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Transformative impact: A meta-analysis of authentic learning activities on course attitudes

Erol Erdem[1]* and Özlem Kaf[2]

[1]Ministry of National Education, Türkiye
[2]Çukurova University, Türkiye.

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ABSTRACT

This study aimed to examine the impact of authentic learning on attitudes towards the course using a meta-analysis method. To achieve this, the researcher established inclusion and exclusion criteria and conducted a literature review. The review included 23 studies, from which they extracted 26 individual effect sizes. The researcher analyzed these effect sizes using the CMA program, finding no evidence of publication bias. Statistical values suggested that a random effects model was appropriate. According to the random effects model, the overall effect size was calculated as (E++ = 0.600), indicating a moderate positive effect. Additionally, when applying the Analog ANOVA test for moderator variables, no significant differences were observed based on the type of research and the educational stage in which the research was conducted. However, a significant difference was observed with regard to the subject area as a moderator variable.

Keywords: Authentic learning, authentic teaching, meta-analysis, attitude, synthesis.

*Corresponding author. E-mail: erolerdem977@gmail.com.

INTRODUCTION

In the history of education, the need to fill the gap between theory and practice has been one of the biggest problems. Before the Industrial Revolution, apprenticeship training was used to fill this gap. However, the rapid increase in the population, the acceleration of change and transformation, and the professionalization and sub-division of occupational branches prevented the sustainability of apprenticeship training. For this reason, new searches have emerged to integrate theory and practice. One of these new approaches is authentic learning (Çetinkaya, 2018; Revington, 2013). Authentic learning is an approach that aims to have students create authentic products that will be useful (for students) in real-world contexts through projects and sees students as active participants (Bektaş and Horzum, 2014; Revington, 2013). Authentic learning is interdisciplinary as it aims for learning activities that are not isolated from their context. In authentic learning environments, students are active participants, critics and autonomous learners (Bektaş and Horzum, 2014). It is based on the principle of lifelong learning as it targets real-world situations.

Authentic learning activities are designed for the development of metacognitive thinking skills, creativity and basic life skills in students (Yuliati, Fauziah and Hıdayat, 2018). These activities are an understanding that aims to enable students to produce solutions to real-life problem situations (Dolapçıoğlu, 2015). Since they find solutions to real problems as active participants, they are more easily motivated on the subject (İneç and Akpınar, 2017).

As a result of the literature review, it was determined that various aspects of authentic learning have been investigated by many researchers using different methods. For example, Dolapçıoğlu (2015) examines the development of critical thinking skills in mathematics courses with an action research method, Gündoğan (2017) deals with authentic learning activities in life science courses from a broad perspective, Aynas (2018) investigates the effect of authentic learning artificial intelligent, Akter, Shahariar, Sakip Qian, Whitman and Wu (2023) examines the use of valid representations of real-world situations by blending online learning activities and authentic learning in science, in a curriculum development study based on authentic learning activities, and Mims (2003) in a study using authentic learning activities for the development of social consciousness. The literature review revealed that there

were experimental studies conducted with different student groups. This made it necessary to conduct a meta-analysis in order to gain a broader perspective on the field. Essentially, science and knowledge are concepts that develop cumulatively. For this reason, it is extremely important to examine the accumulation of knowledge in a certain field and evaluate it from a holistic perspective (Akgöz, Ercan and Kan, 2004). In this regard, it is important to determine to what extent authentic learning activities are effective on students' attitudes towards the course. This study will fill this gap in the literature.

In scientific research, it is extremely important to proceed by taking into account the results of similar studies, to look at the general knowledge in the field with a holistic perspective, and to comprehend the general trend, as it will contribute to the literature (Dinçer, 2014). In this context, the meta-analysis method comes to the fore as a method that helps generalize the results of similar studies in the field (Bakioğlu and Özcan, 2016). Thanks to this method, more qualified and precise generalizations can be reached about similar studies in the literature (Dinçer, 2014; Sarıer, 2013). Based on this context, it is important to examine the effect of authentic learning activities on students' attitudes towards the course.

Purpose of the study

This study was conducted to examine the effect of learning environments created by considering the characteristics of authentic learning activities on students' attitudes toward the course. In order to achieve this goal, meta-analysis was performed on previous similar studies. In this meta-analysis study, answers were sought to the following questions around the main purpose. Analog ANOVA was conducted to find answers to each sub-objective:

• What is the overall effect size of the relationship between authentic learning activities and attitude towards the course?
• Does the effect of the authentic learning activities on attitude towards the course differ significantly by the subject area?
• Does the effect of the authentic learning activities on attitude towards the course differ significantly by the publication type?
• Does the effect of the authentic learning activities on attitude towards the course differ significantly by the educational stage?

METHOD

In this study, the effect of education supported by authentic learning practices on students' attitudes toward the course was examined by the meta-analysis method. This method is essentially a literature review (Dinçer, 2014). In this method, the results of studies designed with quantitative approaches are compiled and it is aimed to look at them with a broad perspective (Durlak, 1995). It aims to reach a general and holistic effect size value by starting from the effect size value of each study (Dinçer, 2014). Meta-analysis studies are generally carried out with the following objectives; To obtain a larger sample by combining the sample selected for each study, thus increasing the strength of the hypotheses tested in the subject of meta-analysis. To identify the differences between the studies included in the research and to reveal their possible causes. To review the studies with the assumption that variables other than the main variables have an effect on the analyzed studies. To examine the results by assuming that variables that are not considered as the main cause in the studies may also have an effect. It is to create a reference source for future studies (Dinçer, 2014; Blettner et al., 1999; Çarkungöz and Ediz, 2009). Based on previous studies and books accepted in the field, inclusion and exclusion criteria were determined for this study (Dinçer, 2014; Sarıer, 2013; Çarkungöz and Ediz, 2009) and these criteria are presented in Table 1.

Table 1. Inclusion and exclusion criteria.

Inclusion	Exclusion
One of the experimental designs was used.	Quantitative methods were not used.
A reliable measurement tool to measure attitude change was utilized.	It was an article or paper derived from a thesis.
Teaching activities supported by authentic learning activities were applied to the experimental group.	Data to calculate the effect size were missing.
The study was conducted between 2012 and 2022.	The study did not examine attitudes toward the course.
The numerical data necessary to apply meta-analysis were provided.	
Accessibility.	Abstract-only access.
Accessibility from surveyed databases.	

In light of the criteria specified in Table 1, 23 studies were included in this study. The flow diagram for the included studies is presented in Figure 1. The criteria given above, the nature of the research was determined by

taking into account the general structure of authentic learning and the qualities of the concept of attitude. While determining these principles, expert opinions were used at every stage.

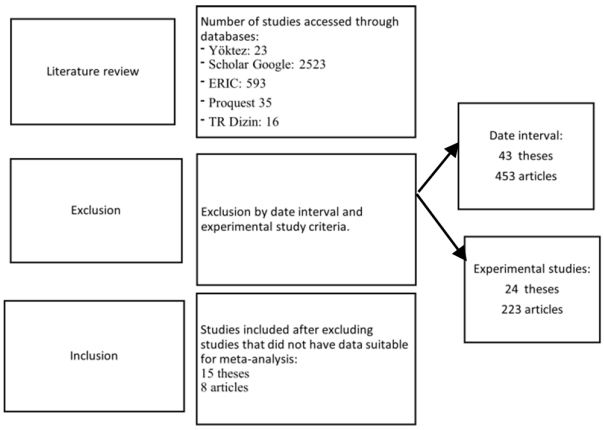

Figure 1. Flow diagram.

Data analysis

While analyzing the data obtained in the study, the individual effect size of each study was calculated and transferred to a draft table. Then, the data on moderator variables were transferred to the table. Then, the data in the table were uploaded to the CMA program. With the help of this program, the overall effect size of the studies included in the study was calculated and the holistic heterogeneity test of the included studies was applied to determine whether there was publication bias in the study. Separate analyses were performed for each moderator variable, and it was tested whether the findings were significant or not.

FINDINGS

This section presents the findings obtained by analyzing the data of the studies included in the research. The following order was followed when presenting the findings; analysis for publication bias, analysis for general method determination, calculation of holistic effect size, and subgroup analyses.

Coding and descriptive analysis of the studies

The coding format, descriptive features and moderator variable information of the 23 studies included in the study are presented in Table 2.

Looking at the information in Table 2, it is seen that 15 of the 23 studies included in the meta-analysis are theses, 12 of these theses are doctoral theses and 3 are master's theses. Eight studies included in the meta-analysis were published as articles.

According to Cohen et al. (1988), when interpreting effect sizes, values between 0.20 and 0.50 are classified as small effect size, between 0.50 and 0.80 as medium effect size and values greater than 0.80 as large effect size. Based on Cohen et al.'s classification, Table 3 shows that 10 of the studies included in this study have small effect sizes, 9 have medium effect sizes and 7 have large effect sizes. The findings regarding whether the studies with individual effect sizes given above have publication bias are presented below. First, publication bias was tested by means of the funnel plot and presented in Figure 2.

Tests for publication bias test whether the studies included in the study were conducted by taking only the criteria into account and with a flawless field scan and whether the researcher acted biased. The results of different tests for publication bias are presented below. In this way, strong evidence is provided that there is no publication bias in the study.

Figure 2 shows that the 26 effect sizes presented by the 23 studies included in the study have a symmetrical distribution. The vertical line in Figure 1 shows the holistic effect size when there is no publication bias in meta-analysis studies. On the other hand, the fact that the distribution is symmetric according to the vertical line indicates that there is no publication bias. The values obtained from the Classic Fail-safe N test, which support the findings obtained from the Begg and Mazumdar rank correlation given above that there is no publication bias, are given in Table 4.

When Table 4 is examined, 880 more studies should be added to the meta-analysis study for the p-value to be above 0.05. Considering the unlikelihood of accessing 880 more studies that investigated the effect of practices supported by authentic learning activities on students' attitudes toward the course, it can be said that there is no publication bias for this meta-analysis study.

As a result of the statistics presented above, it was concluded that there was no publication bias for this study. At the other stage of the meta-analysis, the heterogeneity test was performed, and the relevant statistics are presented in Table 5.

Table 2. Coding and descriptive information of the studies included in the meta-analysis.

Author	Year	Study Type	Stage	Subject Area
Dadlı	2017	Thesis (MA)	Middle School	Science
Gençoğlan	2017	Thesis (MA)	Middle School	Science
Sellüm	2021	Thesis (MA)	Primary School	Science
Koçyigit	2013	Article	Undergraduate	Special Education
Uugwanga	2020	Thesis (PhD)	Middle School	Social Studies
İneç	2017	Thesis (PhD)	Middle School	Social Studies
Karabulut	2018	Thesis (PhD)	Middle School	Science
Pullu	2019	Thesis (PhD)	Undergraduate	Programming
Yıldırım	2020	Thesis (PhD)	Middle School	Social Studies
Myers	2017	Thesis (PhD)	Undergraduate	Nursing
Alioon	2016	Thesis (PhD)	Undergraduate	Computer
Hamurcu	2016	Thesis (PhD)	Middle School	Turkish
Gündoğan	2017	Thesis (PhD)	Primary School	Life Science
Sawalha	2018	Thesis (PhD)	Primary School	Mathematics
Ustaoğlu	2020	Thesis (PhD)	Middle School	Science
Hwang et al.	2016	Article	Primary School	Social Studies
Horzum and Bektash	2012	Article	Undergraduate	Community Service
Widowati et al.	2017	Article	Middle School	Science
Gündoğan and Gültekin	2018	Article	Primary School	Life Science
Irvine	2020	Article	High School	Mathematics
Güneş et al.	2020	Article	Primary School	Social Studies
Aynas	2021	Article	Middle School	Science
Abdel Jaber et al.	2021	Article	High School	Geography

Table 3. Individual effect sizes of the studies included in the study.

Effect size	Study	Effect size	Variance
Small effect size	Sellüm (2021)	0.061	0.083
	Gençoğlan (2017)	0.076	0.058
	Aynas (a) (2021)	0.183	0.065
	Aynas (b) (2021)	0.184	0.066
	Sawalha (2018)	0.195	0.023
	Hamurcu (2016)	0.248	0.086
	Allion (b) (2016)	0.296	0.087
	Irvine (2020)	0.320	0.044
	Allion (a) (2016)	0.357	0.101
	Güneş et al. (2020)	0.358	0.067
Moderate effect size	Uugwanga (2020)	0.508	0.033
	Ustaoğlu (2020)	0.530	0.044
	İneç (2017)	0.560	0.049
	Horzum and Bektaş (2012)	0.571	0.059
	Widowati et al. (2017)	0.650	0.070
	Yıldırım (2020)	0.676	0.085
	Hwang et al. (2016)	0.726	0.085
	Koçyiğit (a) (2013)	0.793	0.061
	AbdelJaber et al. (2021)	0.799	0.054
Large effect size	Myers (2017)	0.870	0.608
	Dadlı (2017)	0.909	0.083
	Karabulut (2018)	0.953	0.087
	Koçyiğit (b) (2013)	0.980	0.069
	Gündoğan (2017)	1.114	0.115
	Gündoğan and Gültekin (2018)	1.569	0.130
	Pullu (2019)	1.588	0.083

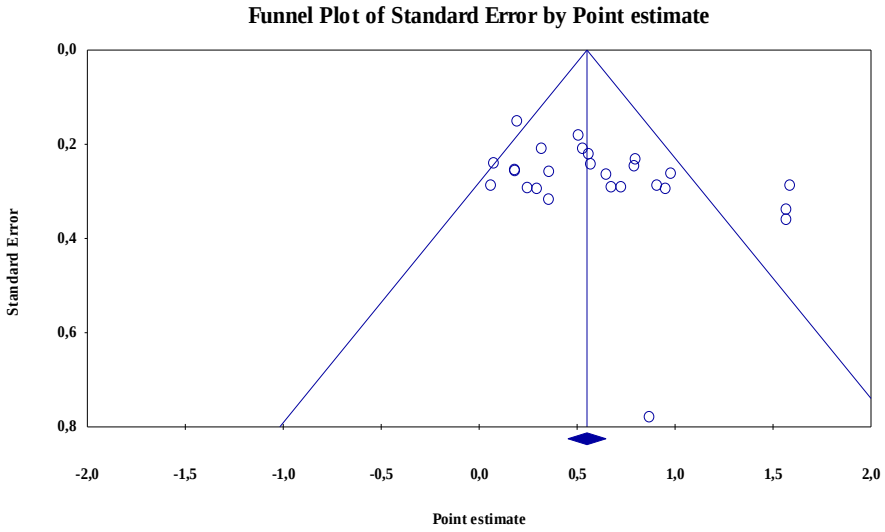

Figure 2. Funnel plot for publication bias.

Table 4. Classic fail-safe N test statistics.

Variables	Values
Z-value of the studies	11.56492
P-value of the studies	0.00000
Alpha value	0.05000
Number of studies	26
Number of studies required for p> alpha	880.000

Table 5. Findings of the studies according to fixed and random effects model and heterogeneity test results.

Model	Confidence interval (95%)				Null hypothesis			Homogeneity values			
	Number of studies	Effect Size	Standard error	Variance	Lower limit	Upper limit	Z-value	P	Q-value	Df (Q)	I2
Fixed	26	0.541	0.050	0.002	0.443	0.638	10.885	0.000	53.109	25	52.927
Random	26	0.600	0.075	0.006	0.434	0.726	7.772	0.000			

When the data obtained from the Fixed Effects Model of the studies included in the meta-analysis in Table 6 are examined, it is seen that the overall effect size is d = 541, the standard error value is SE = 0.050, the upper limit value of the data belonging to the confidence interval is 0.638 and the lower limit value is 0.443. When the values obtained from the homogeneity test of the study were examined, it was seen that Q = 53.109. In order to correctly interpret the Q value obtained from the homogeneity test, the chi-square (X)2 table was consulted. In this table, the intercept value of the data with a significance level of 95% and a degree of freedom of 25 is 14.611. Since this value obtained from the chi-square table is below the value of 53.109 obtained from the Q statistic, the null hypothesis is rejected according to fixed effects. In other words, according to these data, it can be said that the meta-analysis study has a heterogeneous structure. In order to obtain more detailed and precise results regarding the heterogeneous structure of the study, I2 statistic was used (Bakioğlu and Özcan, 2016; Dinçer, 2014; Poppayvd, 2006). The data obtained from the I2 statistic are interpreted as follows; 25% level indicates low heterogeneity, 50% level medium heterogeneity and 75% level high heterogeneity (Dinçer, 2014). The I2 value from this meta-analysis study (52.927) corresponds to high heterogeneity. According to the data obtained from both Q statistic and I2 statistic, the meta-analysis study is heterogeneous. Therefore, the meta-analysis study was conducted with the Random Effects

Model.

The overall effect size calculated based on the random effects model and the overall forest plot of the studies included in the study is presented in Figure 3.

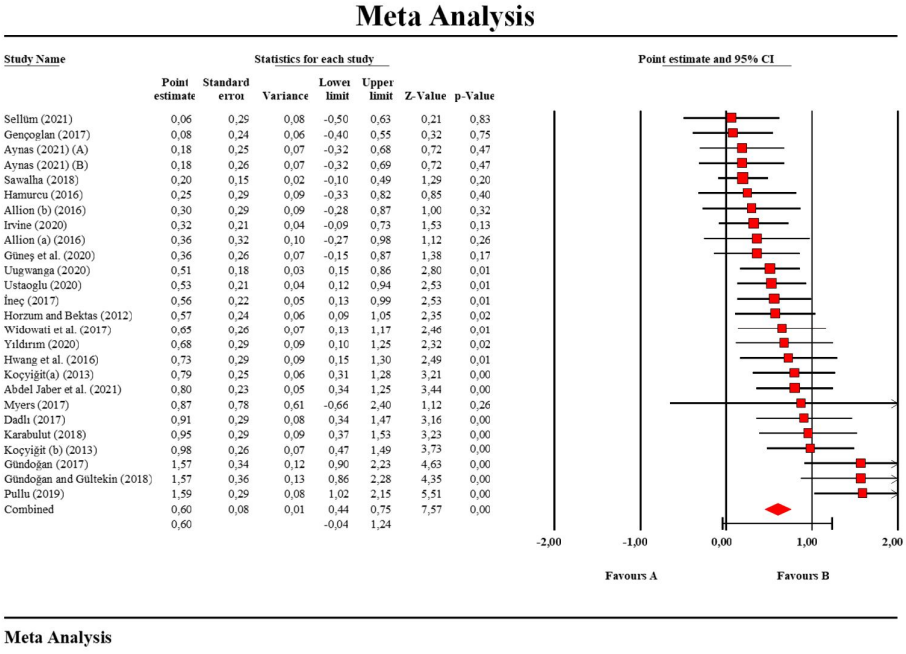

Figure 3. Forest plot for overall effect size.

Figure 3 shows that the overall effect size value was (E++ = 0.600). This value shows that learning activities supported by authentic learning activities have a positive effect on students' attitudes towards the course. The value of 0.600 obtained in the study indicates a moderate positive effect.

Table 6. Analog ANOVA results for the subgroups of the study.

Variable	Variety	N	Impact size	Standard error	Confidence interval		Qb	P
					Lower	Upper		
Publication type	MA	3	0.338	0.272	-0.19	0.871	1.511	0.47
	PhD	15	0.673	0.106	0.465	0.881		
	Article	8	0.555	0.137	0.286	0.823		
Educational stage	Primary School	6	0.700	0.248	0.214	1.185	3.824	0.28
	Middle School	10	0.451	0.080	0.295	0.607		
	High School	3	0.645	0.188	0.277	1.013		
	Undergraduate	7	0.774	0.173	0.436	1.112		
Subject area	Science	8	0.430	0.123	0.190	0.670	37.11	0.00
	Special Ed.	2	0.571	0.243	0.095	1.047		
	Social Studies	5	0.799	0.232	0.344	1.254		
	Programming	1	0.881	0.180	0.528	1.233		
	Computer	2	0.546	0.106	0.338	0.753		
	Turkish	1	1.588	0.288	1.023	2.153		
	Life Science	2	0.324	0.216	-0.10	0.748		
	Nursing	1	0.248	0.293	-0.33	0.823		
	Mathematics	2	1.328	0.247	0.843	1.812		
	Community Service	1	0.870	0.780	-0.65	2.398		
	Geography	1	0.238	0.123	-0.00	0.479		

When the data in Table 6 were analyzed, it was found that the publication type variable did not play a moderating role (Qb = 1.511; p = 0.470) and the educational stage variable did not play a moderating role (Qb = 3.824; p = 0.281). The subject area variable plays a moderating role in the teaching practices supported with authentic learning activities in terms of attitude towards the course (Qb = 37.11; p < 0.05).

Based on these findings, it is seen that the source of the heterogeneity obtained in the research is not the type of publication and the educational stage. On the other hand, the subject area plays a moderating role in the heterogeneity of the study.

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

When conducting a scientific study in a field, one acts in the light of previous studies. This requires a collective and holistic perspective on the accumulation of knowledge in that field. As in many fields, many studies have been conducted and continue to be conducted in the field of 'authentic learning'. Many of these studies have been designed with quantitative research methods. Combining and analyzing similar studies in a systematic way in line with a specific goal will provide a holistic view and show the general trend in that field (Üstün and Eryılmaz, 2014; Sağlam and Yüksel, 2007). In this meta-analysis study, the effect of teaching practices supported by authentic learning activities on attitudes toward the course was investigated. Inclusion and exclusion criteria were determined in line with the objectives of the meta-analysis study. The literature was reviewed in the light of the determined criteria. As a result of the review, it was decided to include 23 studies in the meta-analysis. From the 23 included studies, 26 individual effect sizes were obtained. It was determined that the individual effect size of all the studies obtained had a positive trend. It was determined that the overall effect size of the studies included in the meta-analysis was. The homogeneity test (Q = 53.109; df: 25, p = 0.000 and I2 = 52.927%) values were obtained in the meta-analysis study and as a result of these values, the homogeneity hypothesis was rejected. Therefore, the study was conducted according to the Random Effects Model. According to this model, the combined effect size was calculated as (E++ = 0.600) (lower limit 0.443; upper limit 726; p = 0.000 at 95% confidence interval). This value is in a medium effect size class in Cohen's (1988) classification (Dinçer, 2014). This general effect size obtained coincides with the results of the doctoral thesis prepared by Uugwanga (2020) on authentic learning activities. Similarly, in the studies conducted by Horzum and Bektaş (2012), Hwang et al. (2013) and AbdelJaber et al. (2021), it was concluded that practices supported by authentic learning activities had a moderately positive effect on attitude towards the course. Furthermore, this result regarding the positive effect of authentic learning activities on attitude towards the course is supported by the studies conducted by Pullu (2019), Koçyiğit (2011), Dadlı (2017), Myers (2017) and Hwang et al. (2016).

From the 23 studies included in the study, 26 effect sizes were obtained and the publication bias related to the values was calculated by funnel plot, Begg and Mazumdar value and Classis Fail statistic and it was concluded that there was no publication bias. When the meta-analysis studies in the literature are examined, it is seen that the absence of publication bias is an essential condition for such studies (Baki and Özcan, 2016; Blettner et al., 1999; Sağlam and Yüksek, 2007).

As a result of the meta-analysis, the effect size difference for the moderator variable of publication type was not statistically significant (Qb = 1.511; p = .470). Likewise, the effect size difference for the moderator variables of the educational stage is not statistically significant (Qb = 3.824; p = .281). However, a significant difference was found between the average effect sizes with regard to the subject area variable (Qb = 37.11; p = .000). It can be interpreted that instructional planning supported by authentic learning activities has a positive effect on students' attitudes towards the course and that such activities create a positive perspective on the course. Based on these results, it may be recommended to conduct meta-analysis studies on similar teaching strategies and methods. It may be recommended to examine the general trend in literature by conducting such studies again in certain periods. In this study, quantitative studies on authentic learning were examined in the context of attitude. It may be recommended to conduct similar studies on qualitative and relational research. Since this study examined the effect of authentic learning on attitudes towards the course, meta-analysis studies can be conducted on its effect on various skills and values.

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