Journal of Teaching and Learning
Vol. 18, No. 2 (2024), pp. 128–149
https://doi.org/ 10.22329/jtl.v18i2.8625
www.jtl.uwindsor.ca

Backward Design in Pre-Service Teacher Education to Enhance Curriculum Knowledge

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Abstract

This action research aimed to enhance the curriculum knowledge of 37 pre-service teachers in early-childhood education through backward design (BD) as an innovative framework. Participants enrolled in an online curriculum development course focusing on curriculum elements and underwent BD-based instruction for five weeks. Multiple data collection tools were employed, including pre- and post-achievement tests and curriculum literacy scales, digital learning journals, performance tasks, course observations, and interviews. The results showed a significant improvement in the curriculum knowledge of the pre-service teachers. This was evidenced by a notable increase in curriculum literacy scores, a moderate improvement in achievement test scores, and positive performance task outcomes. These findings highlight the effectiveness of BD-based instruction in enhancing the curriculum knowledge of pre-service teachers. This study provides valuable insights for teacher educators to effectively tailor their instructional approaches. Further research is needed to validate these results and advance instructional practices in pre-service teacher education.

Introduction

Pre-service teacher education (PTE) serves as the foundation of the teaching profession, providing theoretical and practical preparation for prospective teachers (Donkor, 2021; Sevimli-Celik & Johnson, 2016). Recognizing the critical role of comprehensive curriculum knowledge within PTE is essential for navigating the complexities of education effectively. This understanding positions the curriculum as a dynamic framework that not only shapes pedagogical practices but also fosters optimal learning outcomes (Lino, 2016; Pedro et al., 2012; Tan-Sisman, 2021). Acquiring robust

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curriculum knowledge is essential for teachers, as it encompasses a curriculum's objectives, frameworks, the function of a scope and sequence, and the capacity to evaluate a curriculum for coherence and articulation (Gess-Newsome, 2015). This knowledge enables teachers to design well-structured, developmentally appropriate activities that can scaffold children's early learning and skill development (Joo et al., 2020). Conversely, teachers may struggle to analyze curricular materials effectively and make productive adjustments or modify lessons, if they lack this knowledge (Beyer & Davis, 2012). Despite its importance, the recent research reveals deficiencies in both in-service teachers' (Erdamar & Akpunar, 2020; Kahramanoğlu, 2019; Keskin, 2020) and pre-service teachers' curriculum knowledge (Baştürk & Dönmez, 2011; Şahin & Soylu, 2017; Schwarz et al., 2008). Furthermore, one study (Wen et al., 2011) revealed a weak correlation between teachers' curriculum beliefs and classroom practices. However, this correlation strengthens with increased professional training and experience, underscoring the value of comprehensive teacher preparation and ongoing professional development (Wen et al., 2011).

Foregrounding curriculum knowledge in early childhood PTE is crucial not only for cultivating professional competency but also for creating effective educational environments that promote holistic child development. Although pre-service teachers may grasp a theoretical understanding of the curriculum, they face practical challenges (Erdem & Yücel-Toy, 2021). To bridge this gap, they should be provided with richer and more meaningful learning experiences regarding the curriculum (Steiner et al., 2018). Similarly, teacher educators should prioritize instructional practices that improve pre-service teachers' curriculum knowledge (Çetinkaya & Tabak, 2019). Therefore, it may be deduced that effective instructional design will benefit the development of pre-service teachers' curriculum knowledge. This design should actively engage them and encourage the internalization and satisfactory implementation of curricular material.

This article seeks to explore the efficacy of employing the backward design (BD) framework in enhancing pre-service teachers' curriculum knowledge. By examining BD's applicability and impact on curriculum knowledge acquisition, this study aims to contribute to the ongoing discussion surrounding pre-service teacher training and curriculum development in early childhood education. Furthermore, the study provides meaningful learning opportunities to pre-service teachers through BD-based instruction, enabling them to gain curriculum knowledge during PTE prior to entering the real school context. By addressing these crucial issues, this research endeavours to provide insights for policy and practice in PTE, ultimately fostering the professional growth and effectiveness of early childhood teachers.

The importance of curriculum knowledge

Teachers are the cornerstone of education, and their quality indicates the quality of education (Darling-Hammond, 2006; Schleicher, 2016). In recent discourse, teachers have been frequently conceptualized as curriculum agents (Carse, 2015; Poulton, 2020), change agents (Brown et al., 2023; Gunn & Bennett, 2022), as well as curriculum developers and makers (Lin et al., 2021; Shawer, 2010), highlighting their pivotal role in shaping educational practices and outcomes (Ben-Peretz, 1980). They are recognized as essential collaborators in curriculum development, implementation, and evaluation processes (Alsubaie, 2016; Ünver, 2021). Teachers use curricular materials as a guide when planning, and can adapt them in response to students' needs (Beyer & Davis, 2012; Schleicher, 2016). Hence, curriculum knowledge is undoubtedly one of the essential professional knowledge areas for teachers.

Curriculum knowledge is one of the four fundamental components of pedagogical content knowledge identified by Park and Oliver (2008). By integrating robust curriculum knowledge

within PTE programs, future educators are equipped with an understanding of the curriculum concept, its elements, the relationships among these elements, the curriculum development process, and its implementation. This allows them to make sense of the curriculum they are responsible for, reflect on it in practice, and evaluate it critically (Aslan, 2019; Bolat, 2017; Tan-Sisman, 2021). Thus, an empowered understanding of the curriculum enhances teachers' abilities to design, implement, and assess developmentally appropriate learning experiences to meet the diverse needs of children and families within varied educational contexts. However, Erdem and Yücel-Toy (2021) highlighted poor curricular instruction during PTE as one of the contributing factors to deficiencies in curriculum knowledge. Therefore, there is a need to enhance the quality of instructional practices within PTE to address this deficiency (Çetinkaya & Tabak, 2019; Steiner et al., 2018).

PTE in Turkey and Curriculum Development Course

Faculties of education in Turkey are responsible for training prospective teachers. The primary path to becoming a teacher in Turkey involves earning a four-year bachelor's degree from a faculty of education. These faculties offer programs in 25 different branches, with total credits ranging between 140 and 150. Faculties of education not only provide initial teacher training, but also conduct academic research on education. Over the course of four years, students take a variety of courses categorized into three major groups: teaching profession knowledge (30-35% of the curriculum), content knowledge (45-50%), and general culture (15-20%) (CHE, 2018). Although compulsory courses are set by the CHE, the specific activities, subjects, and approaches may vary, based on the instructor's preferences during the implementation of each course.

Another route to becoming a teacher is by completing a pedagogical formation certificate program. Universities with at least five academic staff in the departments of Educational Administration, Curriculum and Instruction, Guidance and Psychological Counselling, Measurement and Evaluation in Education can offer this training with permission from the Higher Education Council and the University Administrative Board. These programs can be offered for undergraduate fields specified by the Ministry of National Education Board of Education and are conducted in line with the Framework Procedures and Principles for Pedagogical Formation Education Certificate Programs. This one-year program, which includes 10 courses and totals 60 ECTS credits, is available to graduate students in non-education fields and senior students eligible for formation education (CHE, 2023). In both programs, student teachers engage in practicum experiences in real classroom settings, allowing them to apply their learning and gain hands-on experience.

The Curriculum Development Course (CDC) is an elective teaching profession knowledge course offered in four-year bachelor's degree programs at faculties of education, but it is not included in pedagogic formation programs. This course is worth four ECTS credits (two local credits) and lasts two hours per week. The content, framed by the CHE (2018), includes topics such as core curriculum elements (objectives, content, learning and teaching processes, assessment-evaluation) and their interrelationships; classification of objectives and their connection to curriculum elements; content organization approaches; identifying educational needs; curriculum development processes and models; and curriculum literacy. After graduating, pre-service teachers are expected to incorporate the knowledge into their teaching and curriculum construction processes (Darling-Hammond, 2006). PTE actively contributes to the improvement of curriculum knowledge. However, Erdem and Eğmir's (2018) study found that prospective teachers enrolled in a public university in Turkey can understand the existing curriculum more

easily, but are deficient in aspects related to curriculum adaptation and enactment, such as creating instructional materials, providing measurement tools, designing activities, setting goals, and enriching content.

Backward Design framework and its adoption in the Turkish context

Backward Design (BD) framework is an instructional design that focuses on understanding by making sense of what is learned, and transferring it permanently to real life or other disciplines, thereby encouraging better and deeper understanding than other instructional designs (Altun & Yurtseven, 2020; McTighe & Wiggins, 2012). In this respect, BD corresponds well with our purpose of encouraging pre-service teachers to develop curriculum knowledge by actively involving them in the process. The BD framework identifies both knowledge and skill objectives (Wiggins & McTighe, 2005). Considering that the concept of curriculum entails the ability to understand and execute the curriculum (Beyer & Davis, 2012), BD will help to maintain a balance between these two types of objectives. Other advantages of BD include flexibility and adaptability (Morrison et al., 2019). Regular reviews maintain a high level of quality and effectiveness (McTighe & Wiggins, 2012). It outlines a precise and practical process in which expected outcomes are initially defined, relevant evidence for students' learning is determined, and then learning experiences and instruction are planned (McTighe, 2010). The stages of BD, including the desired results, evidence, and learning plan, all must be in alignment with one another (McTighe & Wiggins, 2012). It is effectively used to create entertaining tasks that encourage self-directed and lifelong learning (Roth, 2007).

Since the 2010s, Turkey has progressively adopted the BD framework, starting with reputable colleges, and expanding to various private schools. This adoption involved extensive teacher training to ensure effective implementation. Research in Turkey has shown that instruction designed with BD positively affects learners' achievement (Ozyurt et al., 2021; Yurtseven & Doğan, 2018), attitudes and motivations (Açar et al., 2019; Arslan-Buyruk et al., 2018) as well as teachers' professional development processes (Altun et al., 2021; Yurtseven & Altun, 2016). Furthermore, the new curricula (MoNE, 2024) reflect BD principles by prioritizing learning outcomes, assessment, and evidence before designing learning experiences. Additionally, BD's emphasis on differentiated instruction, multidimensional assessment, realization of both knowledge acquisition and skill development, as well as real-life application of knowledge has been highlighted in the new curricula, and further demonstrates its impact on promoting comprehensive and practical learning. In sum, the ongoing research and implementation efforts attempt to refine and expand this approach, ensuring that it continues to benefit educators and learners across the country.

Method

The present study utilized an action research methodology to address the problem of pre-service teachers lacking curriculum knowledge, as identified through researchers' observations and relevant literature (Berg & Lune, 2012). In response, BD-based instruction was implemented as an action plan to facilitate pre-service teachers' learning of curriculum elements. Feedback on the effectiveness of the instruction was gathered through course observations, digital learning journals, and informal interviews with the students, as well as discussions between the researchers. The instructions were iteratively revised, based on the feedback received, with the aim of addressing educational needs. Figure 1 depicts the cyclical action research process for per-week courses.

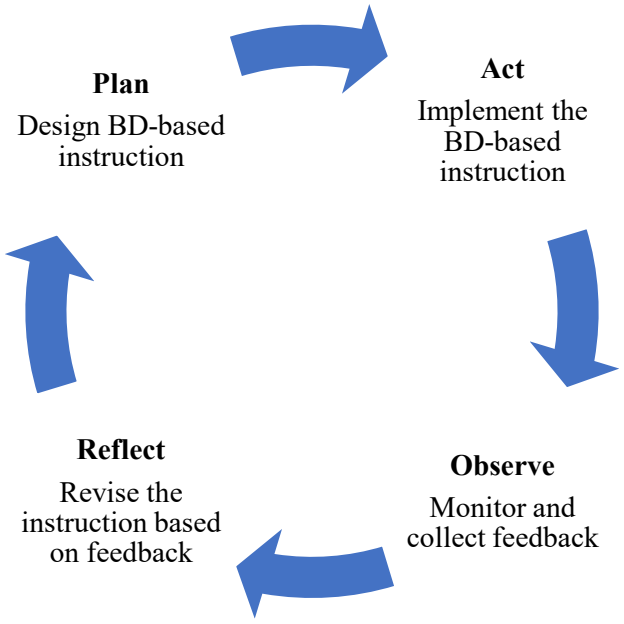


Figure 1: Action research cycle for per-week.

Research setting and participants

The study involved 37 undergraduate students (35 females; 2 males; *M*age = 21.4, *range* = 19 - 36, *SD* = 3.49) majoring in early childhood education and enrolled in the elective CDC at a public university in İstanbul, Turkey. The CDC is typically offered to second-year students, but students from other years also had the option to enroll. Therefore, the participants were mostly second-year students, but there were also students from other years (3 juniors and 1 senior). Prior to this course, students completed basic teaching profession knowledge courses, such as educational philosophy, sociology, and psychology, as well as an early-childhood education curriculum-content knowledge course. This Turkish-language course was delivered synchronously online via the Zoom application and lasted five weeks in the spring semester of 2022, with sessions starting at 11 a.m. on Thursdays. The average class size was 55.

The study targeted undergraduate students majoring in early-childhood education, because they represent the future workforce in this field. Their curriculum knowledge is valuable for creating effective learning environments and adapting curricular changes within early-childhood education programs. Moreover, these students were chosen as they had prior foundational knowledge in education, making them suitable for evaluating elective courses like the CDC. The sampling technique used can be described as convenience sampling, as it involved selecting participants who were readily available, studying at the researchers' university, and possessing the necessary backgrounds to contribute meaningfully to the study.

The course instructor, who is also the second researcher, has been working at the same university for 24 years, and currently holds the position of professor at the Curriculum & Instruction Program, where she teaches Teaching Profession Knowledge courses. She is also the founder of the Designer Teacher learning community. The first researcher implemented BD-based instruction, due to her familiarity with the learning plans and activities. Having obtained an M.A.

in Curriculum and Instruction, she served as a research assistant in the same program for three years.

Data collection procedure

The study consisted of three phases (see Figure 2).

The pre-implementation phase involved a needs' analysis and the design of the BD-based instructions.

- During the needs' analysis, student teachers' traits, interests, background knowledge, and context-related learning and teaching situations were identified. All participants also completed the CLS and achievement test to assess their prior knowledge and perceived level of curriculum literacy skills.
- Based on the data from the needs' analysis, the researchers designed curriculum element instructions in line with the main principles and stages of BD. Additionally, they examined the Bologna webpages of various faculties of education, while determining the objectives.

During the implementation phase, the students were instructed on how to design a curriculum, particularly curriculum elements, and received continuous feedback on their performance tasks. Meanwhile, the second researcher attended all the classes as an observer. Students were asked to keep learning journals after every lesson to review the BD-based instruction for possible improvements throughout the process. Classes were delivered synchronously, utilizing a range of Web 2.0 tools and online technologies, such as Kahoot, GitMind, Canva, WhatsApp, Padlet, Edmodo, Google Forms, YouTube videos, PowerPoint presentations, and online resources.

In the post-implementation phase, the CLS and achievement test, administered as pre-tests, were readministered as in-class online post-tests via Google Forms, and performance tasks were graded. Following the implementation, the BD-based instructions were reviewed to make judgments about quality.

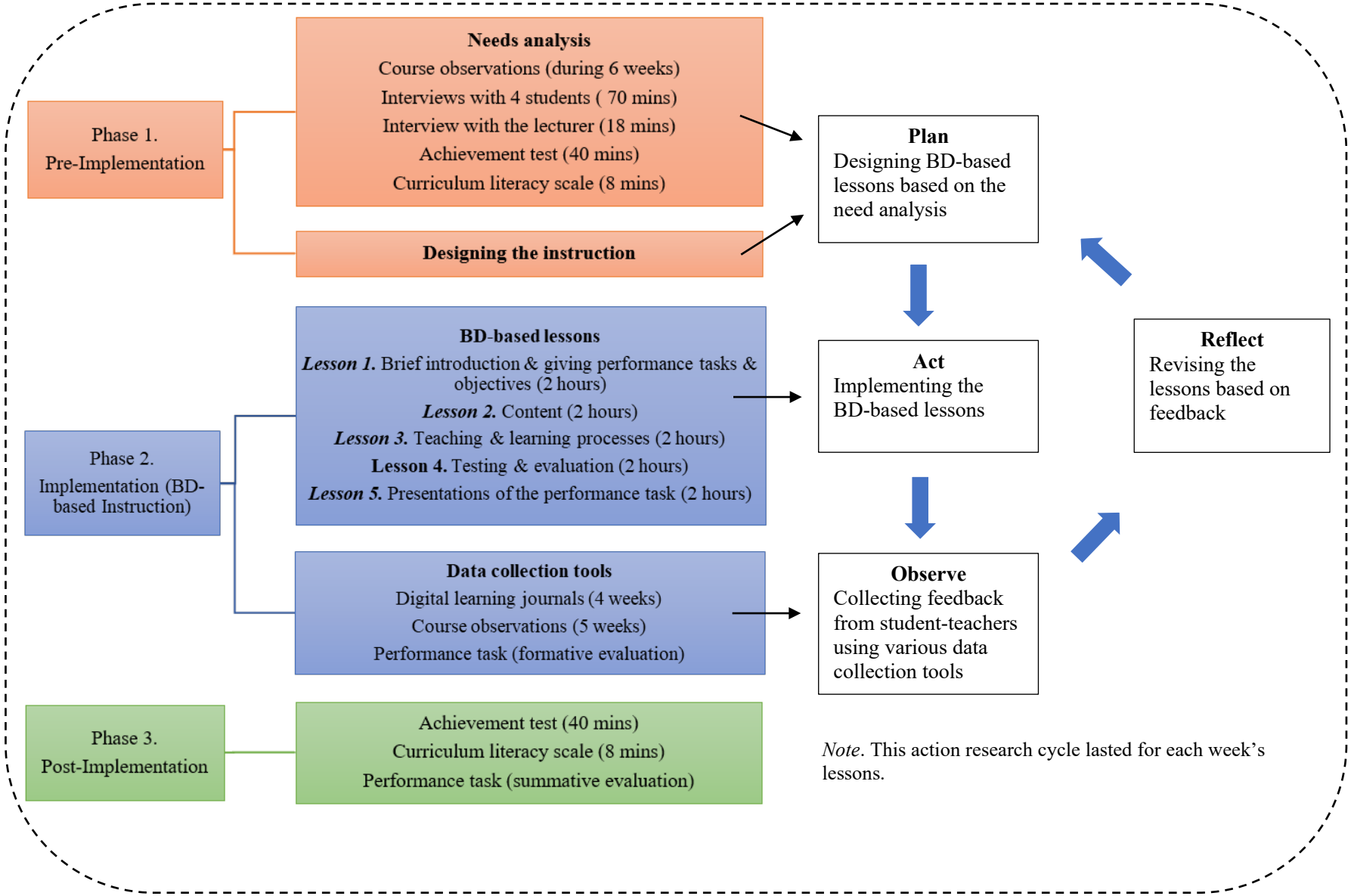


Figure 2: Procedure of the study

BD-based instruction

The desired results' stage of instruction identified five established goals/standards, eight important understandings, ten essential questions, nine knowledge objectives, eleven skill objectives, and three long-term transfer goals. The big idea of this instruction was that implementing a curriculum requires understanding the curriculum elements and how they relate to one another and putting them into practice.

For the evidence stage, students were tasked with designing an early-childhood curriculum as a performance task, considering the features of the curriculum elements. The scenario for the task was set as follows: The Turkish Board of Education and Discipline decided to develop a preschool curriculum with thirteen new or amended themes that would be included in the curriculum: child rights, individual differences, jobs, epidemics, vehicles, my school, climate crisis, financial literacy, animal rights, our planet, healthy life, feelings, our house and its parts. As a component of the curriculum-development process, students were expected to participate in the Program Working Group, which comprised a subject area specialist from a university, a subject area teacher, a curriculum development specialist, and an assessment and evaluation specialist. Additional evidence was gathered through a Kahoot quiz, worksheet, group evaluations, learning journals, and open-ended questions to measure learners' knowledge and skills.

In the learning-plan stage, designers considered the decisions made in the desired results and evidence stages, so that learners could acquire their intended knowledge and abilities and grasp crucial concepts. Participants engaged in a series of learning activities as follows:

First week: Objectives. As a pre-activity, a poster featuring four quotes emphasizing the significance of goal setting was presented. Students collectively discussed the common theme and message of these quotes. After the instructor provided explanations about the subject—objectives—the following essential questions were raised: "Are the objectives related to memorizing a poem, tolerance to different cultures, and writing of the same type and level? Why?" Then, they watched a short film called, "Alike," depicting the life of a father and his son in a modern metropolitan society. Students shared their thoughts on the potential vision and general educational goals of the country in the video. They were then divided into groups with whom they would collaborate on their performance task. They brainstormed ideas about their ideal educational system. They were instructed to determine and write a vision and general goals for this imaginary approach. Finally, the students were told to determine and write specific objectives related to their topics as homework.

Second week: Content. This lesson was designed using the 5E model:

Engage. Preparatory questions were asked to the students to reveal their prior knowledge such as (a) What is content? (b) Why does content matter? (c) What features should content possess? (d) What types of content are taught in early childhood education?

Explore. Students formed groups with their friends to undertake the performance task. Each group was assigned a content organization approach (linear, cyclical, modular, pyramidal, core, thread network and project-based, inquiry-based). They were then given the Content Organization Approaches worksheet created on Canva and instructed to fill it out using available resources, such as the internet and books.

Explain. The instructor provided feedback on the completed worksheets and explanations. Finally, she summarized the subject using a chart.

Elaborate. Two essential questions were asked for enabling the students to transform their knowledge and gain a deeper understanding of content organization approaches. Students then

collaborated in breakout Zoom rooms within their groups to decide which content organization approach to adopt, considering their themes.

Evaluate. A quiz with 10 multiple-choice questions was generated for students using the Kahoot application. They were instructed to communicate with their group members via WhatsApp and collectively answer the questions, leading to the review and correction of any misunderstandings.

Third week: Teaching and learning processes. The visuals of three different classroom environments were shown to grab students' attention. They were asked to identify which classroom environment they considered more effective. Following explanations from the instructor about the lesson's topic, a three-minute video demonstrating the use of holograms and augmented reality in education was screened. Students were prompted to discuss the potential benefits and drawbacks of these technologies for early-childhood education. After teaching Gagne's nine events of instruction, the following essential questions were asked: Why were detailed explanations and examples for the learning-teaching processes not provided in the MoNE's curriculum? What are the differences between student-centered and teacher-centered educational contexts? A case method activity ensued, during which students were tasked with finding the missing activities, which were conclusion-related ones, from the given case. Finally, a concept map was created as a lesson summary using GitMind.

Fourth week: Evaluation. Following an introduction to testing and evaluation and its various types, a debate activity commenced. The topic of the debate was which type of evaluation—summative or formative—is more beneficial for assessing students' learning. Groups 11, 12 and 13 served as the juries. Each group was allotted two minutes to persuade the others, which was monitored by an online timer. Following the debate, the juries convened in a single Zoom room to deliberate and reach a decision. After this activity, the instructor continued mentioning the measurement tools. Essential questions arose during the session. At the end of the lesson, the class collectively shared and recorded their ideas regarding the standards for the curriculum they would design using GitMind. This activity also provided an opportunity for students to review previously covered topics.

Fifth week: Performance task presentations. During this week, students presented their performance tasks in class. Their curriculum designs were evaluated by their classmates as accepted or rejected via Google Forms, and the instructors provided feedback.

Research instruments

Curriculum literacy scale (CLS). The 29-item CLS developed by Bolat (2017) was administered to measure students' curriculum literacy. Its validity and reliability studies were conducted on undergraduate students at the Faculty of Education of a Turkish public university. The scale utilized a five-point Likert scale comprising two factors: reading (15 items) and writing (14 items). The overall scale demonstrated a Cronbach's alpha coefficient of 0.94. In the present study, the Cronbach's alpha coefficient was 0.97 in the pre-test and 0.96 in the post-test, indicating that the scale was reliable for measuring students' curriculum literacy. The scale was administered through Google Forms and required approximately 8 minutes to complete.

Achievement test. The researchers developed a multiple-choice achievement test to gauge students' achievement regarding curriculum elements. Initially, a set of 40 questions was created and tested with a cohort of 46 students. Some questions were subsequently removed due to their difficulty and discrimination index scores, leaving 32 questions. The test's KR-20 reliability was found to be 0.89, and the average difficulty of the items was 0.49. The finalized test was worth a

total of 100 points, with four questions worth four points each and the remaining questions worth three points each. It was administered via Google Forms and required 40 minutes to complete.

Lesson observations. The first researcher observed the natural setting for six weeks before the implementation, and the second researcher conducted observations during the five-week implementation period. Throughout these unstructured observations, the researchers took notes to document their observations.

Semi-structured interviews. Semi-structured interview questions were developed by the researchers with the assistance of an expert in curriculum and instruction. The interview with the instructor was based on eight open-ended main guiding questions and follow-up questions, which lasted approximately 18 minutes. Each student interview consisted of four open-ended main guiding questions and alternative questions, and lasted an average of 18 minutes. While the interview with the instructor was conducted face-to-face, the interviews with the four students were conducted either face-to-face or online via Zoom, depending on the participants' preferred time and place. In addition, informal interviews were conducted with both inter-researchers and students throughout the process to gather their feedback.

Performance task. The students were tasked with designing a curriculum based on one of thirteen topics to be covered in the early-childhood curriculum. During or after each lecture, the students gradually constructed their curricula by developing relevant parts related to the covered topic. They submitted their curricula as a group, and completed 15-item Group Evaluation Forms (Bahar et al., 2015) consisting of a five-point Likert scale. Instructors also evaluated the curricula using a curriculum evaluation questionnaire adapted from Yapar (2018), comprising the subdimensions of the four main curriculum elements. This questionnaire consists of 40 items with a five-point Likert scale and includes explanation boxes for written comments.

Digital learning journal. Digital learning journals were used to collect students' reflections on the teaching and learning processes after each lesson. These assignments were given through Edmodo. The journal framework, developed by the researchers, included three guiding questions: What did I learn? Which part(s) of the lecture did I find most challenging?, and my thoughts about this week's lesson.

Data analysis

Descriptive analysis, such as calculating the arithmetic mean and standard deviation values, was employed to examine the responses to the pre- and post-CLS and achievement tests. A paired-sample t-test was conducted to examine any differences between the pre-tests and post-tests. The scores of the pre- and post-CLS and achievement tests exhibited a normal distribution (Tabachnick & Fidell, 2007). Additionally, performance tasks were independently evaluated using a questionnaire by the researchers.

Qualitative data were analyzed using a deductive thematic analysis method (Braun & Clarke, 2012; Srinivasan et al., 2023), a top-down approach guided by three predetermined main themes: needs analysis results, students' learning outcomes, and the quality of the BD instruction. First, the transcripts were read multiple times for familiarization with the data, and passages relevant to the pre-existing themes, which aligned with the research questions, were highlighted. Each theme's coded extracts were condensed into phrases, which were then examined to ensure that they made sense within both the impact domain and the broader theme.

Rigor and trustworthiness

The rigor and trustworthiness of this study were ensured through several robust measures. The researchers employed both qualitative and quantitative data, enabling methodological triangulation. This approach yielded thorough, well-balanced, and relevant study findings (Frels & Onwuegbuzie, 2013). Additionally, multiple data collection tools were utilized, and the findings obtained from the different tools were compared and cross-checked to ensure consistency. The detailed description of the research setting, participants, and data collection procedures added to the study's transparency by providing a clear context for the findings. Expert reviews were conducted, with specialists in curriculum and instruction who contributed to the development and evaluation of the research instruments and interview questions. Verbatim quotations in the findings section accurately represent the participants' perspectives, enhancing the study's credibility. These rigorous methodological approaches and continuous efforts to ensure data accuracy and relevance contribute to the trustworthiness and credibility of the study's outcomes.

Ethical considerations

In the present study, the researchers took a series of precautions to uphold ethical principles. Participants were informed about the aims of the study and given the opportunity to ask questions before voluntarily participating. Their personal information was kept confidential and used solely for research purposes. Therefore, pseudonyms were used when disclosing the findings to safeguard the participants' anonymity. The researchers also informed participants about the audio recording and its purpose during interviews. This study received approval from the Social and Human Sciences Research Ethics Committee at Yildiz Technical University with the number 20220500359.

Findings

The findings were thematically presented under three headings: (a) needs' analysis, (b) students' learning outcomes, and (c) the quality of the BD-based instruction.

Needs' analysis

Students' background knowledge. To ascertain the pre-service teachers' background knowledge regarding the curriculum elements and curriculum literacy levels, an achievement test and CLS were applied before the implementation of BD-based instruction. As indicated in Table 1, pre-service teachers rated their curriculum literacy at an average of 104.16 out of 145, and their mean achievement score was 49.86 out of 100 before the implementation.

During interviews, Gül proclaimed, "I should delve into the curriculum in more detail, but that's all I know. I'm only familiar with the activity part." Another student, Yıldız, stated:

> I learned about the objectives and content elements in our Early-Childhood Education Curricula Content Knowledge course. The objectives are the achievements we aim for the children to reach ….I am familiar with the content of the teaching process ….I currently know a lot about instructional strategies, but I know very little about assessment and evaluation.

Similarly, the instructor expressed that the students had difficulty integrating what they had learned previously and developing a comprehensive perspective, with the following words, "Pre-service teachers took instruction methods and techniques, and introduction to educational sciences courses, however, they cannot conceive that those courses will be handled and applied holistically in terms of the curriculum and its elements."

Furthermore, the researcher noted that the students' previous learning was lacking: "Despite taking prerequisite courses for this course in basic Teaching Profession Knowledge, the students' prior knowledge was lower than expected ….In general, the same students take turns and answer the questions."

Motivations to learn the curriculum elements. The importance of service teachers understanding curriculum elements was questioned, and Gül explained her motivation: "Learning this subject motivates me more, of course. I think it helps me make more informed decisions and advance my career." Another student, Simge, expressed this sentiment as follows: "…To be a good teacher, we need to know these elements. Thus, we could plan to teach." Another student, Yıldız, unfolds her belief that "I believe it enables me to first select the appropriate objectives. In the future, because of this, our students will improve in accordance with the objectives we specify. In other words, I would correctly guide their learning processes."

Recommendations for effective instruction. According to the interviews and observations, some recommendations were made for planning an effective teaching and learning process. The following recommendations were gleaned from the instructor's interview:

> They (students) enjoy and express admiration for videos ….Students are profoundly impacted when the lecture notes or books are written by the instructor …..The subject should not be taught in a cursory manner; it must be taught by connecting the subjects . . . so, the subject should first be taught by the instructor . . . .We should provide assignments to measure whether the students have internalized the material . . . .Question and answer methods and materials should be used while teaching, and discussions or group work can be beneficial . . . .brainstorming for sure. Exercises based on a genuine problem should be included.

Additionally, the following recommendations are also snippets from the students' interviews:

> …if the studies and articles are given before class, we can study them prior to our in-class discussion . . . .When I discuss the matter with my friends as part of group work, it's fantastic and meaningful. Collaborative learning or discussion is more effective. (Gül)

> …I should be familiar with the entire theoretical basis before proceeding to practice. Lessons in which we actively participate are more memorable.…A five-minute recap of the previous lesson is very catchy for me, and I think it also helps students learn the topic for that week. If they (instructors) come up with examples, I can connect much more immediately afterward . . . .Quiz apps, like Quizlet, are available. There might be some questions that span the entire session and serve as a review at the conclusion. (Gözde)

> It feels better to work on a project, because I research the topics for the projects. When I read multiple sources and explain them in my own words, it just makes sense to me. (Yıldız)

Additionally, the observation reports mirrored the data from the interviews: "The students have difficulty answering questions when asked individually, but they can offer very good answers when asked to discuss and answer as a group . . . .The use of engaging videos increased class participation."

Context analysis. In the context analysis, data was collected through course observations. They demonstrated that technology facilitated the learning and teaching process: "Zoom breakout rooms are very useful for group work . . . Padlet is a helpful tool for keeping track of student work week by week." However, students sometimes encounter impediments: "Some students might not be able to turn on the computer camera in class, because they reside in dorms." Moreover, Simge expressed difficulties in actively participating in online classes and getting a voice as follows:

> …we have class at eleven a.m. and must speak aloud; I live in the dormitory. It is troublesome because people are sleeping. There is no free space. There is a place like a library, but I must also maintain silence there. I am unable to do anything at the cafeteria due to the noise.

Pre-service teachers' learning outcomes

The paired sample t-test results of the students' pre- and post-CLS and achievement test scores are presented in Table 1.

Table 1: T-test comparisons of pre-test and post-test scores of CLS and achievement test.

		N	*M*	*SD*	*t*	*df*	*p*	Cohen's *d*
CLS	Pre-test	37	104.16	19.47	-5.064	36	.000	1.074
	Post-test	37	122.56	14.41				
Achievement test	Pre-test	37	49.86	10.62	-3.175	36	.003	0.615
	Post-test	37	60.21	21.29				

As shown in Table 1, there was a significant difference between the CLS pre-test (M =104.16), and post-test mean scores (M=122.56) of the pre-service teachers ($t(36)$= -5.064; $p<.05$). Additionally, there was a significant difference between the achievement test's pre-test (M =49.86) and post-test mean scores (M =60.21) of the pre-service teachers ($t(36)$= -3.175; $p<.05$). In other words, the pre-service teachers' curriculum literacy and achievement, in terms of curriculum elements, increased significantly after BD-based instruction. The effect sizes of the achievement test scores indicate moderate effectiveness (Cohen's d=0.615), while the CLS scores demonstrate a greater level of effectiveness (Cohen's d=1.074).

The pre-service teachers recorded the subjects they learned every week in their learning journals. For example, Mert explained it for the first week of the instruction: "I learned the general goals of Turkish national education and early-childhood education, the classifications of the objectives, and Bloom's taxonomy. I learned indicators of objectives." Another student, Yaren, expressed it for the fourth week as follows: "I learned what the formative and summative evaluation covers, [along with] which one should be used in scenarios."

The scores of the groups who designed a curriculum as a performance task during the five-week instruction are given in Table 2.

Table 2: Performance task scores.

Groups	Scores
Gr:1	90
Gr:2	95

Gr:3	85
Gr:4	90
Gr:5	85
Gr:6	90
Gr:7	90
Gr:8	70
Gr:9	90
Gr:10	85
Gr:12	75
Gr:13	85

Note. As group 11 did not submit their assignments, no score is included in for group 11.

When examining the results of the performance tasks completed by the pre-service teachers, it can be concluded that their scores are generally good. However, there are some groups that achieve higher or lower results compared to others. The reason for this discrepancy is that certain groups put more effort into their performance tasks. This includes allocating ample time and seeking feedback from the instructor during the process, resulting in a better overall product and grade. On the other hand, it was observed that some groups did not demonstrate enough effort after the lessons, even though the majority of the tasks were completed during the lessons. For instance, group 12 failed to plan the two-hour lesson.

The quality of the BD-based instructions

Positive evaluations. The pre-service teachers' journals provided information about the effectiveness of BD-based instruction. The following are excerpts from their positive comments on the training:

> The interactive nature of the lesson prevented me from becoming distracted, and I was able to concentrate until the end. It can be repeated more often that there is a competition like Kahoot at the end of the lesson. . . .learning with fun provides permanence. (Betül - 2nd week)

> It was good to create a concept map in the lesson. The subjects we discussed in class had more lasting quality. (Yıldız - 3rd week)

> Our debate activity this week was both enjoyable and informative. At the same time, since we prepared for the debate, we came to the lesson with prior knowledge. (Gamze - 4th week)

Additionally, the pre-service teachers had positive emotions towards the implemented instruction. In the first week, Burcu explained, "I love this course and what it has taught me . . . .I am happy to have learned the subjects completely, by delving deeper into what I already knew." In that vein, Seda expressed in the third week: "It was a lesson where we felt that our instructor cared about our thoughts and feedback." Another student, Yaren, said in the fourth week, "I like the lesson, and I think it is beneficial. I am learning information that I will use when I graduate."

Negative evaluations. Pre-service teachers also had negative opinions regarding the classes. In the first week, Gülay declared, "The course is very difficult for me. We're always working on something." Leyla expressed her dissatisfaction with the time constraints in the second week: "I think the time given was limited for some activities we did at the end of the lesson."

Discussion

Curriculum knowledge is a paramount subdomain of pedagogical content knowledge that pre-service teachers must obtain during PTE. This study used BD to ameliorate pre-service teachers' curriculum knowledge, enabling them to apply this information and skills to real-world situations, and organize instruction revolving around a big idea. Since previous studies have shown that BD has a favourable impact on learners' achievement, attitudes, and motivation (Açar et al., 2019; Arslan-Buyruk et al., 2018; Ozyurt et al., 2021; Wiessa, 2011; Yurtseven & Doğan, 2018), BD was employed to enhance pre-service teachers' curriculum knowledge in the present study. The aim was also to determine the quality of these BD-based instructions.

The findings from the needs' analysis reveal that pre-service teachers exhibited limited background curriculum knowledge. The motivation to understand curriculum elements was articulated by the students, who emphasized the importance of this knowledge for informed decision-making and effective teaching. This indicates their willingness to pursue this training for their future professional life. Recommendations for effective instruction, including the use of engaging videos, interactive teaching methods, and group work to enhance learning experiences, are consistent with best practices for PTE that is advocated by researchers (Mishiwo, 2022; Thomas & Brown, 2019; Xu et al., 2024). Context analysis further illustrated the facilitative role of technology in the learning process, albeit with some challenges, such as limited access to technology and disturbances in shared living spaces for some students. While online education presents opportunities for individualized learning and broader access to higher education, it also exposes digital divides among students, due to restricted access to appropriate infrastructure, software, and hardware, making it challenging for every student to benefit equitably and effectively from synchronous teaching and learning (Laufer et al., 2021; Peimani & Kamalipour, 2021). These disparities, influenced by economic status, gender, race, and historical context (Laufer et al., 2021), highlight the need for equitable access to resources and consideration of diverse learning environments in online instruction.

Regarding pre-service teachers' learning outcomes, significant improvements were observed in both curriculum literacy and achievement, in terms of curriculum elements following BD-based instruction. This suggests that the BD-based instructional approach effectively enhanced pre-service teachers' understanding of curriculum concepts and their ability to apply them, aligning with the goals of PTE. Likewise, Gulsvig (2009) noted that BD is viewed as a tool that increases students' achievement when used to design the instruction of a lesson or unit. Given the profound influence that teachers exert on the development of young learners (Scull et al., 2012), further studies are required to explore the impact of acquiring curriculum knowledge during PTE on children's preparation in school. The student teachers' reflections in their learning journals further demonstrated their engagement with course content and the acquisition of specific knowledge and skills related to curriculum elements. BD-based instruction also enhanced the pre-service teachers' performance in designing a curriculum, since they were able to transfer what they had learned to practice, as evidenced by their high results on this task. Uluçınar (2021) concluded that technology supported through BD contributes to pre-service teachers' lifelong learning. In addition, pre-service teachers concretely learned the final point they needed to reach by the end of the instruction, thanks to the big idea, providing them with an important roadmap for organizing their own learning.

As a result, the analysis of the data collected during and after BD implementation revealed that the design was effective and beneficial for pre-service teachers to internalize the subject matter, in contrast to traditional approaches and course design. This study's results are consistent

with those of Yurtseven and Doğan (2018), who found that using activities with BD facilitated teaching. Pre-service teachers' opinions about BD-based instructions are generally positive, as seen in studies in different areas (Açar et al., 2019; Gül & Kaya, 2020; Noble, 2011). Pre-service teachers appreciated its interactive nature and the opportunities it provided for meaningful learning experiences. Similarly, in the study conducted by Som et al. (2016), it was concluded that BD activates positive affective traits and increases active participation in lessons in higher education. Students expressed satisfaction with various instructional activities, such as debates and concept mapping, highlighting the effectiveness of these strategies in promoting learning. These findings imply that student motivation is increased by educational competition activities and collaborative work. On the other hand, a few pre-service teachers had concerns about course difficulty and time constraints. This may be due to not having had such a learning experience before, or not devoting the necessary attention and effort to the lesson. These negative evaluations also indicate areas for improvement in instructional design and delivery to better meet the needs of pre-service teachers.

Limitations and Implications

This study is limited by its focus on a single class within the Early-Childhood Education Department of a public university in Turkey. As a result, the generalizability of the findings may only be relevant to similar contexts. The small sample size further constrains the applicability of results to other PTE departments and institutions. Moreover, contextual factors inherent to the university and region may impact outcomes, necessitating caution in extending findings to diverse educational settings. While the findings indicate significant improvements in curriculum knowledge and positive feedback from pre-service teachers, the study does not explore the long-term retention of curriculum knowledge, or its practical application in real classroom settings. This suggests that further research is needed to assess how pre-service teachers retain and utilize the curriculum knowledge over extended periods and in practical teaching scenarios, ensuring the lasting impact and effectiveness of BD-based instruction.

Despite these limitations, this study provides several insights for policy and practice in PTE. First, pre-service teachers should take the curriculum development course (CDC) after completing the classroom management, testing, and evaluation courses, which are prerequisites. Therefore, CDC can be offered in the fourth year. Offering CDC later in the program allows pre-service teachers to build upon their foundational knowledge and develop a more holistic understanding of curriculum elements. Second, it is recommended that the CDC allocate a minimum of three hours per week to ensure comprehensive coverage of the curriculum topics. This would provide pre-service teachers with ample time to engage deeply with the material and develop a robust understanding of curriculum knowledge. Encouraging collaborative learning and group work, facilitated by technologies like Zoom breakout rooms and interactive tools like Padlet and Kahoot, can enhance engagement and provide immediate feedback. Regularly implementing evaluation and feedback mechanisms, such as formative assessments and reflective journals, will help to continuously improve PTE programs based on the students' needs and feedback. Lastly, this study emphasizes the importance of incorporating effective instructional designs, such as BD, into PTE programs to adequately prepare pre-service teachers for their future roles. Backward design (BD), as an effective instructional strategy, may be used for the instruction of various subjects and courses in PTE. These recommendations aim to bridge the gap between current challenges and desired outcomes, ensuring that pre-service teachers are well-prepared for their professional roles.

Further research across different universities and PTE departments is warranted to validate these findings and enhance instructional practices in PTE. In addition, some pre-service teachers expressed concerns about the lessons' difficulty and time constraints. Future research should delve deeper into these challenges and suggest ways to mitigate them, ensuring that BD-based instruction is both effective and feasible for all students. Moreover, future studies employing larger sample sizes and quantitative methods can provide more robust evidence of the impact of BD-based instruction on pre-service teachers' learning outcomes.

Conclusion

This study demonstrates the effectiveness of using backward design (BD) as an innovative framework to enhance pre-service teachers' curriculum knowledge. The findings revealed significant improvements in curriculum knowledge following BD-based instruction, with positive feedback from pre-service teachers. However, a few pre-service teachers expressed concerns about course difficulty and time constraints. This may be because they had not had such a learning experience before.

Declaration of Interest Statement

No potential conflict of interest was reported by the authors.

Authors' Note

This study was derived from the oral presentation at the 10th International Congress on Curriculum and Instruction in Ankara, Turkey, on the 27th of October 2022.

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