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Original Article

THE EFFECT OF ARTIFICIAL INTELLIGENCE-POWERED EDUCATIONAL TOOLS ON PHYSICAL EDUCATION AND SPORT PRE-SERVICE TEACHERS' CURRICULUM LITERACY

O EFEITO DAS FERRAMENTAS EDUCACIONAIS ALIMENTADAS POR INTELIGÊNCIA ARTIFICIAL NA LITERACIA CURRICULAR DOS PROFESSORES DE EDUCAÇÃO FÍSICA E ESPORTE EM SERVIÇO

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RESUMO

Este estudo examinou a associação entre o uso de ferramentas educacionais apoiadas por inteligência artificial (IA) e os resultados de letramento curricular de licenciandos em Educação Física e Esporte, por meio de um delineamento de métodos mistos sequencial explicativo. A etapa quantitativa utilizou um delineamento quase experimental de grupo único com pré-teste e pós-teste, e a etapa qualitativa adotou uma abordagem fenomenológica. Participaram 30 licenciandos (10 mulheres, 20 homens). Os dados quantitativos foram coletados com a *Curriculum Literacy Scale*, e os qualitativos com um roteiro de entrevista semiestruturada fundamentado no *Technology Acceptance Model* (TAM). A intervenção durou sete semanas. Nesse período, os participantes utilizaram as ferramentas apoiadas por IA (MagicSchool e Eduaide) para elaborar e avaliar planos de unidade, planos diários de aula, planos no modelo 5E, atividades de aprendizagem cooperativa e tarefas de perguntas e respostas. Os dados quantitativos foram analisados por teste t para amostras pareadas, e os qualitativos por análise de conteúdo descritiva. Os resultados indicaram diferença estatisticamente significativa entre os escores de pré-teste e pós-teste de alfabetização curricular, em favor do pós-teste. Os achados qualitativos geraram temas relacionados às percepções e intenções de uso, interpretados à luz de construtos do TAM. Em conjunto, os achados sugerem que integrar ferramentas educacionais apoiadas por IA às práticas de planejamento e design instrucional na formação de professores de Educação Física e Esporte merece maior implementação e investigação.

Palavras-chave: Letramento curricular, Professor em formação, Inteligência artificial, Professor de educação física e esportes.

ABSTRACT

This study examined the association between the use of AI-powered educational tools and Physical Education and Sports pre-service teachers' curriculum literacy outcomes within an explanatory sequential mixed-methods design. The quantitative part employed a quasi-experimental pretest–posttest single-group design, and the qualitative phase used a phenomenological approach. Participants were 30 Physical Education and Sports pre-service teachers (10 female, 20 male). Quantitative data were collected using the Curriculum Literacy Scale, while qualitative data were gathered through a semi-structured interview form informed by the Technology Acceptance Model (TAM). The intervention lasted seven weeks. During the process, participants used AI-powered tools (MagicSchool and Eduaide) to design and evaluate unit plans, daily lesson plans, 5E lesson plans, cooperative learning activities, and question–answer tasks. Quantitative data were analyzed using a paired-samples t-test, and qualitative data were analyzed via descriptive content analysis. Results indicated a statistically significant difference between pretest and posttest curriculum literacy scores in favor of the posttest. Qualitative findings yielded themes reflecting participants' perceptions and intentions regarding the use of AI-powered tools, interpreted through TAM-related constructs. Overall, the findings suggest that integrating AI-powered educational tools into planning and instructional design practices in Physical Education and Sports teacher curriculum warrants further implementation and research.

Keywords: Curriculum literacy, Preservice teacher, Artificial intelligence, Physical Education and Sport Teacher.

Introduction

The Physical Education and Sports Curriculum aim to develop skills such as self-management, communication, cooperation, fair play, social responsibility, leadership, sensitivity, and respect for nature through sports and physical activities[1]. The curriculum is an arrangement of experiences covering all activities related to the teaching of a course[2]. Teachers are primarily responsible for implementing these experiences in educational environments. Therefore, it is crucial for educators to comprehend and implement the curriculum accurately and to organize students' learning experiences in line with the curriculum principles[3]. This also

brings along the importance of curriculum literacy. Curriculum literacy is a competence that can add features such as understanding, interpreting, commenting on the curriculum, arranging the curriculum according to the current conditions, and eliminating deficiencies, if necessary[4]. In this aspect, curriculum literacy is a factor that enhances both the quality of teaching and teacher skills, contributing significantly to student success[5,6]. For this reason, studies aimed at increasing the curriculum literacy competencies of teachers or pre-service teachers to become teachers in the future are very important in achieving the goals of the Physical Education and Sports curriculum. In the literature, it is stated that physical education teachers consider themselves inadequate in the knowledge of curriculum[7], and 56.25% of teachers have problems mastering the physical education and sport course curriculum[8]. Similarly, Özcan and Mirzeoğlu[9] stated that 55% of the Physical education and sport teachers had difficulty in understanding the curriculum. Evaluating all these, there is a need for innovative teaching approaches that will improve the curriculum literacy competencies of physical education and sport teachers or pre-service teachers. At this point, artificial intelligence-powered educational tools can be utilized.

Artificial intelligence (AI), one of today's most important technologies, is the transfer of human intelligence to computers or machines by modelling[10]. On the other hand, AI refers to software or applications that enable computers to simulate human behaviour in tasks like inference, analysis, learning, problem-solving, pattern recognition, and decision-making[11,12]. In this respect, AI applications are seen as an important instrument in improving the quality of education[13]. For this reason, it is seen that AI-powered educational tools are widespread in educational environments. For example, ClassDojo helps teachers to manage their classrooms better by providing real-time analyses of student behaviour and engagement. Edx an AI-powered tool that can grade and provide feedback on student essays. TeacherKit an AI-powered tool that helps teachers manage administrative tasks. The tool can monitor and report students' behaviour. DreamBox an AI-powered tool provides real-time current curriculum by evaluating student performance. Research in the literature indicates that AI-powered applications like ChatGPT enhance students' learning experiences through interactive lesson plans, exercise programs, training methods, health, and nutrition[14]. It is stated that AI-powered educational tools are widely used in higher education[15-18], student assessment[12,19-23], data mining[24] and intelligent tutoring systems[25]. With this study, AI-powered educational tools are expected to contribute to pre-service Physical Education and Sports teachers' future profession.

In the study based on technology acceptance theory, pre-service teachers were enabled to use AI-Powered Educational Tools (AIPET) in educational processes and their curriculum literacy competencies and their views on AIPET were investigated. Technology acceptance model is one of the most basic theories explaining the adoption of a new technology by individuals[26]. According to this model, the acceptance and use of a new technology is explained as the effect of the perceived usefulness, ease of use and attitudes of individuals about that innovation and technology on their usage intentions[27-30] (Figure 1). The adoption of new technology by pre-service teachers will facilitate its effective use in their professional lives, leading to easier acceptance by new generations[31]. It is stated that the teachers find this technology useful and easy and using is increasing day by day by teachers, when the studies on the teachers acceptance of AIPET in the literature are considered[32-34]. Therefore, it is thought that studies on the integration of AI technologies into education and training processes are crucial.

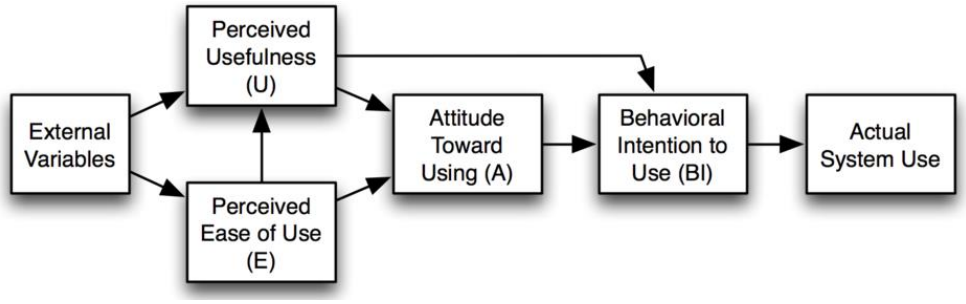

Figure 1. Technology Acceptance Model
Source: Davis[26]

There are studies investigating the curriculum literacy competencies of teachers and pre-service teachers in the literature[35-38], but the studies investigating the curriculum literacy levels of Physical Education and Sports teachers and pre-service teachers are quite limited[39-42]. Additionally, it has been observed that there are not enough experimental studies on curriculum literacy skills. Similarly, there are not enough studies examining the effect of AI-Powered Educational Tools (AIPET) on curriculum literacy competencies. Considering all these, there is a need to investigate the effect of AIPET on the curriculum literacy competencies of pre-service Physical Education and Sports (PES) teachers. The aim of the study, designed in the perspective of the technology acceptance model, is to investigate the effect of AIPET on the curriculum literacy competencies of pre-service teachers studying in the PES teacher education program. The following questions were sought for this purpose.

1. How are the curriculum literacy competencies of pre-service PES teachers?
2. What is the effect of curriculum activities prepared with AIPET on the curriculum literacy competencies of pre-service PES teachers?
3. What are the opinions of pre-service PES teachers about AIPET?

The current study is intended to help the PES teachers to understand how they can use AIPET to support their teaching activities and how they can make their programs more effective with these tools. The explanatory sequential design intends to explain initial quantitative results with qualitative data by connecting the two databases. In this two-phase design, the first phase involves collecting quantitative data, analyzing the results, and then gathering qualitative data to explain the quantitative results in more detail.

Methods

Sample

Explanatory sequential design was employed to examine the effect of AIPET on the curriculum literacy competencies of pre-service teachers enrolled in a PES teacher education program. Explanatory sequential design, one of the mixed method designs, is used to obtain a wide perspective on the topic investigated[43,44]. The quantitative part of the study was modelled as a quasi-experimental pretest–posttest single-group design. In this design, the effect of the experimental procedure is tested with a single group study[45]. For the qualitative component, the study adopted a qualitative descriptive interview approach, informed by a phenomenological sensitivity in the sense that it sought to capture participants' experiences and perceptions[46].

The study group of the study was determined by Criterion Sampling method, one of the non-random sampling models. In the criterion sampling method, preferred to study and review all situations meeting some importance criteria, the criteria can be predetermined or determined by the researcher[46,47]. The criteria include studying in the PES Teaching program, succeeding in the courses of Educational Psychology and Introduction to Educational Science, and continuing with the Principles and Methods of Teaching course. The participants of the study

consisted of 30 students studying in the PES Teaching Program at the School of PES of a State University in Turkey in the 2023-2024 academic year autumn term (Table 1).

Table 1. Participants' information

Gender	N	%
Female	10	33,3
Male	20	66,7
Total	30	100

Source: authors

The criterion for participation in the qualitative part of the study was to have participated in the experimental study investigating the effect of AIPET on curriculum literacy competencies. In the qualitative part of the study, 28 students studying in the PES Teaching program participated, and 2 students participating in the experimental study did not participate. Information about the participants is given in Table 2.

Table 2. Participants' information

Gender	Codes	n	(%)
Female	S1, S12, S16, S17, S18, S20, S22, S23, S24, S28	10	35,7
Male	S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S13, S14, S15, S19, S21, S25, S26, S27	18	64,3
Total		28	100

Source: The authors

Procedures

"Curriculum Literacy Scale" developed by Akyıldız[48] and "Interview Form" designed by the researchers were used as data collection tools in the study.

Curriculum Literacy Scale: The scale consists of 4 sub-dimensions; Curriculum Objectives, Curriculum Content, Learning-Teaching Process, and Assessment and Evaluation. Curriculum Goals sub-dimension aims to measure the literacy levels related to competencies of goals and aims, Curriculum Content related to program content competencies, Learning-Teaching Process related to learning and teaching process competencies, and finally Assessment and Evaluation related to assessment and evaluation competencies. In the original study, scale's Cronbach Alpha reliability coefficients were found to be .84 for Curriculum Goals, .90 for Curriculum Content, .94 for Learning-Teaching Process, .93 for assessment and evaluation, and .97 for the whole scale. In the current study, the Cronbach Alpha reliability coefficients for the sub-dimensions of the scale in the pretest were .92 for curriculum goals, .97 for curriculum content, .97 for learning and teaching process, .97 for assessment and evaluation and .99 for the whole scale. In the posttest, Cronbach Alpha reliability coefficients for the sub-factors of the scale were .89 for curriculum goals, .95 for curriculum content, .97 for learning and teaching process, .96 for assessment and evaluation, and .98 for the whole scale.

Interview Form: This form is a semi-structured interview form including questions about pre-service teachers' use of AIPET for teaching purposes. The pre-service teachers wrote their opinions in their own handwriting. Each pre-service teacher completed the interview form within 10-15 minutes. The activities conducted in all stages of the study are shown in Figure 2.

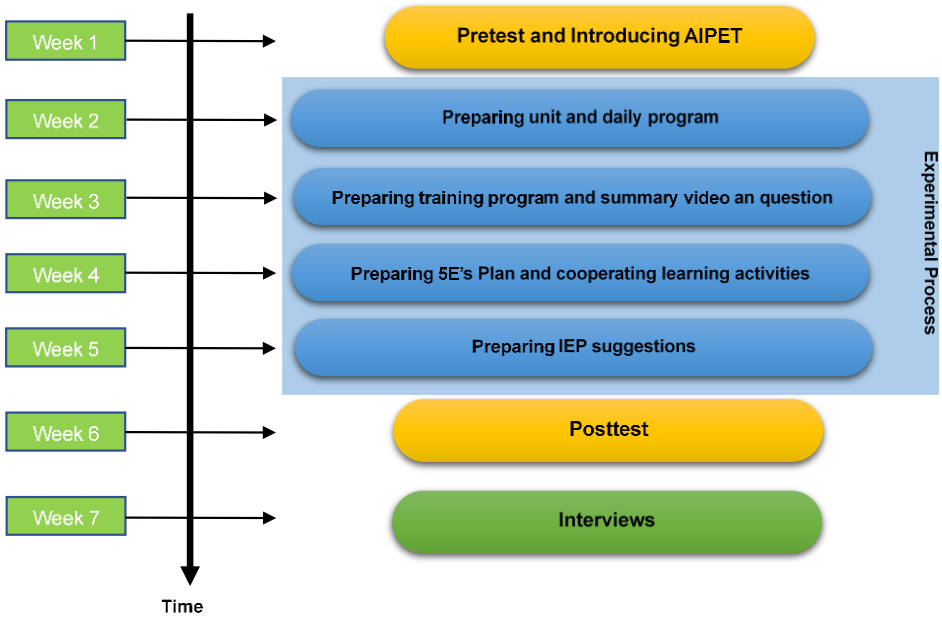

Figure 2. Experimental process
Source: The authors

At the beginning of the experimental process, the Curriculum Literacy Scale as a pretest and posttest measurement tool was applied to the study group. During the process (4 weeks), MagicSchool and Eduaide applications, which can be used within the scope of Teaching Principles and Methods Course, were introduced to the study group. The pre-service teachers prepared unit plan, lesson plan, training plan, video summarising, generating questions from videos, lesson plans in accordance with 5E model, collaborative activities and individualised education program (IEP) for special needs students with the tools included in these applications. The application took 4 weeks and at the end of the application, a post-test was applied and the pre-service teachers were asked for their opinions on the use of AIPET for teaching purposes in the following week. The weekly activities carried out in the experimental group are given in Table 3 in detail week by week.

Table 3. Details of the weekly activities carried out by pre-service PES teachers

	Application	Students Activity	Tools and Materials	Outcome
Week 1	• Pretest • AIPET	• Filling in the curriculum literacy scale. • Students making trials for the elements of the curriculum in the applications	• kebirapor.com • eduaide.ai • magicschool.ai	• Determining the students' curriculum literacy level before the experiment
Week 2	• Unit plan • Lesson plan	• Students create a 5-week unit plan suitable for a sport branch of their choice • Creating the lesson plan of a lesson of the unit plan • Uploading the prepared plans and students' evaluations about the plans to the class in Canvas (LMS)	• magicschool.ai • canvas.instructure.com	• Unit plan • Lesson plan • AIPET experience • Evaluation of prepared materials
Week 3	• Training Program • Video summarisation • Generating Questions from video	• Students to prepare a 30-minute training program from a branch of their choice • Finding a YouTube video suitable for the prepared training program • Summarising this video with AIPET • Generating multiple choice questions from this video by AIPET • Uploading the prepared training program, video summary, multiple choice questions and evaluation report to Canvas	• magicschool.ai • youtube.com • canvas.instructure.com	• Training Program • Experience in summarising video • Application of generating questions • Evaluation of prepared materials • AIPET experience

Week 4	•Lesson Plan 5E's •Jigsaw activity •Think pair share •Learning stations	• Students create a lesson plan according to the 5E plan technique for a different day of the unit plan they created before. • Creating jigsaw puzzles, think-pair-share, and learning stations techniques from collaborative activities that can be used in PES lessons • Uploading the evaluation report of these prepared activities	• eduaide.ai • magicschool.ai • canvas.instructure.com	• Gaining knowledge about 5E's Lesson plan • Gaining knowledge about collaborative activities that can be used in PES lessons • AIPET experience • Educational evaluation of the prepared contents
Week 5	•IEP suggestion	• Creating an IEP for PES lessons activity for a disability group of their choice	• magicschool.ai • canvas.instructure.com	• PES activities for disadvantaged groups • Evaluation of the prepared IEP
Week 6	•Posttest	• Filling in the curriculum literacy scale.	• kebirapor.com	• Determining the students' curriculum literacy level after the experiment

Source: The authors

The ethical report was received by University Social and Human Sciences Ethics Committee with the date 06.12.2023 and number 280.

Statistical analysis

For the quantitative part of the study, the pre-test and post-test data collected for investigating the effect of AIPET on pre-service PES teachers' curriculum literacy were collected via www.kebirapor.com (online data collection platform). At the end of the experimental process, the data were transferred to the SPSS software and normality distribution was analysed at first. The results of the normality test are given in Table 4.

Table 4. Data obtaining pre-service PES teachers' normality distribution analyses

Test	n	Min	Mak	Skewness	Kurtosis
Pretest	30	1.00	5.00	-1.136 ,427	1,859 ,833
Posttest	30	3,11	5,00	-,443 ,427	-,832 ,833

Source: The authors

The results of the analyses showed that the Skewness and Kurtosis values were between -2 and +2 (see Table 4). Therefore, the data obtained were suitable for parametric tests[49,50]. Paired sample t-test analysis was performed on the quantitative data obtained from the participants. Qualitative interview data were analyzed using thematic content analysis guided by the Technology Acceptance Model (TAM).

Results

In this section of the study, the findings are presented according to each sub-problem. In this context, the findings of the first problem of the study, the curriculum literacy levels of pre-service PES teachers according to their pretest scores before experimental process, are presented in Table 5.

Table 5. Curriculum literacy competencies of pre-service PES teachers before the experiment

Dimensions	n	$\overline{X}$	Ss	Level
Curriculum Goals	30	3,84	,90	Mostly
Curriculum Content	30	3,85	,93	Mostly
Learning Teaching Process	30	3,86	,96	Mostly
Assessment and Evaluation	30	3,88	,98	Mostly

Curriculum Literacy Level	30	3,86	,93	Mostly

Source: The authors

It is seen that the curriculum literacy competencies of the pre-service PES teachers vary between 3.86 and 3.88 and are at the level of "Mostly" (see Table 5). The findings of pre-service teachers' curriculum literacy competencies according to the posttest scores after the experimental process are given in Table 6.

Table 6. Curriculum literacy competencies of pre-service PES teachers after the experiment

Dimensions	n	$\overline{X}$	Ss	Level
Curriculum Goals	30	4,28	,54	Always
Curriculum Content	30	4,34	,56	Always
Learning Teaching Process	30	4,30	,11	Always
Assessment and Evaluation	30	4,27	,12	Always
Curriculum Literacy Level	30	4,30	,10	Always

Source: The authors

As it is obvious from the Table 6, the curriculum literacy competencies of the pre-service PES teachers vary 4.27 and 4.34 and the level of "Always". It is seen that Curriculum literacy competencies of pre-service teachers increased after the experimental process.

Paired sample t-test analysis was performed to investigate the second problem of the study, determining the effect of curriculum activities carried out with AI-powered educational applications on the curriculum literacy competencies of pre-service PES teachers, and the results of the analysis are presented in Table 7.

Table 7. Findings of the paired samples t-test for the effect of the AIPET on Curriculum Literacy Competencies

Dimension	**Difference (posttest-pretest)**	**t**	**p**	**Effect size (cohen d)**
Curriculum Goals	,44	3,21	,00*	,59
Curriculum Content	,49	3,52	,00*	,64
Learning Teaching Process	,43	2,90	,00*	,53
Assessment and Evaluation	,39	2,52	,01**	,46
Curriculum Literacy Level	,44	3,15	,00*	,57

**p<,01, **p<,05*

Source: The authors

As a result of the analysis from Table 7, a statistically significant difference was found between the pretest and posttest curriculum literacy scores of pre-service PES teachers, favoring the posttest. The effect sizes (Cohen's d) ranged from .46 to .59, indicating a moderate magnitude[51,52]. Taken together, the results indicate a positive tendency in curriculum literacy scores after the AIPET activities.

In order to determine the third sub-problem of the study, the views of the pre-service PES teachers on AIPET, an interview form was applied to the students and content analysis was performed on the collected qualitative data in the perspective of Technology Acceptance Model. Among the items in the interview form of the students, "1- Have you ever used AI applications before the experimental application? If you have used them, please write their names?" The answers to the question are shown in Figure 3.

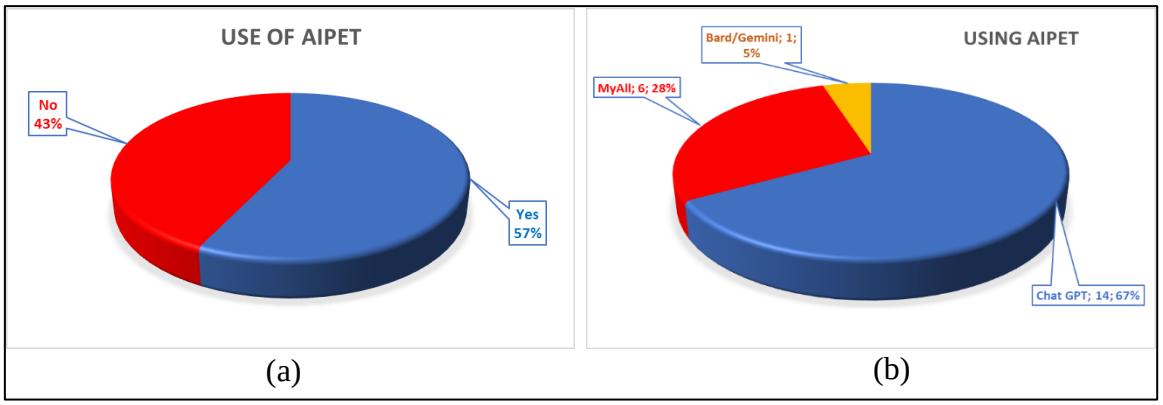

Figure 3. AIPET usage status before the experimental process
Source: The authors

As it is seen in Figure 2(a) that a majority of the pre-service PES teachers (n=18, f=57%) have used at least one AI application before. Pre-service PES teachers stated that they used ChatGPT (n=14, f=67%), SnapChat MyAll (n=6, f=28%) and Gemini (old name: Google Bard) (n=1, f=5%) in order of use (see Figure 2(b)). A part of the pre-service PES teachers (n=12) stated that they have not used any AI application before.

The findings of the content analysis of the responses of pre-service PES teachers to the other items in the interview form in the perspective of technology acceptance model are presented in Table 8.

Table 8. The opinions of Pre-service PES Teachers about AIPET

Theme	Code	Participant	f
Perceived Usefulness	Saving Time	S1, S2, S5, S8, S9, S10, S11, S12, S13, S14, S17, S18, S19, S20, S22, S25, S28	17
	Facilitating Learning	S14, S15, S16, S18, S19, S24, S26	7
	Contribution to Out-of-School	S6	1
	Material Richness	S13	1
	Personalised Learning	S17	1
	Guidance	S23	1
Perceived Ease of Use	Ease of Planning	S2, S4, S5, S6, S11, S12, S28	7
	Lack of Technical Skills	S6, S7, S8, S10, S13, S14	6
	Ease of Access to Information	S3, S13, S20, S22, S27	5
	Lack of Visual Content	S3, S4, S5	3
	Ease of Research	S1, S12	2
	Language Problem	S3	1
	Lack of Keyword	S20	1
Anxiety	Concern	S13, S20, S27	3
	Addiction	S4, S11	2
Reluctance	Laziness	S1, S19, S21	3
Motivation	Intrinsic Motivation	S19	1

Source: The authors

After the content analysis (see Table 8), five different themes related to the use of AIPET by pre-service teachers were observed. Accordingly, it was seen that most of the pre-service teachers' opinions (f=28) on the use of AIPET were in the Perceived Usefulness theme. The Perceived Usefulness theme contains the codes of Saving Time, Facilitating Learning, Contribution to Out-of-School, Material Richness, Personalised Learning, and Guidance. Perceived Ease of Use (f=23) theme follows this theme. The Perceived Ease of Use theme contains the codes of Ease of Planning, Lack of Technical Skills, Ease of Access to Information, Lack of Visual Content, Ease of Research, Language Problem, and Lack of Keywords. The theme of Anxiety (f=5) contains the codes of Concern and Addiction. The theme of Reluctance

(f=3) contains the code of Laziness, and the theme of Motivation (f=1) contains the code of Intrinsic Motivation. This part of the study, quotations and comments related to the codes and themes are presented.

Some quotations related to the "Perceived Usefulness" theme are as follows:

"...it saves time since it minimises the speed that we can get to the subject or its content..." [S1]. *"...a very useful application in order to save time..."* [S22]. *"...the AI application used saved time..."* [S25]. *"...For the student; provides systematic learning, provides better development, provides learning order..."* [S14]. *"...It helped me to do the homework easier and faster..."* [S19]. *"... for a better understanding of the lesson, games can be designed that are related to the lesson outside the lesson and at the same time the student can have fun..."* [S6]. *"...There are many benefits such as instant feedback, personalisation of learning..."* [S17]. *"...Providing guidance, giving sample ideas..."* [S23].

Some quotations related to the "Perceived Ease of Use" theme are as follows:

"...thanks to the AI we used in this context, it provided easy implementation from the planning stage to the evaluation stage of the educational outcomes we wanted to implement..." [S2]. *"...it was a very ideal solution for various planning and programs in a very short time..."* [S11]. *"...At the beginning, I had difficulty in every part of using the application because I was not familiar with computers generally..."* [S10]. *"...it is useful to convey the information we want to transfer to the student both in a short time and in terms of the appropriateness of the goals, targets and acquisitions..."* [S20]. *"...One of the parts I had the most difficulty with was finding external video and visual supporting examples while producing content, and one of the other parts I had difficulty with was translating foreign language themed applications..."* [S3].

Some quotations related to the "Anxiety" theme are as follows:

"... I have a great concern that over time, it may blunt people's ability to make the necessary effort for research, scanning sources and accessing information and create a lazier, ready-made generation..." [S13]. *"...I think that AI will cause bigger problems in the coming period. For example, it can seize us..."* [S27]. *"...of course, AI should be used in the future, but too much will lead both educators and students to ease. This is not something I support. I am in favour of everyone going through difficult periods and difficult exams..."* [S4].

Some quotations related to the "Reluctance" theme are as follows:

"...the disadvantage of AI in education is that it can make students lazy..." [S19]. *"... AI will prepare education and training programs and educators will not need to tire themselves. This is both good and bad because educators will not tire and use their brains, which will prevent the emergence of new ideas..."* [S21].

Some quotations related to the "Motivation" theme are as follows:

"...It helped me to do the homework more willingly and comfortably..." [S19].

Discussion

When the pretest scores of the curriculum literacy competencies of the pre-service PES teachers were examined, their curriculum literacy levels appeared to be high. This finding is consistent with prior studies in the literature[39,41,53]. Similarly, another study[54] examining teachers from different branches reported comparable curriculum literacy levels between PES teachers and teachers from other disciplines. Gülpek & Şahin[39] also highlighted the similarity between PES teachers and pre-service PES teachers in terms of curriculum literacy. This pattern may be related to the practice-oriented nature of PES teaching, which can facilitate the enactment of theoretical knowledge in authentic instructional contexts. In addition, because PES programs admit students through a special skills examination, it is plausible that students' prior field-specific competencies and sustained engagement in sports may be associated with higher curriculum literacy scores. Taken together, the results indicate that the participating pre-

service PES teachers entered the study with relatively strong curriculum literacy competencies.

In the second sub-problem of the study, when the association between AIPET activities and curriculum literacy competencies was examined through pretest–posttest comparisons, it was found that there was a statistically significant difference in favour of the posttest in all sub-dimensions. However, since the study was designed as a single-group pretest–posttest quasi-experiment, these findings should be interpreted cautiously in terms of causal inference. Nevertheless, the results indicate a positive tendency in curriculum literacy scores following the implementation. Darayseh[32] emphasised that AI offers great potential for teachers and students to access the information they need easily and quickly. In addition, rapid content generators, translation assistants, visual and voice advisor bots, course creators, student assessment tools, educational game generators, and collaborative educational activity generators can facilitate the work of students and teachers[18,55]. The MagicSchool and Eduaide applications used in the study allow students to create unit plans and lesson plans with limited input through tools such as the Unit Plan Generator and Lesson Plan Generator. In this context, it can be said that the use of these tools in the study group may be associated with higher competencies related to teaching goals. Similarly, the video summariser and IEP builder tools in MagicSchool enable teachers to prepare lesson content quickly. Eduaide provides advantages in producing collaborative teaching activities (puzzles, learning stations, think-pair-share, etc.) for the desired subject. The findings suggest that the structured use of these applications by pre-service teachers in the study group is accompanied by a positive tendency in competencies related to curriculum content and teaching–learning processes. Additionally, the video-question summarizing feature of MagicSchool and the tools in the questions section of Eduaide enable teachers to generate assessment materials. Calatayud et al.[56] stated that AI offers substantial possibilities for student assessment, although not all of this potential has been reached yet. Bagunaid et al.[57] integrated an AI-based algorithm into a learning management system to evaluate students and make recommendations and reported that the designed system evaluated student data more accurately and produced better suggestions than traditional methods. AI applications are expected to contribute to the creation and evaluation of assessment tools. In the present study, pre-service PES teachers used video-based question generation to create a multiple-choice assessment tool with the desired number of items in a short time. Considering these findings, it can be stated that the assessment-related features of AIPET are associated with more favourable posttest outcomes in the assessment and evaluation literacy sub-dimension; however, this interpretation should be made cautiously given the research design.

Another significant finding from the study is that most pre-service PES teachers are already utilizing existing AI tools. Many of the pre-service PES teachers in the study are aware of AI-powered tools and intend to use them. The analysis of the interview data gathered from pre-service PES teachers, within the perspective of the TAM, revealed that the following benefits were perceived: saving time, facilitating learning, contribution to out-of-school learning, material richness, personalised learning, and guidance. Ease of planning and ease of access to information were also emphasised. Some difficulties were identified, such as lack of technical skills, lack of visual content, language problems, and lack of keyword selection skills. Additionally, it was stated that AI technologies may create anxiety, cause addiction-related concerns, and lead to laziness. In the original TAM, “Perceived Usefulness” and “Perceived Ease of Use” explain the adoption of a new technology, which is mediated by attitude[26]. However, Venkatesh et al.[30] compared various models and demonstrated that external factors (e.g., anxiety, effort expectancy, and social norms) also impact the intention to use technology. In this regard, it can be said that language problems, lack of technical skills, limitations related to visual content, anxiety, and reluctance may negatively influence intention and actual use. At the same time, these concerns should not be viewed only as resistance; they may also reflect critical professional judgment and ethical awareness about responsible technology use (e.g.,

maintaining pedagogical control, avoiding overreliance, and ensuring appropriate use). Several studies have indicated that pre-service teachers' anxiety towards AI may hinder the effective integration of AIPET into education[34,58-60]. Therefore, the anxiety levels of pre-service teachers may be reduced by encouraging more guided interaction with AIPET and ensuring participation in AI literacy training, while also supporting reflective and ethically informed use.

Conclusion

Overall, the study identified statistically significant pretest–posttest differences in favor of the posttest across curriculum literacy and its sub-dimensions (curriculum objectives, curriculum content, learning–teaching process, and assessment and evaluation) among pre-service PES teachers, while the qualitative findings indicated that participants were generally open to AI-powered educational tools, reported intentions to use them in their professional practice, and emphasized benefits such as saving time, facilitating access to information, and supporting instructional planning—alongside concerns (e.g., anxiety, overreliance, reduced effort, language and skill-related difficulties) that may be interpreted not only as barriers but also as reflective professional judgment and ethical awareness regarding responsible technology use.

Although the study found significant effects of using AIPET in the PES curriculum, these results should be interpreted within some limitations: the single-group pretest–posttest design and the absence of a control group limit causal attribution; the small, local sample drawn from a single university restricts generalizability; the exclusive use of MagicSchool and Eduaide introduces a scope limitation that constrains transferability to other AI-powered educational tools and generative AI systems (e.g., ChatGPT, Gemini, Claude); the seven-week implementation period may be insufficient to capture change in slower-moving constructs such as attitudes toward AI; and reliance on a self-report curriculum literacy scale increases the risk of perceptual bias. Accordingly, future research should employ multi-group, control-group experimental designs with larger and more diverse samples across institutions; examine additional outcomes (e.g., learning–teaching process competence, curriculum fidelity, technology literacy, and AI literacy) using multiple data sources (performance tasks, instructional products, observation/rubrics, system logs); replicate the intervention with different AI tools; and deepen understanding of underlying mechanisms through qualitative inquiry (e.g., interviews, focus groups, reflective journals). In parallel, structuring AI literacy and effective/ethical prompting training within teacher education programs may support a more competent, critical, and pedagogically grounded use of AI as an instructional assistant in PES contexts.

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