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Embedding 21st Century Skills into a Pre-Service English Language Teacher Education Program for Sustainability

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Teacher education programs have a vital role in meeting needs of the global education community. Given the recent emphasis on education for sustainable development, several countries have attempted to reform their education policies and upgrade teacher education programs to promote sustainable education. Likewise, embedding critical and creative thinking, communication and collaboration skills (4Cs) into practicums has become an aim of professional development in pre-service teacher education programs for sustainability. With this regard, this study aimed at examining whether embedding 4Cs skills into teacher education programs through a systemic approach to professional development would help pre-service teachers to develop 4Cs skills and competencies associated with those required for education in the field of education for sustainable development (ESD). This study applied a mixed-methods case study that used critical interpretive research approaches to understand pre-service teachers' experiences with the 4Cs and the connection between the 4Cs and ESD skills and competencies such as critical thinking. The results revealed that pre-service teachers developed the 4Cs as indicated by the Partnership for 21st Century Skills (Partnership, 2019). We concluded that the 4Cs skills that were implemented and developed by pre-service teachers were strongly connected with the ESD skills and competencies for sustainability defined by UNESCO.

Introduction

Education, being a human right, is critical to creating a sustainable future. Branden (2015) claims that education is fueled by energy, and that "it runs on the energy of students, teachers, administrators, parents and all others involved in educating" (p. 5471). The author further points out the importance of using energy effectively to produce new energy for future developments, and that this is increasingly becoming renewable energy. He then states that "if energy for learning happens on a regular and systematic basis, and for every single student in the education system, energy for learning is exploited in a sustainable way, rather than being depleted" (Branden, 2015: p. 5472). This energy for learning can be achieved through the

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holistic transformation of knowledge requiring curriculum and assessment reform, new teacher training strategies, leadership development, and the integration of collaborative technologies.

This new paradigm for education has been thoroughly analyzed by The Partnership for 21st Century Skills (P21), which frames education as "the skills, knowledge and expertise students must master to succeed in work and life; it is a blend of reading content knowledge, specific skills, expertise and literacies" (Partnership, 2019: p. 1). P21 also suggests a new set of learning and innovation skills consisting of critical and creative thinking, collaboration and communication (4Cs), which are commonly known as 21st-century skills, although they are denoted as learning and innovation skills within the P21 framework (Partnership, 2019). Teacher education programs must consider various aspects in order to be able to contribute to teachers' professional learning, since pre-service education experiences can and should contribute to teachers' professional development. Many different names are used for the students in teacher education programs, e.g., student teachers, teacher candidates, and prospective teachers. For the sake of clarity and simplicity, the authors in this study have used the terms pre-service teachers and teacher candidates, depending on the context. Accordingly, English Language Teaching (ELT) pre-service teachers are the focus of this study, since they are in the initial stage of bridging theory and practice, thus offering the greatest opportunity for learning for sustainability, which remains largely untapped in Türkiye. However, it is essential to examine the major tenets of sustainable development in order to determine the skills and competencies that pre-service teachers need to improve for sustainable development.

Reviewing the attempts for ESD and realizing the premise of Goal 4 (United Nations, 2019), we aimed to propose an innovative pre-service teacher professional development framework to help teacher candidates transform 4Cs skills into ESD skills and competencies as an attempt to scaffold the sustainable development strategies. The underlying idea is that learning should focus on integrative competencies, which are essential in the 4Cs for professional life, and not on the acquisition of isolated skills and pieces of knowledge. The framework combines the researchers' experiences, critical pedagogy, and a regulatory perspective, and it suggests an innovative and solution-oriented holistic approach to practice, which is distilled into a series of processes. Skills and competencies are often used interchangeably or defined using different words that are similar in meaning. The working definition of skills and competencies in this study is "those skills and competencies pre-service teachers are required to have in order to be effective teachers and citizens in the knowledge society of the 21st century" (Ananiadou & Claro, 2009: p. 8). Therefore, this study explores the opportunities and benefits of embedding 21st century skills into the education for sustainability and responsible citizenship of ELT pre-service teachers. To this end, this study intended; (1) to enable teacher candidates to implement innovative pedagogies to provide effective teaching for satisfactory learning outcomes through 4Cs skills and competencies; (2) to empower them with the knowledge, skills, and values which can help them take actions to address the interconnected social, political, cultural and global realities of the 21st century development. Accordingly, the study addressed the following three research questions:

(1) What are the perceptions of pre-service teachers on 21st century skills (4Cs)?
(2) What are the perceptions of pre-service teachers on Sustainable Development (SD) and Education for Sustainable Development (ESD)?

(3) Does implementation of the professional development framework embedded into practicum for the development of 4Cs skills make a connection with the ESD skills and competencies?

Conceptual Framework

Educational market can no longer stand the pressure coming from the 21st century challenges which require an aspect of interdependence emerging from a new generation of "systems citizens". This trend has shifted education from teaching to learning to prepare students for modern learning and developing qualities to be global citizens. The 21st century imperatives, therefore, have changed the scope of education due to increasing concern about global inequities and lack of fairness as demonstrated by the Sustainable Development Goals (Ananiadou & Claro, 2009) that governments must provide good quality education and make sure all children can access it. Both 21st century and ESD pedagogies address learning content and outcomes, innovative pedagogy and 'learning by doing.' This is holistic and transformational "characterized by elements such as self-directed learning, participation and collaboration, problem-orientation, and inter and transdisciplinary, as well as the linking of formal and informal learning" (Leicht et al., 2018: p. 40). Hence, teachers must enhance their knowledge to develop new pedagogies based on improving the abovementioned skills which are must in the 21st century. Several researchers (Fullan & Langworthy, 2014; Mishra et al., 2011) argue that teachers need to consider important pedagogical strategies in the 21st century teaching and learning to provide quality education. Embedding 4Cs into practicum improves the quality of teacher education which empowers teacher candidates with the key skills and competencies.

Although there are a diverse range of skills and competencies identified by different education systems, they generally include skills such as critical thinking, collaboration, communication, problem solving, and digital literacy. Therefore, we refer to these transferable or transversal skills as 21st century skills. For the purposes of this study, "skills and competencies" are used interchangeably since 4Cs are related to the usage of cognitive, interpersonal, and intrapersonal domains including knowledge, skills and values though they are sometimes used interchangeably and sometimes with distinct meanings. As a result, the following frameworks developed by Assessment and Teaching of 21st Century Skills (ATC21S), UNESCO, and P21 were included in the study (Griffin et al., 2012; OECD, 2005). As can be seen in Table 1, there are key similarities among the skills identified by three frameworks. The skills identified by ATC21S aim at providing some comprehensible operational definitions, which are the ways of thinking, ways of working, Ways of thinking include creativity and innovation, critical thinking, problem-solving, and learning to learn and the development of metacognition. Ways of working involve communication, collaboration and teamwork (Marilyn et al., 2012).

Table 1. 4Cs skills and competencies identified by different frameworks

ATC21S	UNESCO	P21
Ways of thinking (creativity and innovation, critical thinking, problem-solving, and learning to learn and the development of metacognition)	Learning to know (commit to lifelong learning; continually assess what to know and still need to understand for success in work and life, and be ready to retrain when new situations require new skills. **Learning to do** (developing an aptitude for teamwork and initiative, and a readiness to take risks) Learning to know and learning to do requires developing and using critical thinking, problem	Learning and Innovation **Skills** (creativity and innovation, critical thinking and problem solving) Information, Media, and Technology Skills (critical thinking) - Life and Career Skills thinking skills (content knowledge)

	solving, ICT	
Ways of working (communication, collaboration and teamwork)	Learning to be (developing social and cultural skills, personal responsibility and self-regulation, holding the habits of life-long learner Learning to live together (understanding of ourselves/others, seek and value diversity, work in teams, think as world citizens and understand other cultures)	Learning and Innovation Skills (communication, and collaboration) Life and Career Skills thinking skills (social and emotional competencies/social and cross-cultural skills)

Education for Sustainable Development (ESD)

The concept of sustainable development was first defined in World Commission on Environment and Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). ESD, on the other hand, originated from Decade of Education for Sustainable Development (DESD) (2005–2014) initiated by UNESCO and it has been grown into a global movement. There is no consensus on what comprises ESD and in this paper we employ the definition by UNESCO (2014) as "ESD empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity. It is about lifelong learning and is an integral part of quality education. ESD is holistic and transformational education which addresses learning content and outcomes, pedagogy and the learning environment" (p. 12). ESD has also been regarded as a transformative learning approach, an adaptive process which enables learners not only acquire new knowledge but also develop new ways of thinking. For the transformative learning 21st century learners must develop the following skills; "(i) work independently as self-drive, lifelong learners and innovators; (ii) work collaboratively and respect diverse viewpoints; (iii) think critically about new challenges; (iv) apply their knowledge in novel situations to solve new problems; (v) communicate via range of technologies and methods; (vi) work persistently in the face of difficult challenges" (Malik, 2018: p. 16). There is general agreement within the international ESD discourse that the following key sustainability competencies play an important role in thinking and acting for sustainable development (UNESCO, 2005: p.43).

- Systems *thinking competency:* the ability to recognize and understand relationships, to analyze complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty
- *Anticipatory competency:* the ability to understand and evaluate multiple futures-possible, probable and desirable- and to create one's own visions for the future, to apply the precautionary principle, to assess the consequences of actions, and to deal with risks and changes
- *Normative competency:* the ability to understand and reflect on the norms and values that underlie one's actions and to negotiate sustainability values, principles, goals and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions
- *Strategic competency:* the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield
- *Collaboration competency:* the ability to learn from others; understand and respect the needs, perspectives and actions of others (empathy); understand, relate to and be sensitive to others (empathic leadership), deal with conflicts in a group; and facilitate collaborative and participatory problem-solving

- *Critical thinking competency:* the ability to question norms, practices and opinions; reflect on one's own values, perceptions and actions; and take a position in the sustainability discourse
- *Self-awareness competency:* the ability to reflect on one's own role in the local community and (global) society, continually evaluate and further motivate one's actions, and deal with one's feelings and desires
- *Integrated problem-solving competency:* the overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive and equitable solutions that promote sustainable development- integrating the above-mentioned competencies.

Methodology

Research design

A three-phased sequential mixed methods action research study design was utilized in this study. The methods were integrated by first taking the evidence derived from the need analysis based on reviewing the current ELT program and interviews with the participants. Secondly, focus group interviews were conducted to collect feedback, peer observation notes and reflections. Lastly, the participants were encouraged to engage in developing and implementing appropriate skills and competencies for 4Cs and ESD. This also aimed to critically interpret the pre-service teachers' experiences with 4Cs and the relation between 4Cs and ESD through their own accounts and interactions in a reflective and dialogic setting. Action research has been associated with qualitative methods, but the aim of the study may require the researcher to use quantitative and qualitative data collection tools if there is a need to use statistical data for the augmentation of the qualitative data (Mills, 2011).

Priority was given to qualitative data, and the quantitative data obtained from the 21st century skills questionnaire focused on the pre-service teachers' 'can do' preferences on 4Cs. However, the qualitative data obtained from the focus group interviews, lesson plan development and evaluation reflections and classroom observations with rubrics provided more information and evidence on students' knowledge and attitudes towards 4Cs while at the same time it yielded more information that could help the researchers interpret the data gathered for sustainable development competencies. Data gathered from reflections on teaching practice were also analyzed with respect to description, evaluation, justification, dialogue, and transfer (Venkatesh et al., 2013).

Participants

The participants were 24 pre-service teachers in a semester-long English language teaching practicum course at a prestigious university in Turkey. Their ages ranged between 22–24 and most of them were female. None of them had taught full-time at any level, and most were in the process of completing a 14-week teaching experience requirement. The practicum course provided teacher candidates with the following opportunities to: (1) observe teachers in classrooms, (2) plan lessons for different grades (primary, secondary), (3) deliver lessons in short teaching demonstrations to the practicum instructor and their peers, (4) receive constructive feedback on teaching demonstrations and lesson plans, (5) deliver lessons in real classrooms, and (6) participate in guided discussions about teaching evaluated with observation rubric. To obtain qualitative data about preservice teachers' perceptions about 4Cs and ESD, a subset of volunteers consisting of 10 pre-service teachers as focus group

contributed valuable data at the end of the 14 weeks. The interviews were semi-structured, and the number of the questions changed depending on the topics and the researcher asked additional questions to obtain satisfactory data.

Instruments

A 4-point Likert scale questionnaire (4—Always true of me, 1—Never true of me; ordinal data) with four categories; Communication and Collaboration (13 items), Creativity and Innovation (12 items), Critical thinking and Problem Solving (8 items) and Reflection and Awareness (7 items) was used to explore teacher candidates' awareness and perceptions on 21st skills, namely 4Cs. The underlying reason for embedding creativity, critical thinking, communication, and collaboration into practicum is to prepare teacher candidates for the future, which is likely to contribute to sustainable development. The items were adapted from the "Framework for 21st Century Learning Definitions" developed by the Partnership for 21st Century Leaning (P21). The items were originally phrases, but they were adapted into "can do statements" which are mostly preferred by The Common European Framework of Reference for languages (for example, I can demonstrate the ability to work effectively and respectfully with diverse teams). Cronbach's alpha coefficient was used to assess internal consistency reliability. Cronbach's alpha was 0.821 for Communication and Collaboration; 0612 for Creativity and Innovation; 0.718 for Critical Thinking and Problem and, 0.667 for Reflection and Awareness. The questionnaire, therefore, was confirmed to be showing internal consistency. Cronbach's alpha for the overall questionnaire was .71, which confirmed reasonable internal consistency.

To obtain the teacher candidates' beliefs on ESD, the ESD survey consisting of a series of open-ended questions was used. The items in the survey aimed to obtain the teacher candidates' (1) knowledge of ESD (cognitive aspects); (2) emotions toward, and valuing of ESD, its relation to 4Cs (emotional aspects); and (3) integration of ESD into curriculum and possible obstacles (practical aspects). Focus group interviews provided further information via extension on peer observation notes and reflections.

Data Analysis

This study adopted a mixed method by using a triangulation of data collection tools. Both quantitative and qualitative data were carefully analyzed so that we could obtain satisfactory and "credible inferences from these individual analyses" (Venkatesh et all, 2013, p. 18). For the analysis of the data obtained via questionnaires, SPSS was used, and the average mean and standard deviations of the items of communication collaboration, critical, creative thinking and metacognition were calculated. For the analysis of the qualitative data, content analysis was adopted. According to Zhang & Wildemuth (2017), content analysis is an inferencing and interpretation process of raw data to present in categories or themes. The qualitative data were manually coded and were grouped into different categories and subsequently developed into themes by making use of an inductive data analysis.

Procedure

Shifting into the 21st century cannot merely make teacher candidates to be qualified enough to teach 21st century skills for ESD. There must be professional development activities enabling teacher candidates to rethink their ideas about what they teach and why, and to rethink how they are as a teacher Saavedra and Opfer (2012: p. 1) suggest nine principles for teaching these skills: (1) make learning relevant to the 'big picture'; (2) teach

through the disciplines; (3) develop lower and higher order thinking skills to encourage understanding in different contexts; (4) encourage transfer of learning; (5) teach how to 'learn to learn' or metacognition; (6) address misunderstandings directly; (7) promote teamwork; (8) exploit technology to support learning; and (9) foster students' creativity.

We provided a course named Professional development in line with the practicum, which is a part of teacher education program. The course provided teacher candidates with opportunities to: (1) become aware of professional development concepts (2) become aware of and use 4Cs (3) observe teachers in real classrooms (4) plan lessons to teach 4Cs (5) deliver lessons in short to the practicum instructor and their peers (6) receive constructive feedback on teaching demonstrations and lesson plans, (7) receive instruction on rubric use, and observe the peer (8) participate in guided discussions about teaching, (9) reflect on the teaching practices, (10) develop and use assessment tools.

The course content consisted of modules, the aims of which were to help students acquire teaching skills and competencies in the design, implementation and evaluation of the practicum at primary and secondary education levels. We also aimed to provide the teacher candidates with the opportunities to acquire knowledge and practice of the 21st Century Skills within this discipline and to develop a model to transfer these skills to teacher education program for ESD believing that the prospective teachers must be equipped well with necessary skills and competencies so that they were able to facilitate the acquisition of 21st century skills for unknown future. The 21st Century Skills that were chosen as the focus of this study were: communication, critical thinking, collaboration and creativity (4Cs) which formed the framework for classification.

We aimed to establish a comprehensible process aligning the aim of the study with the frameworks suggested in the related literature. Therefore, as presented in Table 2, the embedding process consisted of four modules; (1) Teacher candidates were explicitly presented materials and the 4Cs. They were also presented instructional approaches to teaching 4Cs, (2) They were presented instructional strategies to deepen learning on best examples of instructional strategies; (3) Teacher candidates were presented materials and methods to build a Positive Learning Environment which encouraged learners' motivation, positive behavior, and collaborative social interaction; (4) The assessment module aimed to provide teacher candidates with knowledge and implementation of assessment tools for 4Cs.

The study took place in an instructional environment for the 4Cs interlinking campus activities with a 2-h course and a minimum of a 6-h practicum they were attending at different grades in a state school. During campus course, they practiced through the micro-teaching sessions as a preparation for their authentic practice. Pertaining to the three common dimensions of instructional design- planning, instructing and assessing, the teacher candidates were given feedback and scaffolding when going through the following stages:

- *Planning to teach at least one of the "Four Cs" skills*: Future teachers made their choice for the content from the textbooks used in elementary, middle and high schools, and skills to be taught, the methods to be used, and the assessment tools preferred. They prepared lesson plans adapting the topic from the textbook for the 4Cs and sustainable development. They were offered the opportunity to work in pairs and share ideas on the lesson plan they prepared.
- *Implementation of the lesson plans (1):* They first experienced teaching practice the topics of which they selected from their textbooks and adapted to embed the 4Cs

skills. They decided on the instructional strategies to use during their teaching. They were observed by their peers using rubrics and taking notes which shed light on peer feedback, peer observations, and guided small group discussions about teaching. We assumed that the data obtained from the rubric would improve preservice teachers' ability to identify the indicators of best practices for lesson planning and lesson delivery.

- *Reflective practice*: In line with the aim of the study, the interviews, reflective journaling (on lesson plans, instructional tools and alike) were conducted to promote reflection and engage teacher candidates in the reflective process. During reflective practice, teacher candidates were observed to have gained the ability of being reflective in teaching experience as well. This process enabled teacher candidates to develop experiential knowledge of 21st Century Skills- learning and teaching in a controlled way and getting feedback after teaching experience in order to encourage reflection.

- *Implementation of the lesson plans (2):* Having been given feedback on instructional strategies, materials, learning environment and others of the first teaching practice, the teacher candidates were expected to prepare lesson plans for the second teaching practice. Peer feedback provided authentic and meaningful opportunities for pre-service teachers to learn how to become more reflective in their teaching. Thusly, they shaped their second practice teaching based on the feedback they received from their peers during practicum.

- Assessing *at least one of the "4Cs" skills:* Using measures to determine whether the teacher candidates achieved the established instructional outcomes. It is difficult to assess 21st century skills. Both formative and summative assessments play useful roles in teaching the 21st century skills, but preparing standard summative assessment is difficult. Formative assessment tools are commonly used since they are targeted to remind learning goals, to give feedback about the progress and vagueness.

Table 2. Pre-service teachers' professional development framework

Modules and Descriptions	Contents of the Module—Targeted Teacher Instructional Competence
Module 1 Instructional Planning	Creating a bridge between theory and practice based on the varying needs of students. Raising awareness of the teacher candidates on 21st century skills.
Readings, Videos of good examples, online coursework materials and feedbacks assessments, to plan and implement lesson plans and practice 21st skills in small groups and in practicum.	Specific Areas of Emphasis: • Set short- and long-term goals that target the 21st century competencies, supporting both university life and teaching readiness. • Read the handouts including essential information about 21st century learning, skills, teacher competencies. • Look for learning opportunities based on their interest • Observe instructional models, demonstration lessons, unit or lesson plans to have a vision of practice on which they can develop their own learning. Use a KWL chart • Think pair and share the instructional models for 21st century skills • Set instructional goals and prepare lesson plans that are integrated with the 21st century skills into the topics aligning with SD in the textbooks. • Make instructional and lesson plan modifications to improve the equality for diverse learning needs • Reflect, both individually and collaboratively (group discussion), on the effects of instruction and use the reflective process to continually improve instructional

	practice. Reflect and inquire should be central to learning and development.
PD instruction was planned to target the 21st-century skills within the courses given at the university and practicum.	Reflection process: • Metacognitive reflection that focused on the session's impact on teacher candidates 'lesson planning, teaching experience and potential impact on their students' development • Reflect individually with guiding questions and the use of a Professional development portfolio. • Reflect collaboratively through the use of protocols for providing feedback and looking at student work.
Modules and Descriptions	**Contents of the Module—Targeted Teacher Instructional Competence**
Module 2: Developing and Using Instructional Strategies	Instructional strategies mainly were inquiry based, subject focused, collaborative, and designed to address teachers' conceptual understandings as well as pedagogical content knowledge. Specific Strategies:
Instructional strategies aimed at deepening their learning on specific strategies they can adapt and use.	• Project-based and problem based, inquiry-based approaches to learning with real-world problems (Comparison and classification, Metaphors and Analogies) • Intellectually challenging tasks. (Problem-solving tasks, Decision-making tasks, Investigation tasks.) • Collaborative learning activities. • Setting objectives and providing feedback • Coaching or expert scaffolding (the effective implementation of new curricula, tools, and approaches by the researchers and mentors) Adapting materials for ESD (making connections between classroom by adapting the textbook materials with authentic and real world materials and tasks.) These activities help students actively participate in local and global issues (Down, 2010)
Modules and Description	**Contents of the Module—Targeted Teacher Instructional Competence**
Module 3: Building a Positive Learning Environment	Dumont and Istance (2010: p. 29) state that the effect of a learning environment depends on the interactions between four dimensions—The learner (who?), teachers and other learning professionals (with whom?), content (learning what?) and facilities and technologies (where? with what?)" An innovative/flexible learning environments encourages learners' motivation, positive behavior, and collaborative social interaction
Creating a positive learning environment enables students learn better. A positive environment involves managing the classrooms well, having students set clear learning goals and enhancing their social and academic success. A well-managed classroom centers on respectful, collaborative relationships that support student learning.	Specific Areas of Emphasis: • Establish appropriate rules and routines for authentic learning to occur. • Create collaborative activities for motivation and emotional maintenance • Prioritize sensitivity to individual learner differences and prior knowledge. • Genuinely care about students' cultural, emotional, and intellectual needs. • Change from instructor to facilitator and be adaptor. • Scaffold students' learning in their native language and encourage them to master learning. • Encourage passion and perseverance to increase student motivation and maintain high expectations for student performance. • Encourage students with authentic learning allowing them to formulate problems and solutions that are associated with concrete relevance in the 'real world'

Modules and Description	Contents of the Module—Targeted Teacher Instructional Competence
	(Dumont and Istance, 2010).
Module 4: Assessment	Use formal and informal assessment strategies to evaluate teacher candidates progress toward learning goals, and provide feedback to improve their learning. Formative assessment can better align individual students to targeted support.
Assessment provides a clear picture of students' performance in relation to the standards, informing teaching practice and further learning.	Specific Areas of Emphasis: • Use formative methods that improve teacher candidates' competencies to integrate 21st skills into practicum • Use formative assessment to maintain personalized learning • Use self and peer assessment rubrics, especially for their teaching experiences. • Adjust instructional practices in response to assessment data, • Use rubrics to clearly define assessment criteria. • Create written exams that mirror teacher candidates' reflections on materials, methods and teaching experiences. • Assess student progress in using the textbooks, adapting the materials, preparing lesson plans to solve problems and take action in the classrooms. • Develop a plan for grading and reporting student progress.

Findings

Teachers' perceptions on 4Cs and ESD were categorized in three themes: perceptions of 4Cs (See Table 3), perceptions of ESD (See Table 4), and the interrelation between 4Cs and ESD (See Table 5). The resulting data were tabulated, and qualitative data were presented as categories and themes, and common points emerged. And quantitative data were as average means and standard deviations. The tables below display the joint interpretations of the findings connecting qualitative data with qualitative and qualitative with quantitative data findings in order to fully address the research questions.

Regarding the first research question in this study, perceptions of the pre-service teachers were broken down into indicators of the themes associated with the (4Cs) skills. The themes derived from the participants' reflections (See Table 3) show that teacher candidates were aware of literal definitions of 4Cs, and they had confidence in being able to use critical thinking, creativity thinking, collaboration, communication well. The data obtained from the rubrics used for classroom observation supported the idea that they were effectively communicating with the students and held the ability to actively listen and respond appropriately to them. Teacher candidates valued working with their peers, which paves the way for the use of effective social skills. The findings also demonstrate that teacher candidates could develop original and creative ideas, try different ways to solve problems, and they seemed to have the ability to analyze and evaluate their thoughts.

Table 3. Pre-service teachers' perceptions of the 4Cs

Category	Themes	Emergent Issues
Critical Thinking	Being open-minded Deep learning Analysis Criticize	"Critical thinking enables teachers to be deeper thinker, critical and being open-minded."

Creative Thinking	Finding new things New and imaginative ideas Being an inventor	They struggled to define creative thinking in specific terms and held misconceptions for creativity as they considered "new" as creativity
Communication	Interaction with others Sending and receiving messages Using language effectively	"I know it is important for a teacher, but I am not sure I will be able to communicate well with my students."
Collaboration	Working together (pair or group) Helping each other Supporting each other	"I like to work with my friend since I feel more confident. We share the roles and tasks, and we know our responsibility."
Innovative Pedagogy for 4Cs	Problem based Project based Holistic	Teaching strategies must be based on real-life situations, real problems in the classroom and finding solutions for those real problems
Suggestions for 4Cs integration	Curriculum reconstruction Professional development Collaboration	ELT curriculum must be updated. MoNE, Policy makers, school administrators, parents and collaboration among the teachers from different disciplines can help the integration of the 4Cs

In addition, teacher candidates favored teaching strategies including inquiry and problem-based and holistic approaches. When they were asked about Ministry of National Education's (MoNE) support for the integration of 4Cs, they seemed to be holding negative views saying that there was no certain information about the 4Cs in the textbooks. Responses to the question "What should be done for the integration of 4Cs?" revealed that "curriculum must be reconstructed; professional development modules must be added and there must be collaboration among the stakeholders and teachers of different courses".

Regarding the second research question, the findings indicated that the majority of the teacher candidates did not hold certain information about SD and ESD (See Table 4). Teacher candidates described ESD with the terms pertaining to protecting the environment since they perceived sustainable development as taking care of resources for future generations. When analyzing the common issues emerged in general, we inferred that the participants held a positive attitude towards ESD, since the most common issues were on the link between the quality education and SD. We can also observe from the table that they commonly favored the link between 4Cs and ESD since they believed 4Cs could provide people with knowledge, skills and values, which is a key lever of sustainable development. Observed interconnectedness of all development goals with key inter-linkages between 4Cs and ESD imply that when one is improved more, it affects the other more positively. We can also interpret that both ESD and 4Cs are depended on new skills and competencies development approaches which have become central point of all learning settings.

Table 4. Pre-service teachers' perceptions of ESD

Category	Themes	Emergent Issues
ESD for the environment.	Respect for the environment	ESD enables students to understand themselves before understanding others and build a respect for the environment.
ESD as education for sustainable development	Working together Understanding others	People, as individuals and societies, need to learn to live together sustainably and I think education teaches us how to do it.
ESD as an outcome of 4Cs	Quality education Skills for quality in education	ESD aims to spread the educational opportunities for every person in a life-long span to be aware of sustainability and 4Cs are the key skills that people must gain for ESD.
ESD as sustainable future	Present and Future life	If we provide qualified education for all students, we could create a much more sustainable world for us and also for the future generations
Integrating ESD into the ELT curriculum	CLIL Content Based	Issues of ESD can be presented in the textbooks of different courses. The content provides meaningful learning for both language skills and global problems. Problem and project based teaching strategies can be

		used effectively.
Teaching ESD topics in English Language Course	Environment Saving Energy Understanding Values	The textbooks delivered by the MoNE have the topics related to sustainable development. However, they are used for language development not for knowledge, attitudes and values of the society

Further individual-level analysis of the questions about emotions toward and valuing ESD showed that almost all of the respondents claimed to have a very good grasp of the ESD and stated that they were willing to increase their knowledge about ESD. However, they also complained about high stake examinations which prevented them from investing their time and efforts in learning more about global issues. They maintained that "4Cs help to us apply ESD in our classes in the future," '4Cs has a positive influence on sustainable development and global citizenship'.

Almost half of the teacher candidates seemed to have good knowledge of interconnection between 4Cs and ESD though the others did not make a clear connection. Those who clearly stated the relation between the 4Cs and ESD claimed that 4Cs skills aim to develop the way people think and act, so they learn to be fair-minded, understanding others and working together, sharing ideas and creating new and better ideas, which help SD. They also said that ESD aims to spread educational opportunities for every person in a life-long span to be aware of sustainability, and 21st skills are very beneficial tools to sustain ESD for everyone. They further explained that '4Cs enable us to improve our problem-solving skills since they help us use actual practices as opposed to only learning theories, which help us incorporate global issues into our teaching practice."

They also contended that the content of the topics was used as medium of developing the English language skills not explicitly SD. They suggested Content and Language Integrated Learning (CLIL) and Content based language teaching approaches since they are based on developing both language and content knowledge. Their responses also emphasized the holistic aspect of the ESD. For instance, they were of the opinion that CLIL approach, which refers to the integration of different disciplines, could develop both language skills and global awareness. They similarly suggested that such teaching strategies as problem- and project-based teaching which increase retention of content, improve students' attitudes towards learning, and then enable learners to develop the appropriate qualities and values to go on to build a sustainable society. Teacher candidates were also observed to be quite knowledgeable about the integration of ESD into curriculum. They indicated that the textbook used have such topics as saving energy, climate change, protecting environment and so on related to SD.

Regarding the third research question, a four-point Likert scale questionnaire was used at the end of the study to find out if the pre-service teachers were holding dispositions of the 4Cs and Metacognition set by P21. The mean and standard deviations of the skills and competencies from the questionnaire are given in the first and second column of the table. The ESD skills and competencies by UNESCO to be obtained are given in the third column. Table 5 displays that the majority of the teacher candidates hold a certain level of basic understanding about 4Cs since the average mean value of all categories are over 3.0 out of 4.0 with reasonable standard deviations. This also showed that the teacher candidates were quite positive and certain about the 4Cs indicated by P21. Some of the teacher candidates seemed to have a certain level of knowledge about communication skills. Therefore, there seemed to be a close correlation between 4Cs skills and ESD skills and competencies.

It was observed that practicing the 21st century skills in planning and delivering lessons with

the SD related topics helped the teacher candidates develop transboundary skills and competencies since they not only reflected on the quality of the lesson plans but also the real classroom implementation process. In this respect, we can draw the conclusion that embedding 4Cs into practicum promoted the pre-service teacher professional development on the skills which were not stated in the program. This embedding process helped them develop learning on degree specific skills; critical and creative thinking, communication and collaboration which are interrelated with the ESD skills suggested by UNESCO. The analysis of open-ended questions, on the other hand, revealed that almost half of the respondents seemed to have good knowledge of interconnection between 4Cs and ESD though the others did not make a clear connection. The common idea emerged was that "There is a direct and organic link between 21st century skill and ESD."

Table 5. Interrelation between 4Cs skills and ESD skills and competencies

Categories	Average Mean/SD	Skills from P21 Framework in the Survey	ESD Skills According to UNESCO (2012)
Communication	3.4 0.775	Articulate thoughts and ideas Listen to knowledge, values and attitudes Use ICT Communicate in diverse environment	Communicate effectively both orally and in writing
Collaborate with others	3.2 0.685	Work effectively and respectfully with diverse teams Use social skills in order to avoid conflict and maintain happiness Consider the ideas of others Value the individual contributions made by each team member.	The ability to work cooperatively with other people
Creativity and Innovation	3.1 0.712	Use a wide range of idea creation techniques Develop creative solutions to problems after examining alternative possibilities from many angles Being open and responsive to new and diverse perspectives.	The capacity to move from awareness to knowledge and to action
Critical Thinking and Problem solving	3.0 0.702	Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems Analyze and evaluate evidence, arguments, claims and beliefs and alternative points of view Ask questions at all levels of Bloom's Taxonomy of Thinking solve different kinds of non-familiar problems in both conventional and innovative ways.	The ability to think critically The ability to think about systems (both natural and social sciences) The ability to analyze values underlying differing positions The capacity to develop an aesthetic response to the environment and the arts
Reflection and Awareness (Metacognition)	3.1 0.714	Conscious of the steps and strategies during the act of problem solving Synthesize and make connections between information and arguments.	The capacity to move from awareness to knowledge to action The capacity to use the processes such as knowing, inquiring, acting, judging, imagining, connecting, valuing and choosing.

Discussion

The results revealed that pre-service teachers were knowledgeable about literary meanings of 4Cs which correlated with those defined by P21. It was interpreted from the teacher candidates' responses that they were favoring the integration of 4Cs into the teacher education program with the appropriate teaching strategies. Evidence suggests that the embedding process improved teacher candidates' abilities to exhibit collaboration, communication, critical thinking, and creative thinking skills. The outcomes of this study correspond with the outcomes in the literature, suggesting that innovative approaches such as project-based learning, problem- and inquiry-based approaches facilitate deep learning, which

then develop 4Cs skills, improve levels of engagement, and enhance long-term academic and social outcomes (Darling-Hammond, 2008; Ravitz, 2009).

Teacher candidates said that they would value more opportunities for practical advice, collaborative critical reflection and support for problem solving in relation to ESD though they had difficulty in conceptualizing sustainable development and its sub-components. They also expressed positive attitudes, knowledge and skills in line with 4Cs and ESD. Raskin (2008: p. 469) suggests that both every day and formal education cannot alone positively contribute to a sustainable future, rather, "the shape of the global future rests with the reflexivity of human consciousness- the capacity to think critically about why we think what we do- and then to think and act differently, which requires holistic approaches, envisioning change, and achieving transformation." Teacher candidates favored the student-centered teaching like holistic, problem- or project-based approaches to teaching the 21st century skills. It is interpreted that they were highly aware that these approaches would enable learners to learn both content knowledge and 21st century skills, which in turn could help them develop their knowledge, values and skills for SD. Prettyman, Ward, Lauk and Awad (2012: p. 11) state that these approaches are not teaching 21st century skills, but helping students learn them since they "learn to develop their own ideas," test and share those ideas, and take input from their teachers and peers to further develop their ideas.

The results of the survey made up of open-ended questions aimed to find out teacher candidates' beliefs and perceptions indicated that almost all of the students used literal meanings, not operational definitions of SD and ESD. ESD is not about simply 'knowing' but also about 'doing' as well as valuing. It implies acquiring and applying knowledge and skills to become personally engaged with the challenge of helping to bring about sustainability. UNESCO's guidelines and recommendations for reorienting teacher education to address sustainability suggest that "addressing ESD will require student teachers to think about their profession differently and learn skills that perhaps, teachers in previous eras did not learn or use as well as understanding the interrelatedness of the environment, society, and economy and having this interrelatedness evident in their teaching and their lives as community members" (UNESCO, 2005: p. 43).

Teacher candidates' responses also revealed important insights regarding the extent to which their experience with 4Cs equipped them with the necessary worldviews, skills and competencies for a sustainability-oriented society, mainly SD and ESD. It is obvious that ESD and 4Cs skills and competencies are overlapping. However, developing knowledge and skills do not always provide sustainability as Sterling (2011) claims it is critical to develop a whole system approach emerging from a holistic mapping of sustainability. The analysis of the qualitative data obtained from interviews and observations implied that teacher candidates, when developing lesson plans and practicing in actual classrooms, were making connections between daily activities (such as climate change, energy conservation and waste) and sustainability issues which are directly linked to these activities though they are not explicitly given in the textbooks. However, sustainability issues are characterized by complexity and uncertainty, and as a result ESD needs to evolve itself in order to be able to provide skills and competencies that enable students to cope with this complexity and uncertainty (Sterling, 2011). This is in line with the scope of 4Cs skills and competencies empowering students as future agents of change in the broader context. It was also observed that 4Cs provided teacher candidates with the knowledge, values and skills which enhanced their ability to become open to individual learner differences, and also how to use this in their lesson plans and deliveries, which is essential for sustainable development (USTESD, 2013).

Therefore, the implantation of the framework developed helped teacher candidates use in and out of class activities, which provided an interconnection between 21st century and ESD skills and competencies. UNESCO (2012: p. 11) emphasized that teaching and learning have been shifted "from the content of learning programs and teaching/learning methods to the recognition, assessment and validation of knowledge and skills."

Furthermore, almost all of the teacher candidates were generally positive in their approach to 4Cs though they had difficulty integrating them into their lesson plans and teaching practice. Quantitate data revealed that they were able to integrate 4Cs in their lessons in terms of developing appropriate values and attitudes in line with ESD, but qualitative data showed that they were relatively under-prepared in terms of confidence in their knowledge and skills to implement 4Cs practices in school context. Sterling (2011) suggests that students should go through three orders of learning and change: cognition, metacognition and epistemic learning. Epistemic learning is the transformative stage at which learners consciously alter their previously acquired knowledge for the new situations. The process suggested by Sterling requires that pre-service teachers be open to change, which may be the springboard for a move towards 'future oriented models of teaching and learning' (p. 30). We assume that teacher candidates need consistent opportunities for the three orders of learning, transformative in particular to alter their ways of being in the world, which is the main reason for the inefficiency of ESD.

Conclusion

The study in practice examined an embedding process of 4Cs skills and competencies that teacher candidates can develop to transfer to other contexts. The findings provided evidence that aligning curriculum, teaching approaches, materials to embed 4Cs into practicum with a collaborative and coherent system (a professional development framework) successfully enabled pre-service teachers to develop the knowledge, skills, and values which were strongly connected to ESD. Similarly, pre-service teachers initially expressed only literary meanings of 4Cs in the beginning of the study. At the end of the study, they developed their literal definitions into "I can" of the skills and competencies when they followed a framework that incorporated opportunities for the teacher candidates to practice these skills with the support of feedbacks aiming to improve their both cognitive (think, read, learn, remember, reason, and reflect) and non-cognitive skills (social skills, perseverance, academic mindset, learning strategies). The findings also revealed that teacher candidates perceived ESD only as an education that focuses mainly on respecting the environment and working together (partnership for the goals), and they did not show any more deeply consideration on the competence vision of ESD. The results also implied a disconnection between themes related to sustainability or ESD and actual awareness and views of students in relation to ESD. There is no certain information about the significance and importance of education for sustainable development (ESD) in the teacher education program either. Accordingly, teacher candidates were observed to hold the belief that there was a strong need for periodically revisiting the curriculum to update methodologies to enhance pre-service teachers' knowledge about innovative pedagogies for embedding 21st century skills into teacher education program. The amalgamation of 21st century skills could eventually equip them with skills and competencies to act as change agents to actively incorporate sustainability aspects directly or indirectly into their teaching practices.

The assumption of the study was that improving the quality of pre-service teacher education would be inspiring for sustainable development. We understand that 4Cs are essential skills

and competencies for the teachers in practice who have to solve problems when needed, along with a consideration of the consequences of their decisions and actions. In this sense, a synthesis of information, thoughts and suggestions were offered based on many pre-service teacher education experiences at a global level. The developmental stages of the embedding process with an interdisciplinary approach concerned with ESD were crucial to validate the perspectives about sustainability in a global way. The success of this very embedding which held the possibility of increasing the extent of 21st century 4Cs in pre-service teacher education within a framework developed and used through the study could foster similar initiatives elsewhere.

Based on these findings, one could suggest that teacher candidates should not only focus on the knowledge of targeted skills but also on transferring these skills into real life situations for sustainable development. "A new pedagogy of transformative education must replace the transmission model of teaching and learning that continues as the dominant practice in most schools in the world" (Bell, 2016: p. 52). Furthermore, sustainability uses concrete examples in order to make abstract concepts more meaningful. As teacher candidates indicated, there were abstract terms referring to sustainability in the textbooks. Accordingly, the cross-cutting themes of sustainability and its related issues in textbooks (e.g., climate change and environment) should be supported with excellent real-life examples just like the ones that teacher candidates experienced in this study while developing lesson plans and delivering teaching in real classrooms (Tilbury, 2004). Pre-service teachers were also observed to implement 4Cs which could pave the way to ESD if they were supported. This understanding raises the awareness that policy-makers should target the 21st century skills, thereby facilitate the likelihood of successful integration of SD in the existing subjects (Lambrechts, Mula, Ceulemans, Molderez & Gaeremynck, 2013). It is also reasonable to suggest that there should be a framework within teacher education curriculum which explicitly promotes the awareness and development of ESD competencies among teacher candidates for sustainability. We also suggest that researchers conduct future empirical studies to investigate possible effects of professional development to promote ESD competencies so as to extend the stream of research in the literature on sustainability education.

Limitations

There are three major limitations in this study that could be addressed in future research. First, there is very little prior research on this topic, this created a new gap in the prior literature for further studies to fill this gap. Second is that the study was not designed to be a comparative study, so there were no statistical values to generalize the findings, which warrants further research for more in-depth analysis of both quantitative and qualitative data. The final limitation is that the findings are relevant to the context being investigated. It may yield different findings in other contexts.

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Declarations

Ethics Statements: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest: The authors declare that they have no conflict of interest to disclose.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Data availability: All the contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.