Fostering Turkish Early Childhood Teachers' Professional Growth about Education for Sustainability through Media Literacy [*]

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Abstract

This article aims to document the findings of a professional development intervention study seeking to promote in-service preschool teachers' professional growth about education for sustainability (EfS) through media literacy (ML). The overall aim of this year-long action research project (based on the Analyze, Design, Develop, Implement and Evaluate or ADDIE approach) was to foster teachers' knowledge and awareness regarding EfS via a professional development program incorporating media literacy education. Four preschool teachers participated in the professional development program. Participants' in-class EfS implementations before and after the professional development program were examined utilizing interview, stimulated recall interviews, field notes and content analysis of teacher daily and monthly plans. The principal outcome of the study was that the proposed professional development program does, indeed, lead to the growth of the early childhood teachers' EfS knowledge and awareness. In the short term, examination of participants' pre/post intervention teaching activities indicated that fostering teachers' ML skills helped when designing EfS activities since they were able to access, analyze & evaluate and create EfS related media resources more effectively. Longer-term, the teachers involved in the study incorporated an increased number of EfS related activities in-class, as evidenced by their post-intervention daily and monthly plans.

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Introduction

The recent reports published by the World Wildlife Fund (2018) and Intergovernmental Panel on Climate Change (IPCC, 2018) highlighted that the Earth and its biological components, including humans, are confronted with increasingly sophisticated climate challenges that are forcing us to review our current policies and practices (Davis, 2017). A seemingly miniscule, 1.5 ^{0}C increase in the world temperature (compared with pre-industrial levels) might cause life-threatening heatwaves, droughts, floods, heavy rain, storm, fires; rise in sea levels, and destruction of human health and wellbeing (IPCC, 2018; Watts et al., 2018). To combat these challenges, adopting new "frames of mind" that impact thoughts, decisions, and actions has become a necessity in order to eliminate unsustainable lifestyles (Bonnett, 2004; Elliott, 2010). Education, particularly at the early childhood level, has a critical role in accomplishing such a paradigm shift by re-imagining and transforming public practices related to sustainability (Elliott & Davis, 2009). Without enhancing educators' and practitioners' competencies in designing and implementing effective EfS activities in the classroom, we cannot anticipate significant transformation of children's and, thus, society's attitudes towards more sustainable future. The literature review, on the other hand, points out a lack of studies focusing on the enhancement of early childhood educators' skills in designing/implementing EfS related learning activities. In Turkiye, for example, a recent study of deliberative policy analysis on teacher education (specifically in-service professional development), indicates a deficit in research efforts examining EfS related teaching activities in early childhood settings (Alici, 2020).

Context of the Study

Virtually all early childhood education and care services provided in the country are supervised by two governmental bodies: Ministry of National Education (MoNE) and Ministry of Family and Social Policies (MoFSP) (Göl-Güven, 2018; Tuğrul, 2018). While MoNe is responsible for implementing a nation-wide early childhood curriculum and regulating nearly all public and private schools serving children between the ages of 3-to-6 years old (with the exception of a few religious schools, NGO-run schools and schools operated by foreign embassies); MoFSP governs the licensing and operation for creches (in Turkish context: day care centers providing childcare services within workplaces for workers' children), private day care facilities and children's clubs serving children between the ages 0-to-6 years old (Göl-Güven, 2018; Ünlü-Çetin, 2013).

Regardless of the supervising agency, all early childhood education and care facilities in the country (aside the few exceptions mentioned above) are required to follow the curriculum developed for MoNE by a panel of experts (Tuğrul, 2018). There are two distinct national early childhood education programs being currently implemented country-wide. One program is specifically designed for the education of children between 0-to 36 months old (MoNE, 2013a) while the other one is developed for older children -between the ages of 36-to-72 months old- (MoNE, 2013b).

The literature review reveals only a few studies examining National Early Childhood Education Programs from the lens of 'sustainability', 'sustainable development' or 'education for sustainability' (Alici & Alan, 2022; Bulut & Çakmak, 2018; Pamuk et al., 2021; Yağan-Güder, 2013). There were no studies focusing on the program for younger children at the time of writing thus the term 'National Early Childhood Education Program' or 'MoNE Program' only refers to the program for children between the ages of 36-to-72 months old from this point.

The MoNE program is structured around 63 objectives and 240 indicators (covering several developmental domains: psychomotor, cognitive, social and emotional, language development, and self-care) (MoNE, 2013b). Two studies reviewing the program objectives and indicators found out mostly loose, indirect connections to EfS (Bulut & Çakmak, 2018; Yağan-Güder, 2013). However, the objectives and indicators can be associated with sustainability, e.g. to protect others' and one's own rights, by the teachers during their educational practices (Alici & Alan, 2022; Pamuk et al., 2021). In the current study, all participating teachers are employed at schools that follow the aforementioned national ECE curriculum.

All the teachers participating in the current study have 4-year degrees from universities' early childhood teacher education programs. Similar to the national early childhood curriculum, nearly all Turkish universities offering early childhood education bachelor's degree are required to follow a curriculum developed by the Turkish Higher Education Council, "the primary governmental institution for formulating and coordinating the conduct of all prime directives and strategies for Turkish higher education" (Aydinlı & Matthews, 2021, p. 251-252).

The most recent iteration of the national early childhood teacher education undergraduate program has been implemented at the beginning of the 2018-2019 fall semester. The current program includes 'Environmental Education in Early Childhood' (Compulsory) and 'Child and Media' (Elective) courses as a part of its core requirements in addition to the 'Sustainable Development and Education' course which has been the part of Early Childhood Teacher Education undergraduate program since 2018 (Council of Higher Education, 2018). Even though the addition of new courses focusing on EfS and ML were welcomed, some scholars have been expressing their concerns on the fact that most universities in the country lack the resources and the expertise for teaching these courses effectively (Altun, 2014; Gülay-Ogelman & Güngör 2015; Toran, 2017).

The theoretical background of the Study

This study's theoretical underpinnings originated from an Early Childhood Education for Sustainability (ECEfS) adaptation of Bronfenbrenner's Ecological Approach (McCrea & Littledyke, 2015). Both the original and adapted models put the child at the focal point of five reciprocally interacting social systems (namely, microsystem, mesosystem, exosystem, macrosystem, and chronosystem) each of which influence child outcomes in unique ways (Bronfenbrenner, 1979).

McCrea and Littledyke revised Bronfenbrenner's model to include ECEfS implementations with children. The revised Ecological Model adds organic-looking circles with broken or segmented lines as opposed to Bronfenbrenner's strict, circular structure, to emphasize "the two-directional permeability of influences and relationships'' so children can both be effecter and affected (McCrea & Littledyke, 2015).

The updated ecosystems model encompassed Early Childhood Education for Sustainability (ECEfS) and its components (environmental, societal/cultural, and economics/ political) by emphasizing the profound influence of EfS on the macrosystem (i.e., government policy – such as legislation about non-smoking in public places) and exosystem (such as advertisements for fast-food on television) (McCrea & Littledyke, 2015).

The role of Media Literacy in Education for Sustainability

EfS's primary aim is to bring up environmentally literate citizens who gain the perceptions, skills, attitudes, and habits of mind that encourage long-term actions for sustainable development (Parra et al., 2020; Roth, 1992). To acquire this aim and provide vast multi-sensory experiences that educate and inspire individuals about and for the environment and environmental issues, media is an appropriate resource (Zimmermann, 1996) and should be thought of as a crucial element of any EfS curriculum. The National Association for the Education of Young Children (NAEYC) emphasized that "when used wisely, technology and media can support learning and enhance relationships'' (2012, p.1). Although there were some studies like Pearson, Dorrian, and Litchfield (2011) and Foley, Archambault, and Warren (2015) on university students' knowledge, attitudes, conservation behaviors, and understanding of EfS issues via media literacy (ML), at the time of writing, no studies were to target early childhood teachers specifically. Early childhood teachers can integrate ML into their EfS teachings via a wide range of learning activities that foster children's discovering, creating, problem-solving, communicating, collaborating, documenting, inquiring, and showing their understanding related to the world outside of their classroom (Tzima, Styliaras, Bassounas, & Tzima, 2020). When teachers utilize media and technology (such as virtual field trips, e-books, and public service announcements) in classrooms in interactive, purposeful, and appropriate ways, they also encourage children to establish engagement in and tendencies toward the natural environment as teachers present them facilities to explore and utilize infinite resources virtually (Johannesson, Andersson, Ärlemalm-Hagsér, & Elliott, 2020; Willis, Weiser, & Kirkwood, 2014).

ML plays a crucial role in learning sustainability since a media-literate person knows how to read and write and distinguishes between misinformation and propaganda (Cooper, 2011). The National Association for Media Literacy Education (NAMLE) illuminated ML's purpose as follows: "The purpose of media literacy education (MLE) is to help individuals of all ages develop the habits of inquiry and skills of expression that they need to be critical thinkers, effective communicators and active citizens in today's world" (NAMLE, 2009, p.1).

Professional Training Program for EfS via ML: A research imperative: Analyzing the literature on EfS and ML showed no research has discovered the effect of implementing EfS via ML in the ECE context, both at the international and then national level in Turkiye at the time of writing. Limited research related to EfS or ML in teacher education in early childhood has been conducted, such as Feriver, Teksöz, Olgan, and Reid (2015) who developed a professional development program on EfS based on Mezirow's transformative learning theory. In another study, Lasen, Skamp, and Simoncini (2017) explored how teachers practice EfS in their class and the obstacles that they faced with during their practice. Other notable studies include Akyol, Pamuk, and Elmas (2018) who designed a drama training program including EfS for pre-service teachers; Karaarslan Semiz and Temiz (2021) investigated pre-service teachers' perceptions and teaching practice related to nature based implementations and hinders against nature based practices; and Koşan (2021) developed online teacher training program on sustainability for in-service teachers based on Pedagogical Systems Theory to examine their opinions about the world, individual, and society for sustainability, and how training affected their knowledge and educational practices on sustainability. One study demonstrated the effectiveness of undergraduate level ML training for early childhood teacher candidates (Alici & Sahin, 2016) Alici and Gokbulut (2017) constructed drama sessions targeting preservice teachers' ML competencies. Similarly, Garcia, Seglem, and Share (2013) developed undergraduate and post graduate courses on ML for pre-service and in-service teachers. Haipinge (2016) conducted a phenomenography research to explore pre-service teachers' social media applications and how these applications can be interpreted via ML lens. All in all, there are no specific studies on EfS via ML targeting early childhood teachers. Further, the literature review revealed no studies that have investigated EfS via ML through the lens of the Interconnected Model of Professional Growth.

Thus, the aim of the current research was to investigate the influence of PDP on teachers' professional growth related to EfS and ML in light of the Interconnected Model of Professional Growth. For this aim, before and after PDP, teachers' EfS understandings and practices and how to construct and conduct EfS implementations via ML in ECE learning environments were described.

The following research questions formed the focus of this action research study:

1. To what extent does action research based on analyze, design, development, implementation, and evaluation (ADDIE) approach professional development program contribute to the development of early childhood teachers' personal domain?

2. To what extent does action research based on ADDIE approach professional development program contribute to early childhood teachers' domain of practice?

3. To what extent does action research based on ADDIE approach professional development program contribute to early childhood teachers' domain of consequences?

Based on the research questions, a professional development program (PDP) for early childhood educators was developed. The PDP consisted of both EfS and ML elements. The Interconnected Model of Professional Growth was utilized in designing the program. This model was originally developed by Clarke and Hollingsworth (2002) to elucidate mathematical teachers' professional change and/or growth during in-service training. Moreover, Dyment et al. (2014) applied this model to explain the change in early childhood educators' knowledge, understanding, and confidence levels in terms of EfS. As mentioned in the previous section, McCrea and Littledyke's adaptation of Bronfenbrenner's theory puts ECEfS at the outer part of the ecological systems (chronosystem) to emphasize its influence on the whole of the system. Similarly, ML is placed in the exosystem and teachers in the microsystem, all reciprocally impacting each other and children's development and learning to varying degrees. Thus, the PDP designed by the authors (implemented by the first author) provided support for both EfS and ML in the context of early childhood teacher education.

The Interconnected Model of Professional Growth involves four 'domains': External, Personal, Practice, and Consequences.
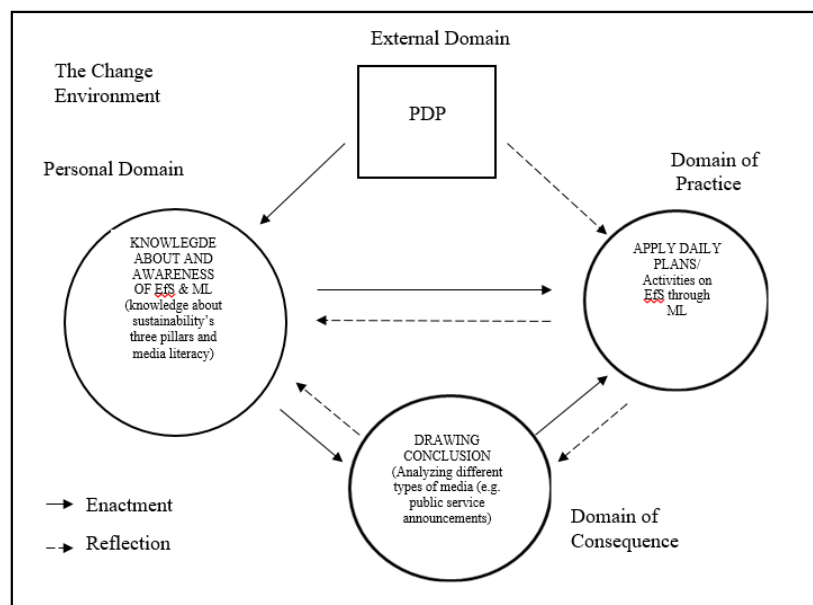

Figure 1. Interconnected Model of Professional Growth for EfS via ML (Adapted from Clarke & Hollingsworth, 2002)

The model's components developed for this study are summarized in Figure 1. Now, we discuss the specific components of this model.

Professional Development Program: Explaining the External Domain

The "external domain" (the PDP of this study) is a stimulus coming from outside the teachers' everyday experience. PDP on climate change –targeting SDG 13- through ML (e.g., analyzing videos advocating different perspectives on climate change, discussions about these, and teachers' creating their own media/media messages about climate change) was the most significant part of this study. Via professional development (PD), the action researcher, the first author, aimed to create a change in the teachers' working lives, specifically to influence their subject matter knowledge and pedagogical content knowledge about EfS via ML and put these into action in their teaching with young children.

"Domain practice", another of the model's crucial aspects, refers to teachers' pedagogical experimentations (in this case, their EfS implementation through ML) in their own classes. **"**Domain consequences and salient outcomes" (such as selection of topic and teaching and evaluation strategies) are pertaining to teachers' values and experiences arising from their classroom practices. The final component of the model, the "personal domain", demonstrates the teachers' practical knowledge that includes their knowledge, awareness, and skills related to teachers' EfS awareness via ML in the current study (Clarke & Hollingsworth, 2002).

To summarize, the model was practical in explicating the findings pertaining to changes in early childhood educators' knowledge, understanding, and confidence about the EfS content and pedagogies (personal domain) as the outputs of PD on EfS via ML in ECE (external domain) thus this model was chosen for this study. Throughout this PD, the action researcher sought to make changes in the teachers' professional lives, specifically to help them reconstruct their subject matter knowledge and pedagogical content knowledge about EfS via ML and to put these into action in their early childhood teaching.

Method

Action research was used to respond to these research questions as advised by Kemmis (2009). For this investigation, a PDP was developed to provide insight into the topical issue of EfS, evaluate the effect, and guide the reflection of the participating professionals. The PDP aimed to enhance teachers' professional growth regarding EfS via ML and draw out some potential generalizations about such PD program's applicability. The findings were then analyzed as four cases (each focusing on a specific early childhood teacher). The action research cycles in the current study design are outlined in Figure 2.
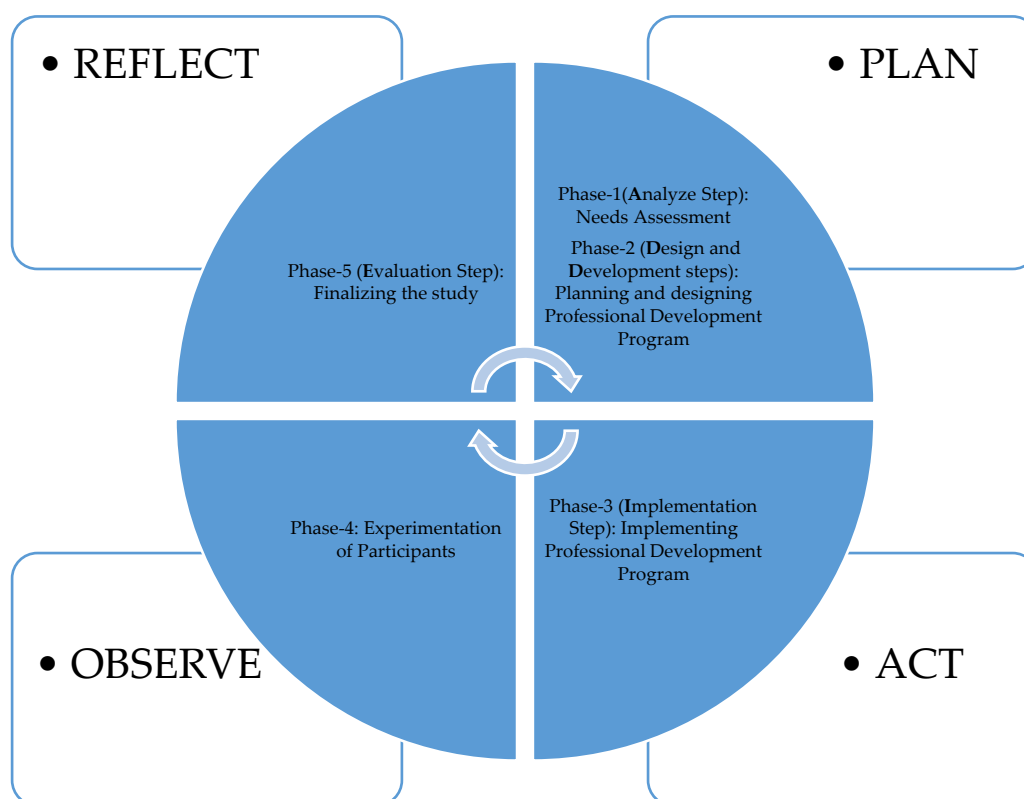

Figure 2. Phases of the study with ADDIE Model and action research cycles

A five-phase study, aligned with the above action research cycles, was conducted. Action research/reflection-on-action is recognized as a critical EfS strategy (Stevenson, Ferreira, Davis, & Evans, 2014) and because of its compatibility with the Analyze, Design, Develop, Implement and Evaluate (ADDIE) approach (Branch, 2009). Therefore, the ADDIE model was also included in the action research design. This was deemed the most appropriate for developing this PDP because the approach was helpful in supporting teachers' knowledge and skills about learning, targeting EfS through ML, and using this new knowledge to change their pedagogical practices. The preference for using this model is that it is one of the most prevalent instructional design approaches, designed to yield an effective and systematic approach for any instructional creator, content, audience, and learning environment (e.g., online or face to face) (Aldoobie, 2015). This approach also facilitates intentional learning by adopting an input and output paradigm by encouraging learner-centered, innovative, authentic, and inspirational learning strategies (Branch, 2009). Schina, Esteve-González, Usart, Lázaro-Cantabrana, and Gisbert (2020) also utilized the ADDIE approach in their research with pre-service student teachers constructing their own projects on Sustainable Development Goals (SDGs) through using Information and Communication Technologies. The ADDIE steps are outlined in Table 1.

Table 1. Steps of the ADDIE approach to Professional Development

Steps	Tasks	Outcomes
Analyze	Early childhood teachers' needs assessment	Determine goals and learning objectives for the PDP
Design	Create learning and teaching plans Specify resources	Measurable objectives Instructional strategy The prototype of the details of PDP
Development	Investigating related PDP Investigating related literature Working with the supervisor and other researchers, and the experts	Creating a draft of the PDP plan
Implementation	PDP with early childhood teachers	Teachers' artifacts developed, e.g., plans for working with children
Evaluation	Taking experts' views about the draft PDP Data collection after PDP	Finalizing PDP Reporting the findings

In phase 1, the existing situation pertaining to EfS via ML in two different early childhood learning environments was described by conducting teacher and children's needs assessment in four different classroom research sites. (See Table 1, the Analyze Step)

In phase 2, in light of the participating early childhood teachers' needs, identified by using data collection instruments, e.g., interviews, stimulated recall interviews, documentation, and field notes (for detailed information, see Data Collection and Analysis section), PDP was developed to support participants' awareness of EfS via ML, and their pedagogical skills in integrating media into EfS when implementing learning activities with children in their classrooms. PDP was constructed by the action researcher in consultation with the experienced early childhood teachers and other experts in ECE, EfS, ML, and teacher education. (See Table 1 Design and Development Steps) Table 2 identifies the content that underpinned five PDP sessions. Each session consisted of two parts, theoretical and practical. In the theoretical part, these PDP sessions covered the concepts of EfS, Environmental Education (EE), types of media, media content including messages, images, and technologies, ML, the relationship between ML and EfS, and how to integrate ML into EfS when creating and implementing learning activities. In the practical part of this theoretical information, as advised by Hobbs (2010) and UNESCO (2012), different kinds of teaching techniques (e.g., group work, creative drama, i.e., role-play and dramatization, examining case studies, cross-media comparison, multimedia composition…etc.) and EfS pedagogy (problem/issue-based learning) fostering critical thinking, social critique, issue analysis, discussions, drawing a poster and writing a story to stimulate creating media messages were used. Each session targeted EfS adult learning principles (e.g., autonomous and self-directed, goal-oriented, practical) (Lieb, 1991).

Table 2. Summary of the Content of the PDP Sessions for teachers

Session	Selected Objectives	Teaching Techniques	Competencies of Digital and Media Literacy	Conducted Activities	Assignment
I	to state what media is to state what EfS is	Lecturing, group work, critical thinking, social critique, issue analysis, discussions	Access Analyze & evaluate	Presentation, watching and analyzing videos	No assignment
II	To state why ML is necessary. To state his/her opinion about the required characteristics that media literate individual has	Lecturing, group work, critical thinking, issue analysis, discussions, writing a story, examining case studies	Analyze & evaluate Create	Presentation, Writing story watching and analyzing videos reading and analyzing articles	To bring media that is related to climate change (CC)
III	to describe that media have own language to state the components of media content	Lecturing, group work, critical thinking, issue analysis, discussions,	Analyze & evaluate Create Reflect Act	Presentation, grouping, composing their own media content, watching and analyzing videos	To watch TV and find any program (advertisement, public service announcement) about CC analyze it and share the message of it with their colleagues
IV	to distinguish CC messages coming from the distinct type of media to create his/her own product to give his/her own message(s)	Lecturing, group work, critical thinking, issue analysis, social critique, discussions, examining case studies, role-playing, dramatization	Analyze & evaluate Create Reflect Act	Presentation, Sharing yesterday's assignment watching and analyzing advertisement Creating their own advertisement	To research how the issues (excluding CC) related to EfS components are broadcasted via media (cartoon, poster, public service announcement) and to bring two of them
V	To tell that media are tools to give messages related to EfS to select and use appropriate media type(s) to give his/her own message(s) about EfS to his/her target group	Lecturing, group work, critical thinking, issue analysis, social critique, discussions, drawing a poster	Analyze & evaluate Create Reflect Act	Presentation, Sharing yesterday's assignment watching and analyzing cartoon reading and analyzing articles creating their own posters	No assignment

In phase 3, the PDP was implemented. Five PDP sessions were conducted for all four teachers during the state-sanctioned annual teacher professional education period. Each session lasted approximately two hours, with the researcher traveling to the teacher's workplace. Thus, around 20 hours of PDP was interactively delivered by the researcher. In addition, data related to the teachers' experiences during the PDP were collected via written and oral reflections and face to face interviews. (See Table 1, the Implementation Step).

After the PDP, **in phase 4**, each participant then planned and applied their own action plans via EfS learning activity plans and/or EfS projects; in a process that covered a semester (at least five action cycles for each teacher), the action researchers provided individual and ongoing support for each early childhood teacher via a mix of face-to-face communication, e-mail, and phone. Each teacher had their own story because of their interest, background and professional experience. They implemented at least two integrated activities for every cycle. During the action cycles, first of all, they started from the environmental and economic aspects of EfS. However, during stimulated recall interviews they realized that they can focus on other aspects of EfS. Time to time, they shared their opinion and draft of their activity plans with the researchers and got support from them in terms of EfS and ML issues and pedagogies.

In phase 5, Clarke and Hollingsworth's Interconnected Model of Professional Growth was used to evaluate the teachers' professional development resulting from this intervention. (See Table 1, the Evaluation Step). The study is the documentation of the effects of the PDP on each early childhood educators' professional growth, in particular, how EfS via ML was integrated into the curriculum (content) and which teaching strategies (pedagogies) were utilized while the early childhood educators were constructing their learning activities/projects in their own classrooms. For this, we used various data collection instruments, e.g., interviews, stimulated recall interviews (including observations) for each cycle, which means at least five stimulated recall interviews encompassing observations, documentation, and field notes (for detailed information, see Data Collection and Analysis section).

Participants

In this study, initially 13 teachers were recruited as research participants. Seven teachers consented to be a part of the post-test procedures. The data from four teachers was included in the final analysis for this study. The participants were selected by convenience sampling, which is one of the types of purposeful sampling (Merriam, 2009). The study participants were four early childhood teachers from two independent public preschools located in mainly middle-class districts of a large city in Türkiye (population 5.6 million). All participants were female, and their ages ranged from 27 to 42 years. All had a 4-year ECE degree from a university. The participating teachers had teaching experience between 5 and 20 years (average eleven and a half years). One of the schools was implementing the 'TEMA Kids' program, an environmentally focused program that has been developed and implemented since 2011. This program is mainly about soil education, focusing on the environmental pillar of sustainability, as erosion is a major issue in Türkiye. To become a TEMA School and actualize the program's goals, teachers should design and implement at least 21 activities based on the principals of TEMA Program. (Çelik et al., 2013).

Researcher Role

We adopted several roles throughout the study process in this action research. One role was to observe the existing situation in the early childhood learning environment to describe the needs of teachers and children. During PDP development, we had an evaluator role in detecting the needs of teachers and children and implementing PDP in the light of these findings. Apart from the evaluator role, our role changed from evaluator to teacher educator while conducting PDP. After implementing PDP, we interacted with the teachers as a critical friend and change agent who offered the teachers a better understanding of EfS via ML, and we encouraged and guided teachers as they designed their own plans or projects as a facilitator role. Synchronically, we also evaluated their plans or projects after PDP data collection. We also played the evaluator role again, but during our evaluator role at the same

time, we observed their plans or projects related to EfS and ML. We also had a chance to work with teachers and discover the efficient ways/ strategies/ methods while implementing EfS activities via ML.

Moreover, we also had an interpreter role throughout this study. During this role, data were interpreted to create all codes and findings. In this action research, the researchers made a strong social relationship with our participants, necessary for successful research output.

Data Collection and Analysis

In creating the PDP, an early childhood teachers' needs assessment was carried out at the study's analysis step. This involved collecting data via various qualitative instruments, including teacher documentation such as daily and monthly plans to detect whether teachers give a place EfS and ML, stimulated recall interviews via both nine semi-structured and unstructured questions based on video recordings (e.g. what are the objectives and indicators of this activity? Can you reach these objectives and indicators?), face-to-face semi-structured interviews including twenty questions (i.e. have you ever heard the concept of education for sustainability? If yes, what do you think about EfS?), and researcher field notes. The interview questions were developed by researchers by taking expert opinion and conducting pilot study. In light of the data analysis (e.g., content analysis for documentation and open coding for stimulated recall interviews, interviews, and field notes), the action researcher designed the PDP specifically for each of the four teachers (See Table 1 Design Step). For the content analysis, codes were determined by analyzing relevant literature. For ML, Hobbs' (2010) essential competencies of digital and ML were utilized (see Apendix 2; and, for EfS, UNESCO (2017)'s SDGs were used. Finally, in open coding (Glaser & Strauss, 1967), each part of the data is investigated to define what the data exactly mean and shape specific categories that elucidate the data adequately (Boeije, 2002; Creswell, 2007). For coding part, two independent researchers worked on data and an inter-coder agreement was calculated as 90%.

During the PDP, at the Implementing step, a variety of interactive and critical pedagogical techniques and EfS pedagogies mentioned in Phase 2 were used with the participating teachers. Additionally, alternative evaluation techniques, e.g., assignments, written and/ or oral reflections, were utilized to evaluate the PDP's impact. (For a detailed explanation, see Table 2).

After the PDP, evaluation strategies were utilized at the evaluation step using the same data collection instruments and data analysis methods used prior to the PDP. Furthermore, to examine the teachers' EfS awareness and to evaluate the implementation of EfS through ML both before and after the PDP, related literature was also examined as well as criteria related to EfS implementation for this study (weak EfS – mainly offering knowledge about sustainability; medium EfS – some direct experience with sustainability issues; strong EfS – taking action for sustainability) These scaled, alternative approaches to EfS are presented in Appendix 2. Thus, using these criteria, each teacher's EfS implementation and ML were evaluated as weak, medium, and strong. (See Appendix 1)

Research Ethics

For this study's ethical clearances, required permissions were received from Middle East Technical University's Research Center for Applied Ethics via 28620816/013 document number and the Turkish Ministry of National Education via 14588481-605.99-E.2489132 document number.

Findings

The analysis of data collected from pre-post Professional Development Program (PDP) indicated a positive change in all teachers' professional growth in awareness and understanding of EfS and ML levels, and their pedagogical practices targeting EfS via ML. The changes in all participating teachers' professional growth were analyzed relying on the Interconnected Model of Professional Growth, though only one teacher's results are included in the discussion in this paper due to the space constraints. (See Table 5)

Teacher case study regarding a one and half-month project on climate change targeting SDG 13

As noted, the first author, as an action researcher, worked with four early childhood teachers for over a year in investigating PD. A detailed account of one of those participants, whom we refer to as Teacher C to preserve her anonymity, is presented.

Teacher C

Based on the data analyses, C's professional growth as a result of participating in the PDP is summarized in Table 3.

Table 3. Summary of Teacher C's Growth

Teacher C	Before PDP	After PDP
Personal Domain	No EfS awareness Basic to medium ML	EfS and Sustainability pillar awareness Advanced ML
Domain of Practice	Weak approach to sustainability Basic to medium ML	Strong approach to sustainability Advanced ML
Domain of Consequences	Environmental aspect of EfS No EfS via ML teaching strategies Picture, photograph No evaluation strategies to support children's create competency	All aspects of EfS EfS via ML Teaching Strategies New resource use (animation, poster, cartoon, teacher drawing) New evaluation strategies to support children's create competency (design product, concept map)

As Table 3 illustrates, after the PDP, there were significant changes in Teacher C's personal domain, domain of practice, and domain of consequences in relation to EfS. In the following part, each domain is examined in detail.

Personal Domain

As mentioned in the introduction part, this domain includes teachers' EfS and ML understandings.

The following explanation from the teacher exemplifies the change in her personal domain during the interview:

> I became familiar with the term, EfS after attending PDP. Based on my teaching and learning experiences, EfS includes nature, environment, the Earth, recycling, everything. Animals, all of the living creatures, human relations as well as our respect for each other... Then, let us say social, economic, environmental … Education must start at the early childhood level for sustainability… I mean, at least starting from this level, we should help them develop such behaviors for them to raise awareness in their own children and the people around them in the future. This way, they can make their own children and people around them more sensitive, or maybe at least they can raise awareness of them…I believe. It is like a drop effect. You know when a drop falls, it spreads.

Additionally, there was considerable growth in her ML. Prior to the PDP, she did not rate at all on the criteria for selecting media types. However, after the PDP, Teacher C could elucidate why she would rather utilize distinct media types in her teaching, which types of media could be utilized in early childhood learning environments, how children's EfS could be promoted via ML, how EfS and ML could be integrated, and what criteria were critical while implementing EfS via ML activities.

Domain of Practices

This domain consists of teachers' EfS through ML practices.

After PDP, the analysis of Teacher C's observed activities via a stimulated recall interview (SRI) indicated that all activities were constructed to support advanced ML levels and a strong EfS approach. (See Table 4)

Table 4. Content Analyses of the Places of EfS and ML in Observed Activities for SRI after PDP

ML	EfS		
	Weak	Medium	Strong
Basic	-	-	-
Medium	-	-	-
Advanced	-	-	*A$_1$, A$_2$, A$_3$, A$_4$

*A$_1$: Activity 1- Introduction to Global Warming, A$_2$: Activity 2- My Global Warming Poster, A$_3$: Activity 3- Recycling, A$_4$: Activity 4-Save Water

After implementing the program, Teacher C used a wider variety of teaching methods and strategies while using media and media tools to promote EfS in her class. She reported during SRI:

I showed the visual materials to the children and asked them about it to lead them to think and help them use their creativity. So, it mainly was questioning. Brainstorming. We made a field trip. We did observation... No matter what kind of activity we did, it always included questioning. I supported the children with questions for them to think and answer, pay attention to the events, focus on them, and set up a cause-and-effect relation. We did group work. For instance, everybody tried to complete some parts of the poster …Therefore, there was peer learning…

Further, Teacher C stated that she frequently implemented EfS activities by using her newly developed ML skills in her daily plans after being involved in the study. Her recount evidenced it during the SRI.

I use posters, cartoons, videos, caricatures, children's books, pictures…Before the training [PDP], I did not utilize these, especially posters, cartoons, caricatures like this. We have not interpreted the messages that the posters convey to us until this training… We also analyze and understand the messages of cartoons and videos on EfS…

One of the interactions between Teacher C and her four/five-year-old children related to the analysis of 'messages' presented by posters on climate change causes and consequences during the discussion part of activity 1 (See Photograph 1): Teacher and researcher talked about these moments during SRI.

Photograph 1. Time of discussion about posters

T: What do you see on the fourth poster?
C1: Earth!
T: How is the Earth seen?
C2: Cars, chimneys…
C3: Dirty, it is crying.
T: Why is Earth crying?
C4: It is dirty!
T: Why does the Earth become dirty?
…
C5: Smoke
C2: Tire.
T: What does Earth want to say to us?
C6: I am dirty.
C7: Clean me!
T: Who designed these posters?
C8: You
C9: Parliament
C10: Photocopier
C11: Printer
T: What is used while preparing a poster?
C8: Pictures.
T: What kinds of the picture?
C12: Earth.
C11: Flowers.

Domain of Consequences

This domain is related to outputs of teachers' EfS via ML practices.

For instance, Teacher C offered an explication of her observation related to change in children's thoughts about climate change with this account during the interview:

> …we did a one-and-a-half-month project about climate change with the kids. While creating a concept map, in the beginning, when I asked the question, what we can do not to increase the world's temperature, to children, their answers were generally about trash like "We should throw our rubbish into the bin." Alternatively, "We should not throw the trash into the water." However, on the concept map, we created at the end of the project, the children's answers were related to electricity, exhaust, cars' exhaust gases; well; what was that? – About the seas and fish… The difference is enormous between the initial and final concept maps. The children mentioned not wasting electricity and water, not spending too much electricity, and economizing those all the time. That is to say, it [project] reached its goal. They also said that waste materials should be piled separately... yes; like storing them in different places...

Based on the field notes, one of the discussions in the classroom about the posters showed a considerable depth of understanding by the children. One of the children constructed a connection between the sun and a book, which showed his complex thinking. He could explain, for example, the relationship between sun-tree-paper and a book. His elucidation of the poster was given as follows:

> C: Sun warms mountains, and the books are formed.
> T: How are the books formed?
> C: The books are made up of paper. The papers are made up of trees. The trees are in the mountains.

These findings, pertaining to Teacher C's new understandings about EfS and ML, prompted her to engage in ongoing cycles of learning based on the lessons from previous action/reflection cycles. For instance, she changed her thinking and strategies about how to carry out effective and transformative activities on EfS through ML in early childhood learning environments and now uses these strategies in her teaching regularly.

Furthermore, the PDP was seen to have directly affected Teacher C's personal domain (awareness of EfS and ML levels). For example, Teacher C became aware of EfS and sustainability dimensions (environment, social & cultural, and economic) and determined which issues (e.g., climate change) were more related to particular dimensions or how they overlapped. The change in her personal domain also directly impacted her domain practice since she highlighted that she could now independently redesign learning activities with the children in her class. The positive impact of her domain practice on her personal domain can also be seen because she became more able to integrate EfS content with ML and better able to support children's active learning and involvement in learning activities.

As illustrated in Table 5, the findings revealed that after the PDP, all four teachers were much more aware of EfS and key sustainability dimensions (environment, social and cultural, and economic related to sustainable development goals, i.e., SDG 11, SDG 13, and SDG 5…) and the complexity of the issues related to these. Also, all teachers' ML levels changed to advanced. Additionally, each of the teachers was able to use a variety of distinct media types (such as cartoons, public service announcements, books, and posters) and a range of interactive teaching strategies and/or methods (i.e., brainstorming, questioning, creative drama, field trip, group work, viewing, listening and discussing) and multimedia composition such as creating a message using a combination of language, images, sound, music, special effects; and, evaluation strategies (preparing a book, poster, and video) to foster children's knowledge about, and awareness of sustainability via ML and children's analyze & evaluate and create ML competencies. Moreover, during the activities, teachers encourage children to create their own media messages using different media types. In other words, the growth in the teachers' knowledge and skills was evidenced through the children's thoughts and understandings about sustainability issues through ML.

Table 5. The Summary of All 4 Teachers' Professional Growth about EfS via ML

	Before PDP	After PDP
Personal Domain	• Only one of the four teachers had heard of the concept of EfS • None of them were aware of sustainability pillars (environment, social & cultural and economic) and related issues. • Teachers' knowledge about EfS and EfS related issues are generally shallow • Three teachers' ML levels were "medium" • One teacher's ML level was " basic"	• All teachers could make detailed explanations about all pillars of EfS • All teachers acquired a notion that EfS should start from the early years • Teacher A-EfS and EE are distinct concepts (SDG 11) • Teacher B-"gender equity" activity. (SDG 5) • Teacher C-change in children's awareness of climate change, recycling, water, and electricity conservation, and reusing paper (SDG 13) • Teacher D-changes in not only her EfS awareness but also children's awareness of attitudes and behaviors toward recycling (SDG 11& 12) • All teachers' ML levels were "advanced"
		• While selecting media for their activity, teachers started to analyze them regarding media components such as clarity of messages and visuals quality. • ML teaching strategies while conducting activities and /or projects targeting EfS through ML
Domain of Practice	• Mostly used a weak to medium sustainability approach • The number of activities focusing on EfS in their daily and monthly plans was low • They were not aware of ML and its teaching strategies and how to carry out these strategies to support EfS • All teachers did not plan and implement EfS activities through ML.	• Change in the number of EfS activities via ML. • Promoted children to create their own media products individually and/or with group work to convey their own messages about specific EfS topics. • To use different media types and research how they selected and used media focusing on EfS.
Domain of Consequences	• Selection of topic-environmental aspect of EfS • Teaching Strategies-no EfS via ML teaching strategies • Resource use-book, video, pictures, -they generally used media to draw children's attention to a topic • Evaluation Strategies-asking question, drawing	• Selection of topic-all three aspects of EfS- related to everyday life & children can understand EfS issues • Teaching Strategies-EfS via ML teaching strategies-to promote children to analyze and evaluate media messages about different EfS topics-observations related to changes in children's analyze & evaluate and create ML competencies. • Resource use-different types of media (i.e. public service announcements, animation…etc.) -they were aware of and knowledgeable about how to support children's ML and awareness, attitude and behavior related to EfS issues • Evaluation Strategies- creating a brochure, find a slogan, preparing a book, making concept map - promote children's create competency

Discussion

The examination of the observational records, stimulated recall interviews and the pre-post PDP document analysis show the PDP as an external domain component of the Interconnected Model of Professional Growth had a positive impact on all four teachers' (demonstrated by Teacher C) professional growth regarding their effectiveness in implementing EfS activities via ML for their young students.

When the overall PDP objectives are considered, the action research PDP process positively impacted all teachers' EfS awareness via ML. For instance, through media analysis and discussions with the teachers, the teachers developed new skills such as being able "to distinguish between climate change messages regarding its quality, veracity, and credibility", and to "be able to comprehend climate change messages which are conducted by media tools" (See Table 2). As a result, they can now utilize these skills when choosing appropriate media for their own learning activities. Similarly, Dyment et al. (2014) found that after specific PDP on EfS for early childhood had a positive impact on teachers' and preservice teachers' knowledge, understanding, and confidence levels in Australia. In addition, the participants' understandings of EfS also changed from mainly being about the simple environmental dimension of sustainability to a more complex understanding, considering the social, economic, and political dimensions.

After the PDP, the analysis of teachers' explanations about EfS and ML indicated substantial growth concerning EfS awareness and ML issues. In the literature on EfS and ML, some research obtained the same findings with university students. Pearson et al. (2011) determined that university students' knowledge, attitudes, and conservation behaviors about a highly endangered orangutan could be developed by using visual media. Further, Foley et al. (2015) found that teacher candidates involved in a "Sustainability Science for Teachers" course, including technology and digital storytelling, could understand sustainability as a multifaceted and interconnected system.

Furthermore, the four teachers could now carry these successes into effect with their classroom activities and/or projects. Share (2017) also researched climate change messages and how these messages influence public statements on climate change. He asserted that if people gained the ability to critique media messages and dominant ideologies, they would then be able to create their own media messages that defy prevailing myths and then encourage others in society to create alternatives for a more sustainable and healthier world. These findings resonate with the findings of the study reported in this paper. Furthermore, Koşan (2021) reached similar outcomes. After attending online PDP, teachers could design and conduct activities targeting sustainability in the light of their sustainability knowledge.

Also, during the PDP, while implementing the activities, distinct teaching strategies (e.g., reading, viewing, listening, analyzing and evaluating media messages, discussion, group work, critical thinking, issue analysis, investigating a case study, role-playing, telling a story) proposed by Hobbs (2010) were used by the researcher. The researchers' analysis of the educators' teaching strategies indicated that they used most of these strategies while also implementing their own activities/ projects to foster children's critical thinking skills. Further, to foster children's analyzing & understanding skills and create ML competencies, which are described as habits of inquiry and skills of expression by NAMLE (2007), participating teachers continue to employ numerous teaching strategies in contrast to their practices prior to PDP when they mainly rely on a single method.

During the PDP, a wide range of teaching resources (analyzing papers, newspapers, videos, cartoons, commercials, articles, PowerPoints, caricatures, covers of magazines, and fragments of documentaries) were utilized to ensure educators with experience of various media types convey different messages about climate change and to compare multimedia. Damico, Baildon, and Panos (2018) found similar results with teacher candidates from different academic experiences in the study about stories related to climate change in the media. In addition, educators also used various media

types (cartoons, videos, caricatures, brochures, and public service announcements) while conducting EfS activities through ML.

Further, in the last part of every PDP session, the teachers' learning was evaluated by asking questions, telling a story, designing and improvising commercials, and designing posters. To put it another way, educators designed their own media artifacts to transmit their own learning from the PDP. Teachers also shared their artifacts with each other. At the beginning of the research, it was anticipated that these sharing and discussion sessions might positively impact every teacher's research and critical thinking skills, thus their own resource choosing criteria, which seemed to be the case. Examining teachers' evaluation strategies indicated that teachers also fostered children to design posters, create art products, and a book to assess the activity, thus supporting learning in children through their own pedagogical creations and innovations.

Overall, it was found that the PDP positively impacted every teacher's personal domain and domain of practice directly and the domain of consequence indirectly. Likewise, Anderson and Moore (2005) also concluded that a new PD course for teachers causes a change in the domain of practice, the domain of consequences, and the personal domain. Additionally, Hollingsworth (1999) also declared that a professional development program resulted in changes in the growth of teachers' personal domains and domains of practice. While this study's target group and focus were different from that of Anderson and Moore (2005) and Hollingsworth (1999), it is apparent that this study could play a pioneering role for ECE researchers on how to combine EfS targeting various SDGs and ML using the action research orientation of the Interconnected Model of Professional Growth. Furthermore, considering its effect on expanding children's EfS understandings in the light of the adaptation of Bronfenbrenner's Ecological Approach, discussed at the start of this paper, has made this study unique. As the ECEfS Adaptation is based on a more eco-centric view rather than being only about human ecology, we can add to explanations of how problems related to SDGs at the outer layer of the model (e.g., poverty, deforestation, human rights, drought…etc.) are likely to influence children's lives and/ or how EfS issues such as climate change can be considered rather than ignored in ECE. Thus, theoretically, this study adds to arguments that indicate that Bronfenbrenner's theory needs updating and reconceptualizing in the light of sustainability issues, as Elliott and Davis (2018) have proposed. In so doing, it has the potential to renew Bronfenbrenner's theory for the 21st century's requirements.

Conclusion and Suggestions

When we consider the study's scope, participants and PDP duration, the duration and context of PDP could be extended, and then implemented fortnightly for a semester. During this time, the teachers could make detailed research for their assignments throughout the PDP. For teachers, network meetings and discussion groups could also be organized to support their professional development. This study could be repeated with other teachers in other districts of Türkiye since all districts have their own characteristics regarding teachers, children and school potential.

All in all, this research is genuine in the sense that it brought together EfS and ML for the benefit of early childhood teacher education via action research through an interdisciplinary approach to support citizenship education, as advised by Bascopé, Perasso, and Reiss (2019). Furthermore, the implementation of the PDP resulted in teachers becoming more willing to address EfS issues related to different SDGs in their classrooms, as evidenced by the increasing number of EfS related activities after the PDP. In other words, educators could perceive themselves as change agents and academic leaders regarding sustainability issues after attending PD focusing on EfS via ML (Baena-Morales, Martinez-Roig, & Hernádez-Amorós, 2020). Moreover, gaining/improving ML levels and skills not only helped them attack the issues more confidently, but also transferred or reinforced some ML components such as critical thinking skills directly to their students.

This study has also called attention to the lack of education about EfS and ML for early childhood teachers in Türkiye, as emphasized by Alici (2020), especially since educators are considered "the locomotives of putting the principles into practice in educational systems" (Alici, 2021). Therefore, unless educators are aware of the ideas and principles of EfS and/or ML, they can foster education that encourages change in children's awareness of skills, attitudes, and behavior toward EfS topics, including SDGs, now and into the future.

Fostering early childhood teachers' ML skills seems to positively affect their efficiency in addressing EfS issues in the classroom. The authors believe further studies expanding this idea to a broader, international population may pave the way to more effective, generalizable practices benefiting the overall wellbeing of young children in the form of a better understanding of EfS issues (Atwell, 2020), which have been becoming more and more critical for the future of a young generation.
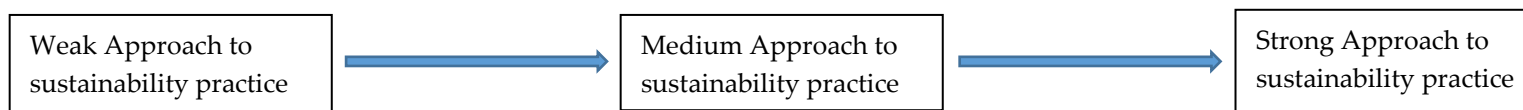
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Appendix 1.

Weak Approach to sustainability practice	→	Medium Approach to sustainability practice	→	Strong Approach to sustainability practice

(Source: Alici, 2018)

Care, respect, awareness and appreciation Non-agentic approach (caring for nature without deeper and critical thinking education about environment and education in the environment In and about environment education Outdoor nature experiences, outdoor play, science activities not making connection to EfS, nature play	Focusing on just environment aspect -respect, worm farm, planting garden, water cycle	Active citizenship (more than obedient recyclers) and decision making-children's right Participatory approach Child-centered Emancipatory teaching approaches play based Holistic approach Experiential Problem-based Collaborative engagement Active involvement- hands and minds on Critical and transformative everydayness Authentic learning through play & guiding children's holistic development Interdisciplinary, co-constructing, building respectful relationships Participating in community action Integrated curriculum Hidden curriculum Critical questioning (instigating discovery, eliciting predictions, probing for understanding, promoting reasoning, serving as a catalyst Encouraging creative thinking and reflecting on feelings) Education for the environment Social-cultural and economic aspects of EfS- reflect, redistribute, recycle

(Source: Alici, 2018)

ML Levels	Explanations
Basic	Be able to use media and media tools and state what they see at the visuals.
	Be able to use media and technological tools.
	Be able to use relevant information about these tools.
	Be able to share his/her knowledge with other people.
Medium	Be able to use media and media tools purposely and support kids to interpret the messages on media/media tools
	Be able comprehend messages which are conducted by media tools.
	Be able distinguish messages in terms of its quality, veracity and credibility.
	Be able to think potential effects or outcomes of these messages.
	Be able to generate a content via using his/her creativity and own tool(s).
Advanced	Be able to ask questions to kids to interpret the message critically and encourage them create their own message through using their own media/ media tools
	Be able to give importance to the content(s) and aim(s) of message, and audience while creating his/her message.
	Be able to use some techniques to conduct his/her own message(s).
	Be aware of ethical principles and his/her responsibility.
	Be able to put these principles and responsibilities into practice.
	Be able to reflect these principles and responsibilities in his/her own identity, communication behavior.
	To be able work individually and collaboratively to share his/her knowledge with families, colleagues and community.
	To be able work individually and collaboratively to solve the problems with families, colleagues and community.
	To be able to participate actively as a member of a community at local, regional national and international levels.

(Source: Alici, 2018)

Appendix 2.

Essential Competencies	Explanation
Access	Finding and using media and technology tools skillfully and sharing appropriate and relevant information with others
Analyze & Evaluate	Comprehending messages and using critical thinking to analyze message quality, veracity, credibility, and point of view, while considering potential effects or consequences of messages
Create	Composing or generating content using creativity and confidence in self-expression, with awareness of purpose, audience and composition techniques
Reflect	Applying social responsibility and ethical principles to one's own identity and lived experience, communication behavior, and conduct
Act	Working individually and collaboratively to share knowledge and solve problems in the family, the workplace, and the community and providing active participation as a member of a community at local, regional, national and international levels

Essential Competencies of Digital and Media Literacy (Hobbs, 2010, p.10)