The chapter also presents suggestions for future research. While the purpose of the study will be revisited to remind the goals and aims of the study, the chapter will consist of several sections that separately discuss findings about student self-efficacy, teachers self-efficacy, comparison of student and teacher self-efficacy in terms of enhancement and sustainability, to make it more coherent.

5.2. Purpose of the Study

This study mainly aimed to examine the impact of a short-term training on student and teacher self-efficacy in computational thinking, programming and entrepreneurship. Another goal of the study was to reveal/understand if a short-term training would have a different impact on teachers' and students' self-efficacy in computational thinking, programming and entrepreneurship when, for both groups, the training is planned the same way and supervised by the same instructors specialized in their subjects.

In addition, the study also aimed to measure students' and teachers' mean sustainability/retention scores of their self-efficacy in computational thinking, programming, entrepreneurship, two months after the short-term training was completed, to understand how they retained it. Finally, the study aimed to reveal if teachers' and students' sustainability of their self-efficacy in computational thinking, programming, and entrepreneurship would significantly differ from each other.

5.3. Student Self-Efficacy in CT, PR and EN

The first three research questions of the study investigated whether the student self-efficacy in three important 21st century domains (CT, PR, EN) could be increased with a short-term training. Each domain had its own scale and the results were more than promising, considering the impact of the short-term training.

Results indicate that student self-efficacy in computational thinking significantly increased after a 1-week short-term training which included Intelligent Games Studio and Game Design instructions along with Web Development and Python classes. These findings are primarily similar to what Shell et. al. (2014) pointed out; that incorporation of computational creativity exercises in an introductory programming course for a semester increased students' computational thinking self-efficacy, which was a finding from a study that included a relatively "short-term" training, compared to the rest of the related literature.

The findings are also similar to what Feldhausen et. al. (2018), Weese and Feldhausen (2016) and Bean et. al. (2015) reported; that a "training" enhances computational thinking self-efficacy in students. In that respect, the study has offered an insight that supports what the related literature reported thus far. When it is considered that most of these studies included long-term trainings, on the other hand, this study can be claimed to be offering an insight for a part of the discussion that has been mostly overlooked.

Results also show that, similar to computational thinking self-efficacy, students' self-efficacy in programming also significantly increased after the students were intervened with a short-term training that included a total of 18 hours Web Development and Python classes. These findings are in-line with those of Emurian (2004), Yükseltürk and Altiok (2016) and Govender (2014); whereas, seem to be not compromising with that of Davidson et. al. (2010) as Davidson et. al. (2010) had reported that re-design of an existing training had no positive effect on student self-efficacy. Still, considering the findings from the rest of the related literature and from this study, it appears Davidson et. al.'s (2010) study will stand a loner in that aspect.

On the other hand, the findings and the study can be regarded as a complementary piece for the related (programming) literature, which seems to focus on the relationship between programming background and concepts such as attitude, gender, and education type. Similarly, it was also observed that the short-term training, which included Entrepreneurship and Digital Design instructions, significantly increased student self-efficacy in entrepreneurship. These findings are effectively in-line with those of Lucas and Cooper (2004), who also studied student self-efficacy in entrepreneurship with a short-term (1-week) training. Rest of the related literature, on the other hand, reported from studies that included a long-term training, even though the results were similar/same.

The related literature was also concerned to understand if and at what level the 'enhanced entrepreneurship self-efficacy' turned into entrepreneurial intentions. (E.g. Dehghanpour, 2013; Shinnar et al., 2014). This was obviously not investigated in this study; however, this study can be seen as a complementary piece for the related literature since it shows that a short-term training has a similar-to-same impact on entrepreneurship self-efficacy, on which the concept of entrepreneurial intention can be studied, just as it was exclusively studied with long-term trainings. So, the researchers may not have to wait for the long-term training and studies to be completed to be able to study entrepreneurial intentions upon entrepreneurship self-efficacy. Overall, the findings from this part of the study support each related, current literature in the sense that a relevant training enhances students self-efficacy in computational thinking, programming and entrepreneurship.

5.4. Teacher Self-Efficacy in CT, PR and EN

Research questions from 4 to 6 investigated whether teacher self-efficacy in CT, PR and EN could be increased with a short-term training which included instructions and classes that aimed these domains. Results indicate that teacher self-efficacy in computational thinking significantly increased after a 1-week short-term training which included Intelligent Games Studio and Game Design instructions along with Web Development and Python classes. Results also show that, similar to computational thinking self-efficacy, teacher self-efficacy in programming also significantly increased after the teachers were intervened with a short-term training that included a total of 18 hours Web Development and Python classes. Similarly, it was also observed that the short-term training which included Entrepreneurship and Digital Design instructions and classes as well significantly increased teacher self-efficacy in entrepreneurship.

While these findings support the current literature in the sense that a relevant training does enhance learners' self-efficacy in computational thinking, programming and entrepreneurship, they also offer a completely new insight to the topic because no related or similar study in the literature has actually examined the topic addressing the "teachers" as learners. In all the studies available, these domains were studied with students. (E.g. Shell, et al., 2014; Feldhausen, Weese and Bean, 2018; Feldhausen & Weese, 2016; Govender et al., 2014, Davidsson, Larzon and Ljunggren, 2010; Emurian, 2004; Abdunani, Hbaci and Ku, 2019; Lucas & Cooper, 2005; Breslin, 2017; Dehghanpour, 2013).

On the other hand, it can be argued that the teachers were in "student" role in this training, as learners; however, the teachers are obviously a group of individuals with a different background as they are older, at a different stage at their lives; and this alone would make the insight valuable enough, it can be counter-argued. Moreover, aforementioned trainings are prepared not only for students but for adults and individuals from various disciplines. Thus, examining the impact of a short-term training on teachers can be deemed to be valuable. Moreover, as stated previously, no other study in the related literature offers findings about the impact of training (short or long term) on teachers' self-efficacy in computational thinking, programming and entrepreneurship and in that sense, this study expands the information and insight the literature has to offer. Last but not least, the fact that the findings suggest that teachers' self-efficacy, too, in computational thinking, programming and entrepreneurship can be enhanced with training is an encouraging output for the related research and the prospective training and projects.

5.5. Students vs. Teachers: Enhancement of Self-Efficacy in CT, PR and EN

Whether the short-term training, which includes the same instructions from the same instructors in the same settings for both groups, would impact student and teacher self-efficacy in computational thinking, programming and entrepreneurship any differently was investigated within the research questions from 7 to 9. Since there was a significant difference between the pretest (pre-training) computational thinking self-efficacy scores of students and teachers, the difference between posttest and pretest scores could not be compared for the groups, for computational thinking. On the other hand, the short-term training had a similar impact both on programming self-efficacy and entrepreneurship self-efficacy both for students and teachers as neither of the groups experienced a significantly more increase in their programming and entrepreneurship self-efficacy scores than the other.

It is hard to describe these findings as encouraging or promising as previous ones concerning student and teacher self-efficacy and it is hard to even call them "interesting" or "expected". On the other hand, these results offer a completely new window for the concept of self-efficacy and also for computational thinking, programming and entrepreneurship research. Not only the related literature will now have a set of results to offer about the impact of a training on teacher self-efficacy in computational thinking, programming and entrepreneurship, it will also be able to offer another set of results about the possible difference the training has on student and teacher self-efficacy, even though the results cannot be called "interesting" or "promising".

It should also be noted that the fact that the training did not impact student and teacher self-efficacy any differently is definitely not a negative output as it may seem; nor it is necessarily a positive one. It is quintessentially a neutral one that can be viewed as positive depending on the perspective. If we will interpret these findings as an indication of the success of the training in enhancing both groups' self-efficacy in same levels, it can be a positive one; but what these finding can suggest only is that a short-term training in the same conditions did not impact student and teacher self-efficacy any differently. To be able to tell anything more than that, the research needs similar studies within the same concept and should actually take it further by including control and experiment groups for both students and teachers. In that sense, this study can be regarded as an evoker of new ideas within the same topic.

5.6. Students vs. Teachers: Sustainability of Self-efficacy

No difference was observed between students and teachers in the way that they sustained their computational thinking, programming and entrepreneurship self-efficacy. That is, sustainability of self-efficacy was not significantly different for the groups. Similar to the comparison of student self-efficacy and teacher self-efficacy in the previous subsection, these findings are neither negative nor positive, but just neutral. On the other hand, these results can be seen "interesting" as sustainability of self-efficacy did not differ for two groups with different age intervals, backgrounds and roles in the learning environment and the daily life, but instead these "dissimilar" groups sustained their self-efficacy indifferently. Moreover, the literature has little to no insight to offer about the sustainability of self-efficacy in computational thinking, programming and entrepreneurship, let alone the comparison of sustainability of self-efficacy for students and teachers in these domains and, in that sense, this study not only informs the literature about the sustainability of self-efficacy in these domains but also offers an insight about how indifferently students and teachers have sustained their self-efficacy in these domains.

Another interesting result is that both students' and teachers' retention (sustainability) of computational thinking and programming self-efficacy notably decreased, whereas, it increased for entrepreneurship self-efficacy for teachers and remained almost the same for students, which means that both students and teachers seemed to have sustained their entrepreneurship self-efficacy two months after the training was completed. This might be related to the fact that entrepreneurship courses, due to the way it was designed and it had to be designed, might have evoked the participants' entrepreneurial intentions and they might have kept trying to produce new entrepreneurial ideas like they did in the classes, unlike instructions for programming and computational thinking, from which the participants probably drifted apart unless they were attending similar courses elsewhere.

It should also be noted that while the mean entrepreneurship score was sustained for both groups from posttest to 2nd posttest, there were notable decreases in individuals' mean scores in both groups, which can be interpreted as an indication implying that while the training encourages the groups in overall, it might have made several individuals from both groups realize that entrepreneurship might not be for them; as entrepreneurship classes covered the difficulties of being an entrepreneur, too.

Sustainability of self-efficacy was studied within the scope of this study so that if a short-term training results are overshadowed by poor sustainability; the literature is informed about it. This does not seem to be case, though, as sustainability of self-efficacy was decent for computational thinking and programming self-efficacy and was even encouraging for entrepreneurship self-efficacy.

5.7. Conclusion and Implications

Computational thinking, programming and entrepreneurship are three of the most important domains in the Information Age, where the world is globalized and digitally networked, and the national economies are internationalized. These domains recently receive more attention from the educational society and research, and computer science research as well. While trainings that aim to enhance self-efficacy in these domains are quite common and the research suggests that these trainings – almost exclusively long-term ones – do work in the sense that they enhance self-efficacy, not much is known about short-term trainings, which are also quite common. The goal of this study, therefore, was primarily to investigate the impact of a short-term training on self-efficacy in computational thinking, programming and entrepreneurship, conducting it as a part or Applied Entrepreneurship and Informatics Training for Youth Project, which included a short-term training. The aforementioned project was therefore an important chance and the utmost effort put in this study by the researcher that this chance could be turned into valuable piece of work for the related literature.

In terms of self-efficacy in computational thinking, it was observed that a short-term training indeed provided a significant increase both for students and teachers. This is primarily in-line with the implications from a study by Shell et al. (2014), as it included a relatively "short-term" training compared to the rest of the studies; although Shell et al. (2014) relied on a true experimental design and compared the results for control and experiment group. These findings are also in-line with those of Bean et al. (2015), who measured computational thinking self-efficacy after the participants were trained with programming-based exercise with a tool called "Scratch". Although this study did not investigate the possible correlation or relation between programming courses (Web Development and Python) and computational thinking self-efficacy, it has, from the very beginning, accepted that these courses would play a role in enhancing computational self-efficacy, based on the analysis of findings and implications from the literature and this may be the reason behind the similar and higher levels of increase in computational thinking self-efficacy and programming self-efficacy for both groups, compared to entrepreneurship self-efficacy. Both the study by Bean et al. (2015) and this study seem to have missed this and a future study could be dedicated to further explore and explain it.

To recall, it was also revealed that computational thinking self-efficacy increased for teachers as well. It can be argued here that the teachers were actually "students" in this training as they were the learners in the classroom; however, teachers are obviously a group of individuals with a different background compared to the students. They are older, at a different stage in their lives, have been in the "teaching" role in the classroom, unlike students. That's why, it can be counter-argued that there is a value in providing insight to the related research about the teachers as well. Moreover, all the available studies – for computational thinking – have employed students as participants (E.g. Shell, et al., 2014; Feldhausen, Weese and Bean, 2018; Feldhausen & Weese, 2016; Govender et al., 2014, Davidsson, Larzon and Ljunggren, 2010; Emurian, 2004; Abdunani, Hbaci and Ku, 2019; Lucas & Cooper, 2005; Breslin, 2017; Dehghanpour, 2013) and it was worth exploring this so that research has insight on the same topic with a participant group that has a different background.

Besides, these trainings are prepared not only for students but also for adults and individuals from various disciplines. In that regard, this study offers an insight that is currently not available in the literature and an insight that unfortunately cannot be compared to implications from other studies. It should also be noted these results about teachers' computational thinking self-efficacy are encouraging both for the related research and prospective training and projects.

Sustainability of self-efficacy in computational thinking, on the other hand, was quite acceptable and maybe even encouraging both for students and teachers, considering that there was only a slight drop and that both groups sustained computational thinking self-efficacy in same levels. These results can be interpreted as an evidence implying that short-term trainings aiming to enhance computational thinking self-efficacy are, in fact, successful, in the sense that they enhance self-efficacy in computational thinking with a lasting effect; unlike what one might have assumed. These findings, too, unfortunately, cannot be compared to the implications from the related literature as the research seems to have failed to explore the sustainability of self-efficacy in computational thinking; also, for programming and entrepreneurship. The researcher of this study failed to find an explanation for this in the literature and argues that as it is for almost every other concept, it is important for self-efficacy to be sustained as well. What value would these trainings offer if it was revealed that their enhancements and improvements are overshadowed by poor sustainability and retention? More future studies should include this in their research design so that related parties – primarily the holders of these trainings – know more about the lasting impact of these trainings.

The observations are quite similar for self-efficacy in programming. The short-term term training significantly contributed student and teacher self-efficacy in programming and both groups sustained their self-efficacy in programming quite well. These results portray a strong case for short-term programming training programs as this study shows that they may indeed enhance programming self-efficacy and their impact is acceptably lasting.

Unlike for computational thinking self-efficacy and entrepreneurship self-efficacy, there is a study that explored teacher self-efficacy in programming. Govender et al. (2014) reported findings implying the enhancement teacher self-efficacy in programming, which are similar the results from this study. It can therefore be argued that the research is aware that since teacher self-efficacy plays a role in student self-efficacy and performance (Ashton, Webb, 1986, as cited in Pajares, 2001; Aurah, MacConnell, 2014), they should be included in these trainings and studies, as one of the two parties in the learning environment. A question then arises: Why do computational thinking and entrepreneurship research seem to have failed to do so when the teachers are obviously the ones that will teach these skills to the students? The answer is not in the literature and hopefully will soon be so with future research.

Entrepreneurship self-efficacy is subject to similar observations as well. The short-term training significantly increased student and teacher self-efficacy in entrepreneurship. Moreover, compared to sustainability of computational thinking and programming self-efficacy, sustainability of self-efficacy was more than encouraging for entrepreneurship, as students almost completely sustained their entrepreneurship self-efficacy and teachers sustained their entrepreneurship self-efficacy even better as they displayed a slightly higher entrepreneurship self-efficacy two months after the training was completed. While the findings about the enhancement of entrepreneurship self-efficacy are neither interesting nor surprising even though they are valuable since they are from a short-term training, the findings about the sustainability of entrepreneurship are actually surprising when compared to two other domains and really encouraging on their own. These results can be interpreted as an indication to the success of short-term entrepreneurship trainings and their lasting impact on individuals' entrepreneurship self-efficacy, which is obviously crucial for individuals to display entrepreneurial intentions and act on them.

Another observation was about the overall indifference of the impact of the short-term training on student and teacher self-efficacy. While the difference could not be investigated for computational thinking self-efficacy since two groups' pretest mean scores were significantly different from each other, it could be investigated for programming and entrepreneurship and the results indicated that the short-term training made no significant difference for students and teachers but instead impacted them similarly, as both groups' self-efficacy in these domains increased in same levels. It can therefore be argued that a short-term training – 1-week long in this case – is too short to make a difference for the groups, even though it is needed for a future research to explore this. If the literature had offered any insight about the comparison of enhancement and sustainability of self-efficacy for two different groups, this argument could have been discussed accordingly and thoroughly; but, at least, this insight from this study, hopefully, can help a future study in that aspect.

Teachers were going to be included in this training anyway, as it was how Applied Entrepreneurship and Informatics Training for Youth Project was designed and planned, but the researcher was more than happy to have teachers as participants in the study because teachers are obviously a different group of individuals, for that they have different background than the students, who are the only group of participants in the related studies from the literature. Why was it important to include teachers, again? For one thing, whether the training would work with them as well could be investigated. Moreover, teacher self-efficacy is actually a key determinant for student self-efficacy and students' academic performance (Ashton, Webb, 1986, as cited in Pajares, 2001; Aurah, MacConnell, 2014) (See Figure 2.3). The researcher of the study therefore argues that this study should serve as a model for the prospective studies and more importantly to the training, in the sense that it included the teachers as well.

It should definitely be also noted, before concluding the implications, that the results from study seem to be not compromising with only those from one study; a study by Davidson et. al. (2010). Davidson et. al. (2010) reported that re-design of an existing training had no positive effect on student self-efficacy in programming. This might primarily be because of the fact that the training was a re-design but not a new instruction; however, the study by Davidson et al. (2010) should serve as a reminder for the literature so that these related parties continue to give well-planned trainings, without assuming that they will work anyway. Still, considering the findings from the rest of the related literature and from this study, it appears Davidson et. al.'s (2010) study will stand a loner in this aspect.

Considering all the findings the study has produced, it can also be said that this study considerably expands the understanding about how a training – a short-term training in this case – affects the student and teacher self-efficacy in computational thinking, programming and entrepreneurship. It also helps understand how differently a short-term training affects student and teacher self-efficacy in computational thinking, programing and entrepreneurship, as well as how differently students and teachers would sustain their self-efficacy in computational thinking, programming and entrepreneurship, two months after the aforementioned short-term training was completed. Moreover, the study provides insight about the overlooked and missed parts of the topics from each related literature, such as employing "short-term" training, including "teachers" and exploring the sustainability.

More future work can be allocated in studying the impact of a short-term training in self-efficacy in educational context, as the research agrees that enhancing self-efficacy helps both students and teachers perform better, and a short-term training can help enhancing self-efficacy when time and other constraints are on the table. When the literature has more to offer about these trainings, they will be planned and designed even better and the chance that they will help individuals transform themselves and the society will increase.

5.8. Future Research

- This study could be replicated with the same design but with a new dimension: performance. A new study could focus on measuring both self-efficacy and performance in these domains before and after a short-term training, and performance indications can be used to interpret self-efficacy-performance relationship for these domains.
- The study focused on a 1-week short-term training; future studies can be dedicated to multiple weeks short-term trainings and programs, as multiple weeks short-term trainings are also quite common.
- This study was conducted with a relatively small sample group and there might be considerable gains if it was replicated with a bigger sample or also with a variety of sample groups.
- The study could be integrated into a longitudinal study to see if the self-efficacy gains in these domains ever translates into permanent performance gains and important career decisions and shifts for the participants.
- A future study might rely on a true experimental design that will include 2 control and 2 experiment groups where both control and experiment groups will consist of a group of students and a group of teachers. This would add another dimension to the findings that can be produced as both the impact of the training on students and teachers would be re-visited meticulously and comparing the impact of the training on students and teachers using control and experiment groups would offer even more insight and might offer interesting results.

- One interesting insight from the study was that even though entrepreneurship self-efficacy mean score remained almost the same – it slightly increased for teachers – both for students and teachers from posttest to 2nd posttest which was conducted two months after the training was over, there were notable and even sharp decreases in several individuals’ mean scores from both groups. A future study might employ a mixed method approach to include a qualitative part to further explore and explain the reason behind.

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APPENDICES

APPENDIX A

Voluntary Participation Form

GÖNÜLLÜ KATILIM FORMU

Değerli Katılımcımız,

Bu çalışma, Orta Doğu Teknik Üniversitesi Sürekli Eğitim Merkezi tarafından yürütülmektedir.

Bu çalışmanın amacı nedir? Bu çalışmanın amacı "Gençlerle Uygulamalı Girişimcilik ve Bilişim Projesi" kapsamında alacağınız eğitimlerin etkisini araştırmaktır.

Katılımcı olarak ne yapmanızı istiyoruz? Size verilecek anketleri samimi bir şekilde eksiksiz cevaplamanız beklenmektedir. Soruları, proje kapsamındaki almış olduğunu eğitimi ve tecrübelerinizi düşünerek cevaplayınız.

Alınan bilgiler ne amaçla ve nasıl kullanılacak? Uygulamalar sırasında isminiz kimseyle paylaşılmayacak şekilde incelenecektir. Verdiğiniz cevaplar sorulan soruların etkisini anlama amaçlı değerlendirilecektir. Çalışma sonuçları proje raporunda ve bilimsel amaçlarla kullanılacak olup hiçbir şekilde ad, soyad gibi bilgileriniz belirtilerek paylaşılmayacaktır.

Çalışmayı yarıda kesmek isterseniz ne yapmalısınız? Cevaplayacağınız soruların psikolojik gelişiminize olumsuz etkisi olmayacağından emin olabilirsiniz. Yine de katılacağınızı belirtmenize rağmen çalışmadan ayrılma hakkına sahipsiniz. Katılım sırasında sorulan sorulardan ya da herhangi bir uygulama ile ilgili başka bir nedenden ötürü kendinizi rahatsız hissederseniz çalışmaya derhal son verilecektir.

Bu çalışmayla ilgili daha fazla bilgi almak isterseniz: Araştırmayla ilgili sorularınızı aşağıdaki e-posta adresini kullanarak bize yönetebilirsiniz.

sem@metu.edu.tr, nevzathuruzoglu@gmail.com

Saygılarımızla,

Çalışmaya gönüllü olarak katılmayı kabul ediyorum. ☐

Adı : **Tarih:**

Soyadı : **İmza:**

ÖNEMLİ NOT

SORULARI, PROJE KAPSAMINDAKİ ALMIŞ OLDUĞUNU EĞİTİMİ VE TECRÜBELERİNİZİ DÜŞÜNEREK CEVAPLAYINIZ.

APPENDIX B

Scales of the Study

1- Bilgi-İşlemsel Düşünme Becerisine Yönelik Öz-yeterlik Algısı Ölçeği

	Madde	1 Katılmıyorum	2 Kararsızım	3 Katılıyorum
1	Algoritmaların hangi amaçla kullanıldığını anlıyorum.			
2	Algoritmanın ne olduğunu biliyorum.			
3	Basit algoritmalar oluşturabilirim.			
4	Koşullu algoritmalar oluşturabilirim.			
5	Döngü yapısında algoritmalar oluşturabilirim.			
6	Algoritma oluştururken mantıksal sorgulama yapabilirim.			
7	Bir algoritmanın çıktısının ne olacağını tahmin edebilirim.			
8	Algoritmada bulunan hataları ayıklayabilirim.			
9	Algoritmaların dijital araçlar için nasıl koda dönüştürüleceğini anlıyorum.			
10	Problemi çözüp sonucunu bulduktan sonra yaptığım işlemleri kontrol ederim.			
11	Problemi çözüp sonucunu bulduktan sonra yaptığım işlemleri kontrol eder varsa hataları düzeltirim.			
12	Bir problemi okuduğumda, çözüm için hangi bilgiye ihtiyacım olduğunu düşünürüm.			
13	Problem çözüm sürecinde işlem önceliklerine dikkat ederim.			
14	Bir problemi okuduğumda, çözüm için gerekli ve gereksiz olan bilgiyi ayırt edebilirim.			
15	Farklı çözüm yollarını inceleyerek daha iyi bir çözüm bulmaya çalışırım.			
16	Bir problemi okuduğumda, daha önce çözdüğüm problemleri düşünerek benzerlik ve farklılıklarına göre aralarında ilişki kurarım.			

17	Problem çözerken, hangi işlemi neden yaptığımı sürekli sorgularım.			
18	Bir problemi çözebilmem için yeterli veri sunulup sunulmadığına karar verebilirim.			
19	Bir problem için ürettiğim çözümü farklı problemlere genelleyebilirim.			
20	Verinin ne olduğunu biliyorum.			
21	Veri toplamanın önemini anlıyorum.			
22	Verinin farklı türleri olduğunun (sayı ve metin) farkındayım.			
23	Veri ve bilgi arasındaki farkı açıklayabilirim.			
24	Problemlerin çözümünde farklı veri türleri kullanılabileceğini biliyorum.			
25	Verilerin tablo yapısında daha anlamlı sunulabildiğini biliyorum.			
26	Dijital verinin farklı biçimlere dönüşebileceğini biliyorum.			
27	Değişkenleri tanımlayıp kullanabilirim.			
28	Koşullu yapıları ve döngüleri oluştururken aritmetik operatörleri kullanabilirim.			
29	Bir döngüyü sonlandırmak için değişken ve ilişkisel operatörleri kullanabilirim.			
30	Farklı kontrol durumları için değişik döngüler oluşturabilirim.			
31	Belirli işlemler için hazır fonksiyonları kullanabilirim.			
32	Yönergelerin ve işlem adımlarının önemini biliyorum.			
33	Çözümleri göstermek için şemalar kullanabilirim.			
34	Aynı problem için farklı çözümler üretilebileceğinin farkındayım.			
35	Problem çözme sürecinde hatalarımı nasıl düzelteceğimi biliyorum.			
36	Dijital araçlar tarafından en iyi başarılan işlemlerin ne olduğunun farkındayım.			

2- Programlamaya Yönelik Öz-yeterlik Algısı Ölçeği

MADDE	**1** *Kendime hiç **güvenmiyorum***	**2**	**3**	**4**	**5**	**6**	**7** *Kendime kesinlikle güveniyorum.*
2. "Merhaba Dünya" mesajının görüntülenebileceği bir program yazabilirim.							
3. Üç sayının ortalamasını hesaplayan bir program yazabilirim.							
4. Verilen herhangi bir sayı dizisinin ortalamasını hesaplayan bir program yazabilirim.							
5. İstenilenler açıkça tanımlandığında bir problemin çözümüne yönelik oldukça karmaşık ve uzun bir program yazabilirim.							
6. Yazacağım bir programı modüler bir biçimde organize edip tasarlayabilirim.							
7. Yazdığım uzun ve karmaşık bir programdaki tüm hataları ayıklayabilir ve çalışabilir hale getirebilirim.							
8. Uzun, karmaşık ve birden fazla dosya gerektiren bir programı kavrayabilirim.							
9. Bir programın daha okunabilir ve açık olması için uzun ve karmaşık kısımları yeniden yazabilirim.							
10. Çevrede bir sürü dikkat dağıtıcı olsa bile programa odaklanma yollarını bulabilirim.							

3- Bireysel Girişimcilik Algı Ölçeği

	Madde	**1** *Hiç katılmıyorum*	**2**	**3**	**4**	**5** *Kesinlikle katılıyorum*
1	Yeni başladığım bir işte geliştirmem gereken yönlerimi önceden belirleyebilirim.					
2	İlgi duyduğum meslek alanındaki bilgi gereksinimlerimi giderecek etkinlikleri planlayabilirim.					
3	Kendi yeteneklerimi kullanabileceğim projeler üretebilirim.					
4	Planlı çalışırım.					
5	Alanımla ilgili gelişmeleri düzenli takip ederim.					
6	Soru sormaktan çekinmem.					
7	Zayıf yönlerimin farkındayım.					
8	Takım çalışmalarında öneride bulunmaktan çekinmem.					
9	Fikirlerimi hayata geçirmek için gerekli kaynakları belirlerim.					
10	İçinde bulunduğum grubun liderlikle ilgili sorumluluklarını almaktan hoşlanırım.					
11	Hata yaptığımda vazgeçmem.					
12	Yeni fikirler uygulamayı severim.					
13	Yaptığım işlerin zayıf yönlerini tespit edebilirim.					
14	Başkalarının yapmadığı yeni şeyler yapmaktan hoşlanırım.					
15	Takım çalışmalarında kendi fikirlerimi rahatlıkla söylerim					
16	Fikirlerimi söylemekten çekinmem.					
17	Başladığım bir işi bitirmekte kendime olan güvenim tamdır.					
18	Bir konuda deneyimimin olmaması o konuya ilgi duymam için engel değildir.					

19	Çevremdeki insanların büyük bir çoğunluğu kabul etmese de kendi fikirlerimi uygularım.					
20	Başkalarının önerilerini kabul etmeden önce üzerinde düşünürüm.					
21	Bir problemle karşılaştığımda farklı çözüm yolları üretebilirim.					
22	Yaptığım işlerin güçlü yönlerini tespit edebilirim.					
23	Takım çalışmalarında bireysel sorumluluk almaktan çekinmem.					
24	Sosyal çevrem geniştir.					
25	Çalışmalarımı sonlandırıncaya kadar heyecanım hiç bitmez.					
26	Her zaman bir hedefim vardır.					
27	Bir işe başlamadan önce ön hazırlık yaparım.					
28	Rekabet etmekten çekinmem.					
29	Başladığım bir işi bitirmekte çoğunlukla sabırlıyımdır.					
30	Yeni başladığım bir işte karşılaşabileceğim engelleri önceden belirleyebilirim.					
31	Planladığım bir işte başarılı olabileceğime inancım tamdır.					

APPENDIX C

Parental Permission Form

……./……./…….

ANKARA VALİLİĞİ

İL MİLLİ EĞİTİM MÜDÜRLÜĞÜNE;

Türkiye Ulusal Ajansı tarafından desteklenen ‘Gençlerle Uygulamalı Girişimcilik ve Bilişim Eğitimi’ isimli KA347 projesi kapsamında 28 Ocak-1 Şubat 2019 tarihleri arasında ODTÜ Sürekli Eğitim Merkezinde ve Bera Otel’de Bilişim ve Girişimcilik eğitimi; 26 Nisan 2019 tarihinde Girişimcilik Çalıştayı düzenlenecektir. Bu proje kapsamında düzenlenecek olan etkinliklere velisi olduğum ……………………………. isimli kızımın/oğlumun katılmasında, 28 Ocak-1 Şubat 2019 tarihleri arasında çocuğumun Bera Otel’de konaklamasında, eğitimler için ODTÜ SEM’e servisler aracılığı ile ulaştırılmasında, 29 Ocak tarihinde Feza Gürsey Bilim Merkezini ziyaret etmesinde, proje süresince bilimsel amaçlar için kişisel bilgi paylaşılmadan kullanılmak üzere veri toplanması (anket, ölçek) sürecine dahil olmasında, tüm etkinlikler sırasında çekilecek fotoğrafların ODTÜ SEM ve Mamak İlçe Milli Eğitim Müdürlüğü’ne ait görsel materyallerde ve elektronik ortamda (kitap, afiş, katalog, web sitesi, facebook, twitter, tanıtım filmi…) kullanılmasında sakınca yoktur.

Saygılarımla,

İmza

VELİ ADI-SOYADI

APPENDIX D

METU Ethics Committee Permission

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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23 Mayıs 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç.Dr. Ömer DELİALİOĞLU

Danışmanlığını yaptığınız **Nevzat HURUZOĞLU, Amine Hatun ATAŞ'ın "Bilişim ve Uygulamalı Girişimcilik Eğitimlerinin 21. YY Becerilerine Etkisi"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **043-ODTÜ-2019** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof. Dr. Tülin GENÇÖZ

Başkan

Prof. Dr. Tolga CAN

Üye

Doç.Dr. Pınar KAYGAN

Üye

Dr. Öğr. Üyesi Ali Emre TURGUT

Üye

Dr. Öğr. Üyesi Şerife SEVİNÇ

Üye

Dr. Öğr. Üyesi Müge GÜNDÜZ

Üye

Dr. Öğr. Üyesi Süreyya Özcan KABASAKAL

Üye