

How Project-Based Learning Improves Critical Thinking Skills for Sustainable Development

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Abstract: This research aims to reveal the effectiveness of project-based learning on enhancing the critical thinking skills of students. The research was conducted on a sample of student in the Department of Curricula and Teaching Methods, after dividing them into two equal groups (control and experimental) at random. The main research tool consisted of a measure of critical thinking. The results showed that project-based learning had a positive and statistically significant effect on the development of critical thinking skills of the experimental group, which was mediated by the underlying factors of identifying and controlling variables, testing hypotheses, and reasoning.

Keywords: Project; critical thinking skills; learning; Project based learning

INTRODUCTION

It should be emphasized that prior research has shown that project-based learning can produce a range of learning outcomes, for instance, it has a considerable favorable impact on students' academic progress when compared to traditional schooling [1]. Additionally, it significantly enhances students' ability to think creatively [2, 3]. Likewise, implementing project-based learning to improve self-efficacy [4, 5]. A thorough attempt to use project-based learning to improve the critical thinking abilities of students in the College of Education at Najran University was not, however, indicated by a review of pertinent literature. Critical thinking also includes scientific thinking processes such as identifying and describing an issue, collecting information to better understand the problem, evaluating scenarios related to the issue, providing viable solutions to the problem at hand, and evaluating recommended solutions [6-9]. It allows the learner to evaluate existing knowledge while encouraging the creation of new knowledge [10]. Participation, taking responsibility for our actions, and rational decision making are all examples of critical thinking [11, 12]. The core of critical thinking abilities is to unite learners in order to address difficulties that arise during the learning process [13]. In addition, developing and improving critical thinking skills is one of the primary goals of all educational systems [14-17]. Debates can help learners develop critical thinking skills [18]. Critical thinking is also seen as a prerequisite for progressing to the most complex real-life events and actively participating in social circles [19]. Critical Thinking as a Desired Learning Outcome Teaching methods (such as project-based learning) that help students actively

participate in the educational process and increase their willingness to participate [20-22]. The educational process should help learners develop critical thinking [23], and at the same time, learners' critical thinking skills cannot be improved through teacher-centered teaching method [24-27]. Based on the foregoing, the current research attempts to bridge this gap by examining the effect of project-based learning on enhancing critical thinking skills of optimal investment students.

RESEARCH PROBLEM

The significant decrease in the level of critical thinking skills with regard to the "Research Methods" course for optimal investment students is the basis of the problem of this research, which hinders the achievement of the course objectives. Critical thinking skills are also a primary goal of this course and should be generally encouraged in higher education institutions. As mentioned in the introduction to the research, it is not possible to improve learners' critical thinking skills through the teacher-centered teaching method [28-31]. Project-based learning also leads to a shift to learner-centered learning rather than teacher-centered or subject-centered learning [32, 33]. Many previous studies emphasized the importance of project-based learning in stimulating students' thinking compared to direct education [34-36]. However, little is known about whether project-based learning is effective in enhancing critical thinking skills in investment optimization students. Based on this, the problem of this research can be formulated in a question about "What is the effectiveness of project-based learning on enhancing critical thinking skills of optimal investment students?"

RESEARCH AIMS

For this research, the main objective is to explore the effectiveness of project-based learning on enhancing the critical thinking skills of optimal investment students in the Department of Curricula and Teaching Methods at the College of Education at Najran University.

RESEARCH IMPORTANCE

The findings from this study are anticipated to:

- Serving the teaching and learning processes by taking advantage of project-based learning.
- Achieving course objectives by employing interaction and collaboration between peers in project-based learning.
- Benefit in higher education institutions from project-based learning.
- Enhancing critical thinking skills in the "Research Methods" course.

RESEARCH LIMITS

The following list of limitations for this study can be explained:

Objective Determinants

The current research is limited to revealing the effectiveness of project-based learning on enhancing critical thinking skills for optimal investment students in the Department of Curricula and Teaching Methods for students of the College of Education at Najran University in the "Research Methods" course. Where the course is presented to the experimental group in virtual classes integrated with the e-learning management system. Through a short discussion to activate the participants' prior knowledge.

Human Determinants

The sample of this research is limited to the employees of the optimal investment in the Department of Curricula and Teaching Methods at the College of Education - Najran University.

Temporal Determinants

The temporal determinants were represented in the first semester of the year 2022.

Spatial Determinants

The spatial determinants of the current research were represented in the College of Education at Najran University.

RESEARCH TERMS

Project Based Learning

Project-based learning is a methodical approach to teaching and learning that involves students in challenging, real-world assignments that culminate in either an audience presentation or the creation of a repeatable final product. This method helps students gain knowledge and skills that will help them live better lives [37]. The researcher as a procedural definition uses this term.

Critical Thinking Skills

Critical thinking skills Scientific thinking processes such as identifying and describing an issue, gathering information to better understand the problem, evaluating scenarios related to the issue, providing viable solutions to the problem at hand, and evaluating recommended solutions [38]. The researcher adopts this definition as a procedural one

METHODOLOGY

The methodology of this research was to use the semi-experimental approach in order to find out the effect of an independent variable (project-based learning) on the dependent variable (critical thinking skills), and accordingly, the following design was used:

Table (1): Design for a quasi-experimental study

	Treatment	Post-test
Control Group	Traditional way	Critical thinking scale
Experimental Group	Project based learning	

Critical Thinking Scale

The Critical Thinking Scale was developed based on several previous studies [39-44]. The scale was divided into three parts: definition and control of variables (five items), hypothesis testing (six items), and inference (five items). A five-point Likert scale was used to rate each item (1 = strongly disagree, 5 = strongly agree). By presenting the critical thinking scale to a group of arbitrators and experts in the fields of psychology, kindergarten, educational techniques and teaching methods, it is assessed whether the scale is correct, and whether it needs to be deleted, added or modified. Moreover, the internal consistency of the scale is evaluated by applying it to a survey group consisting of ten participants from the eighth level of the same department who were not included in the main sample of the study, and by calculating the stability of the scale by Cronbach's Alpha equation, reaching (0.90). So that the results obtained when applying the scale can be trusted.

RESEARCH SAMPLE

The final sample of the research consisted of (60) employees of the Optimum Investment Diploma in the Department of Curricula and Teaching Methods at the first level in the College of Education - Najran University. During the first semester of the year 2022, after dividing them equally into two groups (control and experimental), for the control group to study the course "Research Methods". Through the traditional method, and the experimental group through project-based learning.

RESEARCH VARIABLES

The following list of variables is part of this study:

The independent variable: project-based learning.

Dependent variables: critical thinking skills.

Experimental processing material

Through the Blackboard platform, this research was based on the "Research Methods" course, and continued during the first semester of 2022. The participants in the experimental group were divided into a number of subgroups (each subgroup consisted of 5 students), as suggested by Chen and Yang [45] and Olatoye and Adekoya [46] (references in project learning in their place) for the size of the project-based learning group, with the aim of reaching the best interactions between the participants. So that the

process goes through a number of steps, namely 1- Teacher progression, for the course through the virtual classroom integrated with the learning management system used in the university through discussions that activate the previous experience of the participants. 2- Encouraging the participants in the sub-group so that they can devise a motivation question, with the aim of providing the participants with the motivation to continue focusing on the subject of the project. 3- Determine the roles and tasks of the sub-group participants; then collect data associated with the leadership question from each participant individually. 4- Participants in each sub-group should share the information they have reached with their peers for discussion and evaluation. The teacher also provides some important observations for the sub-groups. 5. Finally, each subgroup cooperatively presents the final product to the other subgroups.

The control group receives education through (8) lectures in the usual classroom. It should be noted that the traditional classroom is not devoid of cooperation between the participants in the control group, with the aim of enhancing their participation and allowing for discussion and exchange of views. In the end, each student has to submit a research plan that demonstrates his critical thinking skills, after which these plans are evaluated using the critical thinking scale.

Statistical processing

To answer the main research question, Multiple-group confirmatory factor analysis (CFA) was used within the Structural Equation Model (SEM) to see if the use of project-based learning also produced significant differences in critical thinking skills.

RESULTS

To find out whether the use of project-based learning affected the development of critical thinking skills among students to answer the question of the research. In additions, by using Multiple-group confirmatory factor analysis (CFA) (CFA) within the Structural Equation Model (SEM) through the AMOS program, to calculate The three underlying aspects of critical thinking, namely identifying and controlling variables, testing hypotheses, and reasoning, as shown in Figure 1.

From the previous figure, it appears that the use of project-based learning has a positive effect on the side of identifying and controlling variables ($\beta = .39$, $p > 0.05$) in the control group. Moreover, at the same time it appears that the use of project-based learning has a positive effect on the aspect of choosing hypotheses ($\beta = .87$, $p < 0.05$) in the experimental group. Nevertheless, the use of project-based learning has a less effect On the side of choosing hypotheses ($\beta = .36$, $p > 0.05$) in the control group. In addition to that, the use of project-based learning had a positive effect on the side of reasoning ($\beta = .91$, $p < 0.05$) in the experimental group, but the use of learning Project-based has less effect on the inference side ($\beta = .32$, $p > 0.05$) in the control group.

In addition, the aspect of identifying and controlling variables had a positive effect on critical thinking ($\beta = .85$, $p < 0.05$) in the experimental group, but the aspect of identifying and controlling variables had a less effect on critical thinking ($\beta = .35$, $p > 0.05$) in the experimental group. In the control group, in addition, the side of choosing hypotheses had a positive effect on critical thinking ($\beta = .82$, $p < 0.05$) in the experimental group, but the side of choosing hypotheses had a less effect on critical thinking ($\beta = .33$, $p > 0.05$). Finally, the reasoning side has a positive effect on critical thinking ($\beta = .89$, $p < 0.05$) in the experimental group, but the reasoning side has less effect on critical thinking ($\beta = .28$, $p > 0.05$) in the control group. .

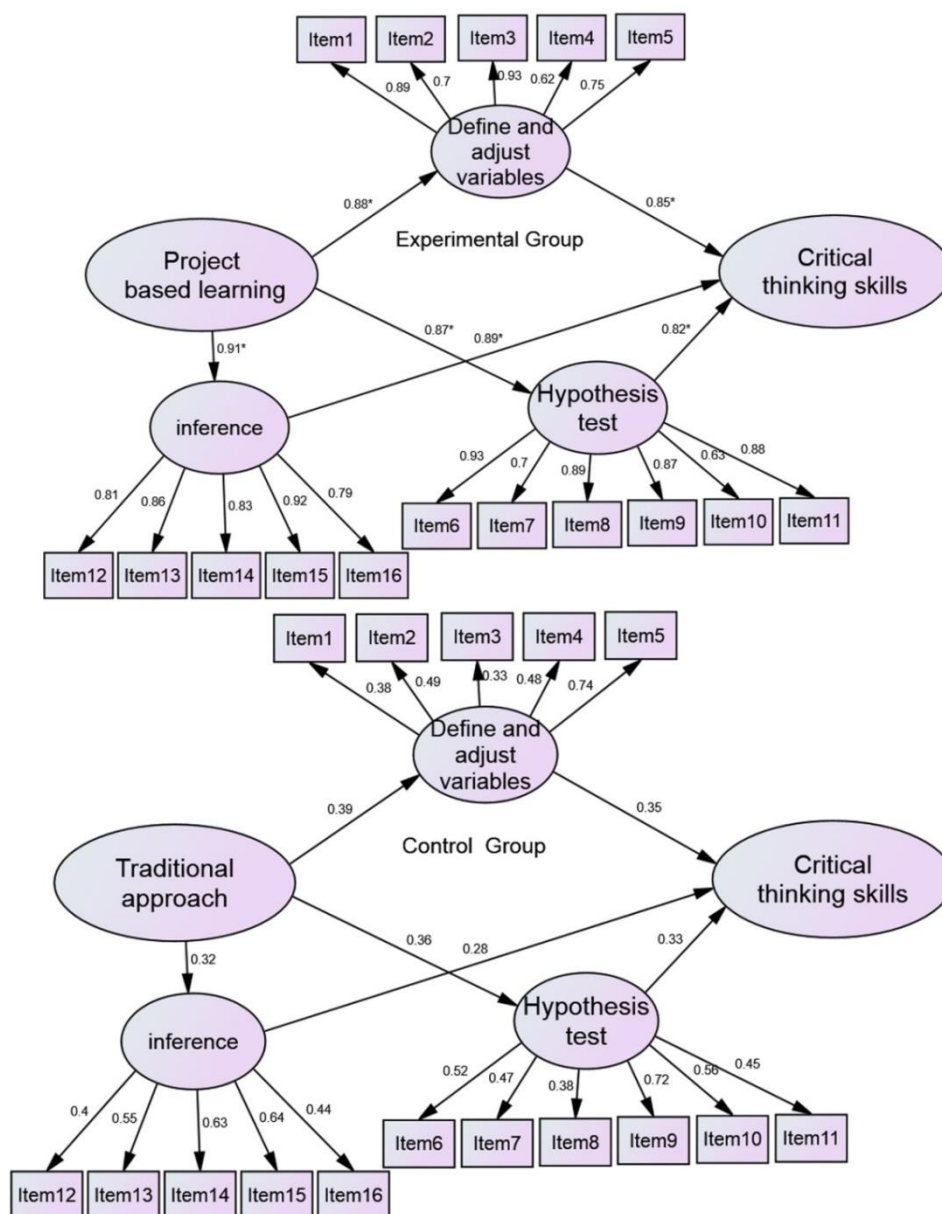


Figure (1). Multi-group confirmatory factor analysis (CFA) for latent aspects of critical thinking (identifying and controlling variables, testing hypotheses, and reasoning)

Note: * $p \leq 0.05$

DISCUSSION

The aim of this research was to reveal the effectiveness of project-based learning on enhancing critical thinking skills among optimal investment students in the Department of Curricula and Teaching Methods at the College of Education at Najran University. The results showed that project-based learning had a positive and statistically significant effect on the development of critical thinking skills for the group. Empiricism, which is mediated by the latent factors of identifying and controlling variables, testing hypotheses, and inference. These results are consistent with the results of a number of previous researches such as [47-50], and the results of this study specifically indicate that project-based learning has a significant and statistically significant effect. To develop the aspect of "identifying and controlling the variables", which includes "asking a main research question", "identifying the independent and dependent variables", "identifying theories, laws and concepts related to the subject" and "describe the proposed experimental design". The results also indicate that project-based learning has a significant and statistically

significant effect on the development of the "hypothesis testing" side, which includes "investigating the effect of the independent variable on the dependent variable", "explaining the relationship between variables", and "formulating zero and alternative hypotheses for research". "Decision making and problem solving", and "Differentiating between hypotheses that can be tested quantitatively and descriptively". The results also indicate that project-based learning has a significant and statistically significant impact on the development of the "reasoning" side, which includes "identifying methods and tools for data collection", "analyzing data to ensure its validity", and "making decisions and evaluating solutions to problems".

RECOMMENDATIONS

According on the findings of this study, the researchers recommend the following:

- Within the disciplines of the succeeding faculty members, they should be trained in the skills of using project-based learning.
- Enhancing critical thinking skills using other methods and strategies.
- Paying attention to enhancing critical thinking skills in other educational levels.

SUGGESTED RESEARCH

The researchers reach several conclusions in light of the research problem:

- Confirming the effectiveness of using project-based learning in other environments by conducting other research at the undergraduate levels.
- Enhancing critical thinking skills by conducting more research to reveal the effectiveness of using augmented reality.
- Conducting research to explore the effectiveness of collaborative e-learning on enhancing critical thinking skills among samples of female students.

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