

Reflective and critical thinking as determinants of academic achievement: A study in physical education and sport teacher candidates

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Type: Research Article (Received: 30.01.2024 – Accepted: 19.05.2024)

Abstract

This study examined the relationship between reflective thinking and academic achievement in physical education and sports teaching students. The research aimed to investigate to what extent the reflective and critical thinking tendencies of prospective physical education and sports teachers explain academic achievement. Based on John Dewey's vital and reflective thinking approaches, considered among thinking skills, an answer to this question was sought. A traditional and positivist paradigm was adopted as the research model, and a quantitative research approach was used. The study was designed with the relational method, and the relationship between critical and reflective thinking dispositions of physical education and sports teacher candidates and their academic achievement was analysed. The study group consisted of 200 participants studying in the first, second, third and fourth grades of the physical education and sports teaching program. The mean age of the participants was 22.20 ± 2.98 ; 44.5% exercised regularly, and 49% were licensed athletes. Data collection tools included personal information forms, academic achievement grouping, the Critical Thinking Scale, and the Reflective Thinking Scale. The Critical Thinking Scale was adapted to Turkish using a two-dimensional model. The Reflective Thinking Scale has four sub-dimensions. The Confirmatory Factor Analysis indicated that some items were not suitable due to high error variances and cross-loading. After removing these items based on expert opinions, the remaining items in the reflection and critical reflection dimensions showed very good factor loadings. The reliability coefficients for the scale were satisfactory. Final year students scored higher in critical reflection and reflective thinking than third-grade students. No significant difference was found in critical openness, reflective skepticism, and critical thinking. Male physical education and sports teacher candidates scored higher in reflection, critical reflection, and reflective thinking tendency than their female counterparts. Consequently, the findings show that reflective thinking can potentially increase academic achievement in prospective physical education and sports teachers. These findings emphasize that developing thinking skills should be a priority in education programs.

Keywords: Thinking skills, Critical thinking, Reflective thinking

Introduction

Thinking is the process of evaluating everything that comes to mind. People often think about things that are not directly perceived. The quality of thinking varies considerably from person to person. Good thinkers express their thoughts clearly and accurately. They know the steps for control and remember their purpose when focusing on questions. They are capable of meaningful and logical thinking, expanding their thoughts from various perspectives. They think independently of emotional and desire influences, objectively evaluate their emotions, and explore how their mind works (Paul & Elder, 2006). Creative thinking involves generating and assessing ideas (Kampylis & Berki, 2014). Modern creativity includes decision-making, critical thinking, and metacognition (Feldhusen & Goh, 1995). Analytical thinking breaks down thinking and examines its elements (Elder & Paul, 2007). Reflective thinking is actively and carefully evaluating beliefs (Dewey, 1933).

Critical thinking is a style that improves the quality of thinking by analysing, evaluating, and reconstructing an issue (Dewey, 1933; Paul & Elder, 2006). Critical thinking requires an active process to solve problems and make better decisions (Critical Thinking, 2008). According to Dewey, the best way to learn is for students to reflect on what they learn at school in real life. The reflective thinking process involves seeking solutions when faced with problems (Dewey, 1933; Shavit & Moshe, 2019). Developing critical thinking is tightly linked to reflective thinking habits (Kuhn, 1999). Thinking is a process that generally involves mental manipulation. It encompasses many activities, such as concept formation, problem-solving, creativity and cognitive functioning (Soliman, 2005). It is about recognising critical issues, asking and answering questions at the correct times, and applying essential questions to all situations. Critical thinking helps us guard against error by critically viewing existing beliefs. Strong critical thinking does not involve abandoning one's initial beliefs but rather strengthening them by examining them critically (Browne, 2010). Critical thinkers can deal not only with the tools of logic and science but also with various issues such as language, communication, morality, and politics. This way of thinking requires an inquiry into questions of truth and falsity, general matters of meaning and the imperatives of moral and political action (Foresman, 2016). Critical thinking skills include open-mindedness, making logical inferences, evaluating evidence, thinking independently, understanding alternative perspectives, and articulating critical thinking (Sternberg et al., 2007). This thinking requires an open-minded approach to what is read or thought to provide objective answers. Another important aspect of critical thinking involves various types of thinking. Critical thinkers show openness to new ideas, do not argue when information is lacking, recognise the lack of information, know the difference between truth and reality, and try to separate emotional thinking from logical thinking (Harnadek, 1998). This approach involves problem-solving and reasoning skills. Critical thinking, which includes observation, curiosity, scepticism, recognising problems, evaluating statements, and understanding logic, emphasises raising awareness (Starkey, 2010). Critical thinking requires a sustained effort to evaluate beliefs or knowledge in the light of supporting evidence and possible consequences. This process involves the ability to recognise problems, find applicable tools, gather and sort information, recognise values, understand the accuracy of language, interpret data, and evaluate evidence and arguments. Critical thinking is often associated with scepticism, but this does not mean being sceptical of everything, but rather a polite scepticism of what we hear and see. Critical thinking involves cognitive skills and strategies to solve problems and make logical decisions (Halpern, 2013). This process involves questioning one's thinking, countering prejudices, and making logical inferences. Critical thinking involves using reason to determine the truth of a claim, which is not about making true or false claims but about evaluating claims (Moore,

Parker, & Silvers, 2012). Critical thinking, unlike other forms of thinking, involves evaluating knowledge and thinking processes. Critical thinking approaches prejudiced assumptions and presents information with scepticism; it analyses ideas, evaluates them from various angles, and ultimately reaches specific ideas (Gürkaynak, Üstel, & Gülgöz, 2009).

Reflection is based on John Dewey's experiential learning approach and was introduced initially by Dewey in 1933. This approach aims to explain educational issues in depth and to find effective solutions to practical problems. Reflective thinking is a type of thinking that involves thinking deeply about a topic and seriously evaluating it in the mind (Dewey, 1933). In Dewey's view, reflective thinking will be achieved through flexible and logical thinking based on deep knowledge and experience, supported by personal qualities such as open-mindedness, sincerity, and responsibility. Reflective thinking enables teachers to guide their students' learning processes. In this context, reflective teachers guide students' access to information and create environments where students can freely express their ideas (Ersozlu & Kuzu, 2011). Reflection is a mental activity that involves thinking about what is going on during and after the teaching process and correcting these thoughts (McCollum, 2002). It has also been suggested that reflective practice is a way of thinking that positively motivates students' self-confidence and personal development, as well as enriching the activities carried out in the classroom (Vitanova & Miller 2002). According to Kolb, reflection is the activity of rethinking the previous learning experience and making observations as part of a learning cycle (Kolb, 1984).

Critical thinking and reflective thinking are closely related but distinct cognitive processes. Critical thinking involves reasonable reflective thinking that focuses on deciding what to believe and do (Su & Shum, 2019). It is a meta-cognitive skill that requires individuals to interpret, apply, analyze, synthesize, and evaluate information to make informed decisions (Zhao & Liu, 2022). On the other hand, reflective thinking is a higher level of thinking that involves individuals becoming more aware of their perceptions, feelings, actions, and behaviors (Göğüş et al., 2020). While critical thinking is essential for decision-making and problem-solving, reflective thinking plays a crucial role in self-awareness and understanding one's thought processes (Zhang et al., 2017). Critical reflection is considered a key mechanism in the process of critical thinking (Kim et al., 2018). It is argued that all degrees should promote reflective thinking as it is necessary for making reflective judgments when dealing with complex, ill-defined problems (Kember et al., 2008). Moreover, critical-thinking curricula that incorporate reflective exercises are more successful in engaging students in critical thinking (Cone et al., 2016).

Physical education and sports courses offer more than just physical activities; they serve as platforms for students to enhance their mental skills, problem-solving abilities, and readiness for real-life challenges. Teachers who possess advanced thinking skills, such as critical and reflective thinking, can cultivate environments that foster students' mental development (Tiwari et al., 2006). Moreover, implementing service-learning programs in physical education can provide valuable teaching and learning models for all involved parties, contributing to a holistic educational experience (Ordás et al., 2021). These lessons are environments where students use their mental skills, solve various issues and prepare for solving problems in daily life. Teachers with high-level thinking skills, such as critical and reflective thinking, can create learning environments that will develop students mentally. Therefore, determining the effect of reflective and critical thinking skills of physical education and sports teacher candidates on their academic achievement will contribute to physical education teacher training policies that will design learning environments and teaching methods according to their educational philosophy. This study examines the

relationship between the critical and reflective thinking skills of prospective physical education and sports teachers and their academic achievement.

The hypotheses of the study are as follows:

H₁ There is a relationship between critical thinking and academic achievement.

H₂ There is a relationship between reflective thinking and academic achievement.

H₃ There is a relationship between critical thinking and reflective thinking.

H₄ There is a difference between men and women regarding critical thinking.

H₅ There is a difference between men and women regarding reflective thinking.

H₆ There is a difference between exercisers and non-exercisers regarding critical thinking.

H₇ There is a difference between exercisers and non-exercisers regarding reflective thinking.

H₈ There is a difference between licensed and non-licensed athletes regarding critical thinking.

H₉ There is a difference between licensed and non-licensed athletes regarding reflective thinking.

Material and Method

Research Model

This research aims to determine how much the reflective and critical thinking tendencies of potential physical education and sports teachers explain academic success. The study is based on the thinking skills that John Dewey has identified in response to the question, "How should we think?" A literature review and theoretical framework were created, and data were collected from prospective physical education and sports teachers through self-report measures. The research approach used was quantitative, a traditional and positivist paradigm, and the research was designed with the relational method. The study analysed the relationship between the critical and reflective thinking tendencies of prospective physical education and sports teachers and their academic achievements.

Study Group

The study involved 200 participants from the Physical Education and Sports Teaching program who volunteered to participate. The participants were from the first (n=37, 18.5%), second (n=54, 27%), third (n=42, 21%), and fourth (n=67, 33.5%) grades. The average age of the participants was 22.20 ± 2.98 , with a mean age of 22.98. Of the participants, 49% were females (n=98) and 51% were males (n=102). The GPA distribution was as follows: 10% between 0-2.00 (20 students), 18.5% between 2.01-2.50 (37 students), 28% between 2.51-3.00 (56 students), 42.5% between 3.01-3.50 (65 students), and 11% between 3.51-4.00 (22 students). Among the participants, 44.5% reported they exercised regularly (n=89), while 49% were licensed athletes (n=98).

Data Collection Tools

A Personal Information Form was used to gather the demographic and personal information of the participants. The researcher created the form, including age, gender, grade, GPA range, exercise, and sports participation status. The information collected will be kept confidential by the Personal Data Protection Law, ensuring the anonymity of the participants.

A system was created to evaluate participants' academic achievement by forming groups with equal divisions. Five groups were formed within each group based on GPA, with two digits taken after the decimal point (0.01, 0.02, 0.03). Various studies have calculated that GPA is a reliable measure of academic achievement (Steinmayr et al., 2014; Casillas et al., 2012; Casanova et al., 2023).

The Critical Thinking Disposition scale, developed by Sosu (2013), was adapted into Turkish by Akın et al. (2015). The scale has two dimensions - critical openness and reflective scepticism - and consists of 11 items. Scale item loadings are between 0.34 and 0.88. In the original study, two dimensions with an eigenvalue above one were removed due to the exploratory factor analysis of 467 participants. It was concluded that the two-factor model of the scale showed a good fit ($\chi^2(53) = 116.55$, TLI = 0.91, CFI = 0.94, RMSEA = 0.051, 90% CI 0.038-0.063, SRMR = 0.037). The alpha internal consistency coefficient of the whole scale is 0.79. The sum of all items yields a score between 11 and 55, representing the individual's overall predisposition score. Scores between 11 and 34 indicate low, 35-44 indicate medium, and 45-55 indicate high disposition. For the subscales, the total score of the Critical Openness scale ranges from 7 to 35 (7-21 low, 22-28 moderate, 29-35 high). Reflective Skepticism ranges from 4-20 (4-12 low, 13-16 moderate, and 17-20 high). In the confirmatory factor analysis, Akın et al. found that the two-dimensional model had a good fit ($\chi^2=53.24$, $df=40$, RMSEA=0.040, NFI=0.90, NNFI=0.96, GFI=0.96, AGFI=0.93, CFI=0.97, IFI=0.97, SRMR=0.046). The scale's Cronbach Alphas were 0.78 for the whole scale, 0.75 for the reflective scepticism subscale, and 0.68 for the critical openness subscale. The item-total score correlation coefficients of the scale ranged between 0.25 and 0.57.

The Reflective Thinking Scale, developed by Kember et al. (2000), is a tool that will be employed to gauge the reflective thinking tendencies of the participants. The scale has four sub-dimensions, namely Habitual Actions, Understanding, Reflection, and Critical Reflection, consisting of 16 items. The sub-dimensions have alpha internal consistency coefficients of 0.62, 0.75, 0.83, and 0.67, respectively. Items are rated on a scale of 1-5, with the minimum score being 16 and the maximum score being 80. The four-factor model of the scale was found to fit well, with a good fit ($\chi^2= 179.3$, $df =100$, CFI=0.903).

Data Collection Process

Once the translation process was finished, the data collection process began. The data was collected using a digital form created with Google Drive and a printed form. The online form was distributed to the physical education and sports teaching program advisors, while the responsible researcher collected the data in person. The data was gathered at the faculties of sports sciences.

Translation Process

Beaton et al. (2000) proposed specific steps for adapting a scale, which were followed in this study. Two independent translators were involved: one knowledgeable about the concept and subject (T1) and another uninformed about the concept (T2). The researcher combined the items from both translators to create a synthesis scale (T12), which was then translated back into the original language by two translators (CT1 and CT2). Finally, a committee of six experts evaluated the entire process of scale adaptation.

Statistical Analysis

The analysis of data was conducted using SPSS 25 and AMOS 24 computer programs. We determined whether the data met the assumption of normal distribution by examining the

kurtosis and skewness values. To explore the differences between the two variables, we used independent sample t-test analysis. We evaluated the relationships between variables using Pearson Correlation and Regression analyses. The construct validity of the adapted scale was tested with Confirmatory Factor Analysis, and we calculated content validity indices. Exploratory factor Analysis was applied since the scale's factor structure could not be confirmed with confirmatory factor analysis.

Content Validity

The item and scale level validity indices of the scale were calculated and evaluated by taking expert opinions (Lynn, 1986; Waltz & Bausell, 1981). The experts who evaluated the scale items scored 1-4. The indices were calculated using the universal agreement calculation method based on the scores.

Construct Validity

Confirmatory Factor Analysis (CFA) model was created to test the construct validity of the scales. First of all, the maximum likelihood method was selected. The recommended indices (Hu & Bentler, 1998; Brown, 2015) were chosen for the fit indices (CFI, RMSEA, SRMR, χ^2 , df). CFA is a more appropriate method for testing previously theoretically based models (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Hurley et al., 1997; Kline, 2023). The significance of parameter estimates and factor loading values were considered for each item. Kaiser-Meyer-Olkin (KMO) and Bartlett Sphericity test values were calculated to determine the suitability of the data for factor analysis. Exploratory factor Analysis was applied since the scale's factor structure could not be confirmed due to confirmatory factor analysis.

Reliability

The consistency analysis of the scale was calculated with Cronbach's alpha coefficient. The reliability coefficient was calculated with composite reliability. When the errors are uncorrelated, and the assumptions about the Cronbach Alpha coefficient are not met, the Cronbach Alpha internal consistency coefficient is not calculated unbiasedly, and there may be differences between the coefficient in the population and the reliability coefficient obtained from the sample (Rae, 2006). Thurber and Bonyne (2011) stated that it is more appropriate to calculate the composite reliability coefficient in such cases. Composite reliability is calculated by factor loadings and error variances obtained from CFA (Yang & Green, 2011).

Ethical Approval

This research was approved by Muğla Sıtkı Koçman University Social and Human Sciences Ethics Committee with the decision dated 27/02/2023 and numbered 230015/33.

Findings

Table 1. Content Validity Index of the Reflective Thinking Scale

Item	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6	Number of Agreement	I-CVI
1	3	4	3	4	3	4	6	1
2	3	4	4	4	3	4	6	1
3	4	4	2	4	4	4	5	0.83
4	4	4	4	4	3	3	6	1
5	4	4	3	4	3	4	6	1
6	4	4	4	4	4	4	6	1
7	4	4	4	4	3	4	6	1

8	4	4	4	4	3	2	5	0.83
9	4	4	2	4	4	4	5	0.83
10	3	4	3	4	4	2	5	0.83
11	4	4	4	4	4	4	6	1
12	4	4	4	4	4	4	6	1
13	4	4	4	4	4	4	6	1
14	4	4	4	4	4	4	6	1
15	4	4	4	2	3	4	5	0.83
16	4	4	3	4	4	4	6	1
							S-CVI	0.95
							Total Agreement	11
							S-CVI/UA	0.6875

Table 1 presents the results of the content validity analysis of the reflective thinking scale. Once the translation process was completed, the scale items were sent to experts in physical education for feedback. The experts rated the items on a scale of 1-4, with 1 and 2 indicating inappropriate items and 3 and 4 indicating appropriate items. The scale items' item-level content validity indices (I-CVI) ranged from 0.83 to 1.00, indicating good content validity. The content validity index at the scale level was 0.95, further supporting the scale's content validity. However, the Universal Agreement Calculation Method (S-CVI/UA) yielded an index of 0.68, which is relatively low. Despite this, the reflective thinking scale was found to have content validity. Following the content validity analysis, the construct validity was also examined.

Table 2. Factor Structure of the Reflective Thinking Scale

Items	Item Factor Loadings		
	Discrimination	Reflection	Critical Reflection
λ_3	0.78	0.40	
λ_7	0.30	0.77	
λ_{11}	0.36	0.72	
λ_{15}	0.37	0.85	
λ_4	0.48		0.68
λ_{12}	0.22		0.89
λ_{16}	0.57		0.43
Reliability			
Composite Reliability		0.81	0.78
Cronbach's Alpha		0.79	0.78
Factor-Factor Correlation	0.74 (%95CI: 0.64-0.84)		
KMO=0.86, Bartlett's test of sphericity= 579.605 (p<0.05), CR=0.89, a=0.84			

Table 2 shows the factor structure of the reflective thinking scale. The results of the Confirmatory Factor Analysis revealed that items 1, 2, 5, 6, 8, 9, 10, 13, and 14 of the scale were not appropriate due to high error variances and cross-loading (loading of an item on another factor that does not belong to it) although their factor loadings were high. It was understood that the related construct was not validated. After the examinations, the associated items were removed from the analysis based on expert opinions, and EFA was conducted. The items in the scale's reflection and critical reflection dimensions were observed to have very

good factor loadings. Factor loadings ranged between 0.40 and 0.85 for the reflection dimension and 0.43 and 0.89 for the critical dimension. The composite reliability coefficient of the scale is 0.81 for reflection and 0.78 for critical reflection, and these values are sufficient for reliability. The internal consistency coefficient of the reflection subscale is 0.79, and the internal consistency coefficient of the critical reflection subscale is 0.78. The composite reliability coefficient for the total value of the scale is 0.89, and the internal consistency coefficient is 0.84.

Table 3. Comparison of Critical and Reflective Thinking Scores of Physical Education and Sports Teacher Candidates at Class Level

		n	$\bar{X} \pm ss$	F	Post Hoc
Reflection	First	37	3.85±1.04	2.37	
	Second	54	3.66±1.03		
	Third	42	3.57±1.21		
	Fourth	67	4.02±0.68		
	Total	200	3.80±0.98		
Critical Reflection	First	37	3.59±0.97	3.63*	3<4
	Second	54	3.44±0.95		
	Third	42	3.38±0.93		
	Fourth	67	3.88±0.74		
	Total	200	3.60±0.90		
Critical Openness	First	37	3.98±0.69	0.17	
	Second	54	3.93±0.53		
	Third	42	4.02±0.56		
	Fourth	67	3.97±0.62		
	Total	200	3.97±0.59		
Reflective Scepticism	First	37	4.12±0.49	0.20	
	Second	54	4.11±0.58		
	Third	42	4.03±0.61		
	Fourth	67	4.11±0.66		
	Total	200	4.10±0.60		
Critical Thinking	First	37	4.03±0.51	0.04	
	Second	54	3.99±0.51		
	Third	42	4.02±0.54		
	Fourth	67	4.02±0.60		
	Total	200	4.02±0.54		
Reflective Thinking	First	37	3.74±0.92	3.55*	3<4
	Second	54	3.57±0.87		
	Third	42	3.49±1.01		
	Fourth	67	3.96±0.60		
	Total	200	3.71±0.85		

Table 3 compares the critical and reflective thinking tendencies of first, second, third, and fourth-grade students in the physical education and sports teaching department. The results indicate no significant difference between the classes regarding reflection, critical openness, reflective scepticism, and critical thinking. However, the critical reflection subscale has a statistically significant difference ($F=3.63$, $p<0.05$). The analysis shows that the critical reflection scores of fourth-grade students were higher than those of third-grade students.

Moreover, fourth-grade students also had higher reflective thinking scores than third-grade students ($F=3.55$, $p<0.05$).

Table 3. Distribution of Critical and Reflective Thinking by Gender

	Gender	N	$\bar{X} \pm ss$	t	p
Reflection	Female	98	3.55±1.21	-3.60	p<0.01*
	Male	102	4.04±0.62		
Critical Reflection	Female	98	3.39±0.96	-3.29	p<0.01*
	Male	102	3.81±0.80		
Critical Openness	Female	98	3.98±0.55	0.13	p>0.01
	Male	102	3.97±0.63		
Reflective Scepticism	Female	98	4.12±0.50	0.47	p>0.01
	Male	102	4.08±0.68		
Critical Thinking	Female	98	4.03±0.47	0.28	p>0.01
	Male	102	4.01±0.61		
Reflective Thinking	Female	98	3.48±1.01	-3.90	p<0.01*
	Male	102	3.94±0.59		

Table 4 displays the breakdown of critical and reflective thinking based on gender. The study found no significant difference in critical openness, reflective scepticism, and critical thinking dimensions ($p>0.05$). However, in the reflection subscale, male physical education and sports teacher candidates scored higher than their female counterparts ($t=-3.60$, $p<0.01$). Similarly, in the critical reflection subscale, males had higher scores than females ($t=-3.29$, $p<0.01$). Additionally, males had higher scores in reflective thinking tendency than females ($t=-3.90$, $p<0.01$).

Table 4. Distribution of Critical and Reflective Thinking According to Exercise Status

	Regular Exercise	N	$\bar{X} \pm ss$	t	p
Reflection	No	89	3.63±1.02	-2.20	p<0.05*
	Yes	111	3.93±0.94		
Critical Reflection	No	89	3.56±0.88	-0.59	p>0.05
	Yes	111	3.64±0.92		
Critical Openness	No	89	3.94±0.55	-0.70	p>0.05
	Yes	111	4.00±0.63		
Reflective Scepticism	No	89	4.07±0.63	-0.61	p>0.05
	Yes	111	4.12±0.57		
Critical Thinking	No	89	3.98±0.54	-0.73	p>0.05
	Yes	111	4.04±0.55		
Reflective Thinking	No	89	3.60±0.87	-1.72	p>0.05
	Yes	111	3.81±0.82		

The results are presented in Table 5, which shows the distribution of critical and reflective thinking based on regular exercise. The analysis indicates no significant difference between individuals who exercise regularly and those who don't regarding critical reflection, critical openness, reflective scepticism, critical thinking and reflective thinking ($p < 0.05$). However, it was observed that those who exercise regularly have higher values than those who do not in the reflection subscale ($t = -2.20$, $p < 0.05$).

Table 5. Distribution of Critical and Reflective Thinking According to Being a Licensed Athlete

	Athlete	N	$\bar{X} \pm ss$	t	p
Reflection	No	98	3.73±0.99	-0.99	p>0.05
	Yes	102	3.87±0.97		
Critical Reflection	No	98	3.70±0.86	1.46	p>0.05
	Yes	102	3.51±0.93		
Critical Openness	No	98	3.96±0.60	-0.27	p>0.05
	Yes	102	3.98±0.59		
Reflective Scepticism	No	98	4.05±0.67	-1.02	p>0.05
	Yes	102	4.14±0.51		
Critical Thinking	No	98	3.99±0.58	-0.60	p>0.05
	Yes	102	4.04±0.50		
Reflective Thinking	No	98	3.72±0.86	0.01	p>0.05
	Yes	102	3.71±0.84		

Table 6 presents the distribution of critical and reflective thinking among licensed athletes. The analysis suggests that being a licensed athlete does not affect an individual's critical and reflective thinking tendencies.

Table 6. Correlation between Critical and Reflective Thinking and Grade Point Average

	1	2	3	4	5	6
1. GPA	1					
2. Reflection	0.14*	1				
3. Critical Reflection	0.11	0.59**	1			
4. Critical Openness	-0.03	0.30**	0.42**	1		
5. Reflective Scepticism	-0.06	0.27**	0.24**	0.64**	1	
6. Critical Thinking	-0.05	0.32**	0.39**	0.95**	0.84**	1
7. Reflective Thinking	0.14*	0.93**	0.84**	0.39**	0.29**	0.39**

Table 7 displays the correlation analysis results between critical thinking, reflective thinking, and GPA. The findings indicate a statistically significant relationship between reflective thinking and GPA ($r = 0.14$, $p < 0.05$). Moreover, Table 4.7 provides evidence for the criterion-related validity of the reflective thinking scale. As a result, the sub-dimensions and total value of reflective thinking were statistically significantly associated with the sub-dimensions and total value of critical thinking.

Table 7. Regression Analysis Between Reflective Thinking and General Academic Average

Model	R	R ²	Adjusted R ²	F	Standard Beta	t
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1	0.146	0.021	0.016	4.332*	0.146	2.081*
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*Dependent variable: GPA, Independent variable: Reflective Thinking, *p<0.05*

Table 8 shows the regression analysis on the level of reflective thinking explaining the general academic average. GPA is ranked between 1 and 5 as a series grouped from the lowest to the highest. Accordingly, a 1-unit change in reflective thinking leads to a 0.14-unit change in GPA.

Discussion

This study examined the relationship between reflective and critical thinking and academic achievement of prospective physical education and sports teachers. The measurement tool developed by Kember et al. (2000) was adapted into Turkish to measure the reflective thinking tendencies of the participants. First, the translation process was completed using the method suggested by Beaton et al. (2000). The content validity index was calculated based on expert opinions. It was determined that the content validity indices of the measurement tool at the item level were appropriate (Lynn, 1986). The content validity index at the scale level and the index obtained using the universal agreement calculation method were appropriate (Davis, 1992; Grant & Davis, 1997; Polit & Beck, 2004). Then, the construct validity of the measurement tool was analysed.

In this study, reflective thinking was found to increase academic achievement. Research shows that thinking styles statistically predict academic achievement (Zhang, 2001). Critical thinking has been positively associated with achievement (Villavicencio, 2011). Some findings revealed that critical thinking, reflective thinking and creative thinking are positively and significantly related to each other and that these variables positively and significantly predict academic achievement (Akpur, 2020). Critical thinking ability and its elements can be considered essential in increasing academic achievement in adolescent students (Sherafat, 2015). A positive relationship exists between students' critical thinking levels and academic achievement levels (Musa, 2020). Ghanizadeh (2017) evaluated the relationships between higher-order thinking skills (reflective thinking, critical thinking) and self-monitoring that contribute to academic achievement among university students. Self-monitoring had an indirect positive effect on achievement through comprehension and reflection. Self-monitoring was found to impact achievement through comprehension and reflection indirectly positively. Taghva et al. (2014) found a significant relationship between teachers' critical thinking and students' educational achievement. Student achievement will increase as students' critical thinking skills increase (Jafari & Yazdani, 2015). Ip et al. (2000) found that critical thinking and academic achievement are related, and as critical thinking tendency increases, academic achievement will also increase. Stupnisky et al. (2008) found a positive relationship between grade point average and critical thinking. Critical thinking positively affects students' average academic performance (D'Alessio et al., 2019).

Akbıyık and Seferoğlu (2002) examined the relationship between critical thinking and academic achievement, classifying students into high and low-critical thinking tendency groups and comparing these two groups regarding academic success. According to their

findings, students with a high tendency for critical thinking demonstrated higher academic achievements.

Critical thinking is among the fundamental values in higher education. Creativity and critical thinking are not entirely different forms of thinking, and both are important in academia. However, our norms, rules, and structures can hinder creativity (Adriansen, 2010). The role of critical thinking attitudes and cognitive learning styles in academic success is inevitable. It is recommended that faculty members respect students' different learning styles and cognitive needs and implement new approaches and procedures to enhance critical thinking skills (Hassanali, Setareh, and Zabihollah, 2012). Teaching and learning methods for critical thinking must be implemented and developed to increase students' potential for critical thinking (Shah, 2015). In-class/educational and out-of-class experiences provide positive, statistically significant, and unique contributions beyond students' pre-university characteristics and levels of critical thinking (Terenzini et al., 1995).

Reflective thinking is valuable and necessary for self-determined terms (Brookfield, 2009). Reflective thinking practices and achievement goals are significant factors in predicting students' academic success (Phan, 2009). Reflective thinking allows us to correct distortions in our beliefs and errors in problem-solving (Mezirow, 1990). Reflective thinking can be a precursor to encouraging critical thinking in teachers (Choy and San Oo, 2012). Deringöl (2019) examined the relationship between reflective thinking skills and academic achievement in fourth-grade elementary school students, finding that fourth-grade students had high reflective thinking skills and that girls had higher reflective thinking levels. For male students, a positive relationship was found between reflective thinking skills and mathematics and academic achievements.

Asakereh and Yousofi (2018) investigated the relationship between reflective thinking, general self-efficacy, self-esteem, and academic achievement among Iranian students learning English as a foreign language. They found that reflective thinking had no significant relationship with self-esteem, self-efficacy, and academic achievement. Lew and Schmidt (2011) examined whether writing in a deep-thinking journal effectively promotes self-reflection and learning. They assessed whether students who consistently engage in deep-thinking journal writing demonstrate better self-reflection. The study concluded that self-reflection on how and what students learn improves academic performance. Some potential factors that could influence the results were identified, including a) students generally being weak in self-reflection, b) students in this study being defined as "inexperienced," lacking experience in reflecting on what and how they learn, and c) differences between responses across weeks, potentially influenced by factors such as the type of questions asked by the teacher each week.

Studies indicating that activities based on reflective thinking enhance students' achievements have been identified (Ersozlu and Kazu, 2011; Bölükbaş, 2004; Uygun and Çetin, 2014). It has been determined that teacher training programs emphasise reflective thinking practices most (Ustabulut, 2021). A moderately positive and significant relationship between middle school students' tendencies towards critical thinking and metacognitive awareness has been found. Additionally, it has been observed that the critical thinking tendencies of middle school students significantly predict their metacognitive awareness (Bakır and Eğmir, 2022). In a study by Yüksel et al. (2021) investigating the impact of critical thinking tendencies on religiosity among theology faculty students, it was found that individuals with a tendency for critical thinking had higher levels of religiosity.

Aybek, Yalçın, and Öztürk (2019) experimentally investigated the relationship between high school students' critical thinking skills and their physics course. They found a significant increase in attitude scores towards critical thinking in the experimental group. The attitude scores towards critical thinking were highly correlated with physics achievement scores. Additionally, they concluded that students had different thoughts about critical thinking.

Erbir and Ünlü Aslan (2022) discovered a significant correlation between emotional intelligence and the tendency towards critical thinking in university students. They also found that emotional intelligence positively and significantly impacted the tendency towards critical thinking. In a study by Şahin, Çakmak, and Hacımustafaoğlu (2015) examining the critical thinking skills of academics, they found no significant difference in critical thinking skills based on gender and discipline. However, they concluded that despite having sufficient knowledge about critical thinking skills, teacher candidates could not effectively use activities to enhance critical thinking skills in their teaching processes.

In their study, Gökkuş and Delican (2016) found that the tendency towards critical thinking among prospective primary school teachers was moderate. The tendency towards critical thinking did not show a significant difference based on gender, but there was a significant difference favouring fourth-grade students over other classes. They also found a moderate, positive, and significant relationship between the tendency towards critical thinking and attitudes towards reading books.

Aşkın Tekkol and Bozdemir (2018), in their study examining teacher candidates' reflective thinking tendencies and critical thinking skills, concluded that there was a significant difference in reflective thinking tendencies in favour of male students. However, they did not observe a significant difference in scores based on gender and class level. They also found a positive, moderate-level relationship between teacher candidates' reflective thinking tendencies and critical thinking skills.

This research has determined that fourth-grade students have higher reflective thinking values than third-year students. Yıldırım and Şensoy (2017) conducted a study examining the critical thinking tendencies of science teacher candidates. The study concluded that there was no significant development in critical thinking tendency levels from the first to the fourth grade, and there was a positively high correlation between critical thinking tendency, critical thinking skills, and problem-solving skills.

Kuru and Şimşek (2022) reviewed studies on critical thinking skills in primary schools and found that critical thinking practices are most frequently conducted in Science and Turkish language classes. It was observed that primary school teachers are highly aware of critical thinking. While pre-service teachers' awareness of critical thinking is at a moderate level, primary school students' awareness level was found to be high. It was determined that all applied studies were generally practical in a positive direction, but there was insufficient emphasis on critical thinking skills. Students with high levels of critical thinking tendency are reported to develop a positive attitude towards reading and consist of students who comprehend what they read (Bozpolat and Kurga, 2021). In this research, it was observed that males have higher values in reflective thinking tendencies than females. It was found that students whose critical thinking tendencies were increased through the application of the academic debate model showed a significant increase compared to students who followed the existing program (Kayman and Aydın, 2021). Öztürk et al. (2019) found a high level of positive and significant relationship between the entrepreneurial characteristics of teacher candidates and their critical thinking tendencies. Küçük and Uzun (2013) examined the critical thinking tendencies of music teacher candidates. They found a moderate tendency in

general critical thinking and its sub-dimensions, with high-level positive and significant relationships between critical thinking tendency and its sub-dimensions.

Aybek and Demir (2013) found a low positive relationship between students' general critical thinking tendency scores and literacy levels. Alkan and Cengiz (2022) mentioned in their study that teachers lack sufficient knowledge about methods to develop creativity. Kartal (2012) found in their study that the critical thinking tendencies of science teacher candidates were generally above the moderate level of 60%. Durnacı and Ültay (2020) examined primary school teacher candidates' critical and creative thinking tendencies and concluded that these tendencies were not very high.

Conclusion and Hypotheses

This study examined the relationship between reflective and critical thinking and academic achievement of physical education and sports teacher candidates. The results related to the proposed hypotheses are provided below:

H₁ There is a relationship between critical thinking and academic achievement.

It has been determined that there is no significant relationship between critical thinking and academic achievement. Therefore, H₁ has been rejected.

H₂ There is a relationship between reflective thinking and academic achievement.

Reflective thinking has been found to have a significant relationship with academic achievement. Therefore, H₂ has been accepted.

H₃ There is a relationship between critical thinking and reflective thinking.

There is a significant relationship between critical thinking and reflective thinking. Therefore, H₃ has been accepted.

H₄ There is a difference between men and women regarding critical thinking.

As critical thinking does not differ based on gender, H₄ has been rejected.

H₅ There is a difference between men and women regarding reflective thinking.

Since reflective thinking differs based on gender, H₅ has been accepted.

H₆ There is a difference between exercisers and non-exercisers regarding critical thinking.

As critical thinking does not vary with exercise participation, H₆ has been rejected

H₇ There is a difference between exercisers and non-exercisers regarding reflective thinking.

Reflective thinking partially differs based on exercise participation and has been accepted.

H₈ There is a difference between licensed and non-licensed athletes regarding critical thinking.

Critical thinking does not differ based on being a licensed athlete; therefore, H₈ has been rejected.

H₉ There is a difference between licensed and non-licensed athletes regarding reflective thinking.

Reflective thinking does not differ based on being a licensed athlete; therefore, H₉ has been rejected

Recommendations

The findings obtained in this research have shown that reflective thinking has the potential to enhance academic achievement in physical education and sports teacher candidates. The following recommendations include strategies for the use of reflective thinking to improve the academic achievements of physical education and sports teacher candidates:

1. Seminars emphasizing the importance of reflective thinking in enhancing academic achievements can be organized for physical education and sports teacher candidates.
2. Reflective thinking activities can be incorporated into teaching materials for physical education and sports teacher candidates. This can help students take a more active role in learning and gain a deeper understanding of the subjects learned.
3. By teaching reflective thinking strategies to physical education and sports teacher candidates, it is possible to enable students to think more efficiently and effectively during the learning process.
4. Teachers can encourage physical education and sports teacher candidates to use reflective thinking in their assessment processes. Opportunities can be created for students to think about how much progress they have made and what they have learned throughout the learning process and express these reflections.

Limitations

This research is limited to the measurement power of the measurement tools. The research is limited to the study group determined in an easily accessible way in Turkey. The most important limitation of the study is that the participant group could not be determined by the purposive sampling method. Another limitation of this study is the use of GPA for academic achievement. Another limitation is that performance tests could not be used for academic achievement and performance.

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