

**The Development of Learning Activities on Statistics in Everyday Life Course
through Authentic Project Based-Learning Approach
for Undergraduate Students in Private University**

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Abstract

The research objectives were (1) To develop Learning activities on Statistics in Everyday Life Course through Authentic Project-Based Learning (APBL) approach for Undergraduate students in a private university. (2) To compare learning achievement of Undergraduate students before and after participating in learning activities on Statistics in Everyday Life Course through APBL approach. (3) To compare the abilities of project work and the criteria of 70% of Undergraduate students after participating in learning activities on Statistics in Everyday Life Course. The sample for the study was 97 first-year students in different majors of St Teresa International University who enrolled in Statistics in Everyday Life Course in the 1st semester of academic year 2023. The research instruments included five lesson plans of learning activities for the Statistics in Everyday Life Course using the APBL approach, pre-test and post-test of learning achievement, and an evaluation form of abilities of project work. Mean, Standard Deviation, t-test-dependent, and t-test-one samples were used for data analysis. The results were (1) The five lesson plans of learning activities using APBL approach were evaluated by experts at the high level ($\bar{x} = 4.38$, S.D.=0.35). (2) Post-test of learning achievement scores ($\bar{x} = 24.40$, S.D.= 3.43) were significantly higher than pre-test ($\bar{x} = 10.53$, S.D.= 5.60) at the level of .05. (t = -27.4), and (3) The scores of abilities of project

work ($\bar{x} = 43.36$, S.D = 3.04) were significantly higher than the Criteria of 70% at the level of .05 ($t = 21.47$).

Keywords: Authentic Project-Based Learning, Statistics in Everyday Life Course

1. Introduction

In response to the rapidly changing work environment, universities are increasingly adopting pedagogies that cultivate twenty-first century competencies, emphasizing the practical application of knowledge. This shift necessitates a transition from traditional content delivery to active learning, wherein teachers act as facilitators and students become self-directed learners. Project-Based Learning (PBL) exemplifies this approach, allowing students to apply theoretical concepts to real-world challenges (Pan et al., 2021; Seow et al., 2019). Despite its benefits, PBL's implementation remains inconsistent across educational institutions, often hindered by misunderstandings about the roles of teachers and students (Lee et al., 2014; Shpeizer, 2019). Grounded in constructivist principles, PBL promotes meaningful learning through authentic inquiry (Kokotsaki, 2016). Key processes include problem definition, solution generation, prototyping, and real-world testing (Boston University Center for Teaching & Learning, 2023). Research supports various structured approaches to PBL, such as Jalinus's seven-step model, which enhances productive competencies (Jalinus, 2017), and Mohammed's findings demonstrating PBL's effectiveness in developing essential skills (Mohammed, 2017). These studies highlight the value of collaborative and experiential learning, indicating that PBL can effectively complement traditional instructional methods.

2. Research Problems

The researcher, works as an officer in the Department of Registration at a private university, the researcher found that most students who studied Statistics in Everyday Life Course received very low scores. The researcher talked to some students about studying this course. It was found that these students were not happy to study this course and they said that the instructor used “Chalk and talk”. These challenges are likely linked to ineffective teaching methods, as traditional approaches often emphasize theoretical concepts and fictional examples, which do not lead to positive educational outcomes. As a result, students tend to perform poorly, experience low motivation, develop negative attitudes toward statistics, and face increased anxiety about the course. Additionally, the researcher used to check the prior grade level on Mathematics of these poorly students; it was found that these poorly students had low grade level on Mathematics at the high school level too. Variations in teaching experience and student's prior knowledge—especially in high school mathematics—further impact their learning. Additionally, the clarity of teaching materials can either facilitate or hinder the learning process. Many students mistakenly believe they must memorize content rather than cultivate statistical thinking skills. Instructors aim for students to understand fundamental statistical concepts and critically evaluate quantitative information. The interactions among teachers, students, and instructional materials will be examined, along with alternative pedagogical approaches to improve statistics education. The researcher was interested in developing the new teaching method to solve the students' problems.”

3. Research Objectives

- 3.1 To develop learning activities on Statistics in Everyday Life Course through Authentic Project-Based Learning Approach for Undergraduate students in a private university.
- 3.2 To compare learning achievement scores of Undergraduate students before and after participation in learning activities on Statistics in Everyday Life Course through an Authentic Project-Based Learning Approach.
- 3.3 To compare between the scores of Abilities of project work and the criteria 70% of Undergraduate students after participation learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach.

4. Hypothesis

- 4.1 The post-test scores of Learning achievement of Undergraduate students after participation in learning activities on Statistics in Everyday Life Course through an Authentic Project-based learning approach was higher than the pre-test scores of Learning achievement.
- 4.2 The scores of Abilities of project work of Undergraduate students after participation learning activities on Statistics in Everyday Life Course through Authentic Project-based learning approach was higher than the criteria 70%.

5. Importance of the Study

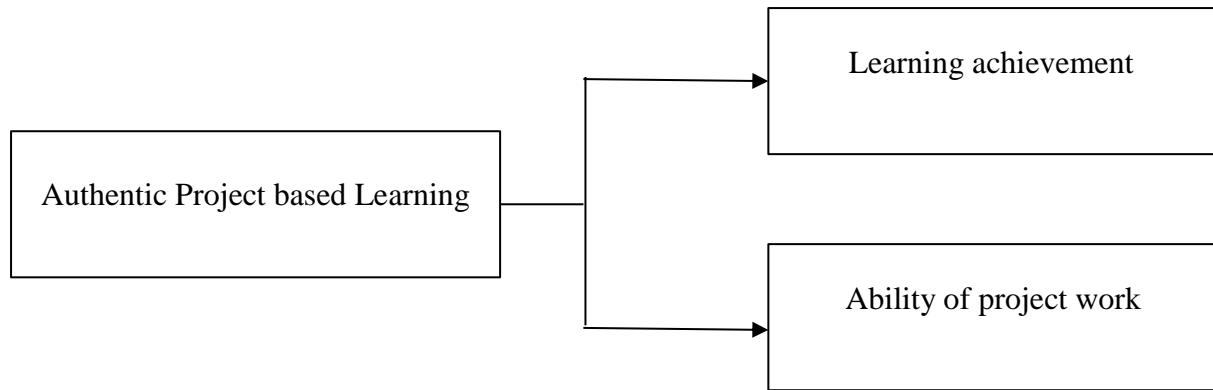
5.1 Authentic Project based learning is as a new type of teaching and learning method in the context of curriculum and teaching reform that takes real life as the background; is driven by practical problems; breaks the disciplinary boundaries; integrates multiple disciplines into one project; and develops students' future-oriented abilities-creative thinking, problem raising, problem solving, critical thinking, communication, and collaboration.

5.2 Authentic Project based learning cultivates students with higher-order thinking skills that students can adapt to the future development of society and reasonably cope with the complex real world and has become an important mission in the current education reform as well as development around the world.

5.3 This research can be the guidance to design and implement Authentic Project based learning to promote effective students' learning for other researchers.

Ultimately, this study may be anticipated to yield substantial benefits for higher education institutions through the integration of Authentic Project-Based Learning practices into their curricula.

6. Conceptual Framework



7. Review of Literature

7.1 Theoretical Background of Project-based learning

The roots of project-based learning extend back over a hundred years to the work of educator and philosopher John Dewey (1959), whose Laboratory School at the University of Chicago was based on the process of inquiry. Dewey argued that students will develop a personal investment in the material if they engage in real, meaningful tasks and problems that emulate what experts do in real-world situations. In the last two decades, learning science researchers have refined and elaborated Dewey's original insight that active inquiry results in deeper understanding. New discoveries in the learning sciences have led to new ways of understanding how children learn. There are four major learning science ideas: (1) active construction, (2) situated learning, (3) social interaction, and (4) Cognitive tools. (Bransford, Brown, & Cocking, 1999)

7.2 Project-based learning procedure

Boston University Center for Teaching & Learning (2023) states that there are 4 key processes of Project-based learning: (1) defining problems — in terms of given constraints or challenges, (2) generating multiple ideas — to solve a given problem, (3) prototyping — often in rapid iteration and potential solutions to a problem, and (4) testing the developed solution products — or services in a “live” or authentic setting.

Shabbir (2020) states that there are 6 Steps to implement Project-Based Learning in the classroom: 1) Identification of a Problem or an Opportunity, 2) Project Planning, 3) Schedule, 4) Monitor Progress, 5) Assessment, and 6) Evaluating the Experience.

Jalinus (2017) found that there are 7 steps of Project-based learning application: (1) formulating the expected learning outcome, (2) understanding the concept of the teaching materials, (3) skills training, (4) designing the project theme, (5) making the project proposal, (6) executing the tasks of projects and (7) presentation of the project report.

Krajcik & Shin (2014) propose the following six features as key characteristics of PBL: (1) driving question, (2) learning goals, (3) scientific practices, (4) collaboration, (5) using technological tools, and (6) creating an artifact.

7.3 Authentic learning

Authentic learning describes learning activities that they are either carried out in real-world contexts, or have high transfer to a real-world setting. Authentic learning activities should have both personal and cultural relevance. (Stein, Isaacs, & Andrews, 2004).

Authentic learning typically focuses on real-world, complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice. The learning environments are inherently multidisciplinary. They are not constructed to teach geometry or to teach philosophy. A learning environment is like some 'real world' application or discipline. (Oblinger, 2007)

Authentic Learning is rooted in constructivist theory, which says that actively engaging with problems and materials constitutes the best way to learn. Authentic learning is based on a constructivist view in which students create their own understandings of new concepts and practices by integrating their previous experience, the resources they have, their own research and their current experience (Mayo, 2010).

7.4 Authentic Project-based learning

Savery and Duffy (1995) specify that Project-based learning problems must include the concepts relevant to the subject domain and that the problems must be real because real life has richer, more multifaceted problems than are possible to fictionalize, real problems are more engaging and students may be more familiar with a real context than a fictional one.

Barab et al. (2000) consider Project-based learning as a special case of authentic learning and support this argument for real problems by taking forward the notion of real-life richness. They suggest that authenticity can neither be pre-planned, nor pre-authenticated by teaching staff. Rather in true constructivist fashion, the students must find their authentic learning answers, in other words, there should be many variations of the right answer.

8. Research Methodology

8.1 Research Design: This research design was a one-group pretest-posttest design. The study used a pretest to measure students' previous knowledge, followed by learning activities through an authentic project-based learning approach for undergraduate students at a private university as the treatment. Afterward, a posttest was administered to measure students' post-knowledge.

Y1	X	Y2
Pretest	Treatment	Posttest
	(Independent Variable)	(Dependent Variable)
	Authentic project-based learning	Learning Achievement score

The procedures of the experimental research that used a one-group pretest-posttest design were as follows:

(1) A pre-test was administered to measure knowledge about statistics in everyday life for undergraduate students before using an authentic project-based learning approach.

(2) The treatment was applied through learning activities on the Statistics in Everyday Life Course using an authentic project-based learning approach for undergraduate students at a private university.

(3) A post-test was administered to measure knowledge about statistics in everyday life for undergraduate students after using an authentic project-based learning approach.

In this study, the researcher used pre-experimental research with a quantitative approach. The researcher aimed to study the effectiveness of learning activities through the authentic project-based learning approach for undergraduate students at a private university.

8.2 Population and Sample of the Study

The population of the study was first-year students from different majors at a private university who enrolled in the Statistics in Everyday Life Course in the first semester of the academic year 2023. The total group of students consisted of 274 individuals. The researcher used 25% of Kerlinger's (1966) recommendation and selected participants through cluster random sampling, resulting in a sample of 97 students. There were 11 students from the Education major, 4 from the Communication Arts major, 3 from the Accountancy major, 9 from the Airlines Business major, 8 from the International Logistics major, 8 from the International Business major, 5 from the Tourism and Hotel major, and 49 from the Nursing Science major.

8.3 Research instruments

The research instruments included (1) lesson plans of learning activities on the Statistics in Everyday Life Course through an authentic project-based learning approach, (2) Pre-test and Post-test of a learning achievement test, and (3) an evaluation form of the ability of project work.

8.4 Data collection

Data collection was composed with:

(1) Using a learning achievement test with the undergraduate students before using an authentic project-based learning approach.

(2) Using an authentic project-based learning approach for 5 periods or (7.5 hours).

(3) Using a learning achievement test with the undergraduate students after using an authentic project-based learning approach.

(4) Using an evaluation form for the ability of project work after using an authentic project-based learning approach.

8.5 Data Analysis

The data were analyzed as follows:

(1) Calculated Mean scores and standard deviation of Post-test and Pre-test of Learning achievement then tested the significant difference of Mean scores by using t-test (dependent) through statistical package program.

(2) Calculated Mean scores and standard deviation of the scores on abilities of project work then tested the significant difference of Mean scores and criteria 70% by using t-test (one sample) through a statistical package program.

9. Research Results

Table 1: The quality level of learning activities on Statistics in Everyday Life Course through Authentic Project-based learning approach for Undergraduate students in a private university.

Learning activities in Lesson Plans	The 1 st Expert	The 2 nd Expert	The 3 rd Expert	S.D.	\bar{x}	Level
Lesson Plan 1	4.00	4.50	4.50	0.42	4.33	High
Lesson Plan 2	4.83	4.00	4.17	0.29	4.33	High
Lesson Plan 3	4.33	4.50	4.50	0.45	4.44	High
Lesson Plan 4	4.50	4.17	4.67	0.27	4.45	High
Lesson Plan 5	4.00	4.67	4.33	0.36	4.33	High
Average	4.33	4.37	4.43	0.35	4.38	High

Table 1 showed that the quality level of Learning activities in Statistics in Everyday Life Course through an Authentic Project-based learning approach for Undergraduate students in a private university evaluated by the three experts was at a high level ($\bar{x} = 4.38$, S.D.= 0.35)

Additionally, it was found that the quality level of Learning activities in Lesson Plan 1, Lesson Plan 2, Lesson Plan 3, Lesson Plan 4 and Lesson Plan 5 were at the high level ($\bar{x} = 4.33$, S.D. =0.42, $\bar{x} = 4.33$, S.D.=0.29, $\bar{x} = 4.44$,S.D.=0.45, $\bar{x}=4.45$, S.D.=0.27, $\bar{x} = 4.33$, S.D.= 0.36)

Table 2: The comparison of Pre-test and Post-test scores of learning achievement of Learning activities on Statistics in Everyday Life Course through an Authentic Project based learning approach for Undergraduate students in a private university.

	n	\bar{x}	S.D.	t	df	Sig.
Pre-test	97	10.53	5.60	-27.41*	96	0.000
Post-test	97	24.40	3.43			

P<.05

Table 2 showed that Post-test score of Learning achievement ($\bar{x} = 24.40$, S.D.= 3.43) after implementing Learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach for Undergraduate students in a private university was significantly higher than Pre-test score of Learning achievement before implementing Learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach for Undergraduate students in a private university ($\bar{x} = 10.53$, S.D.= 5.60) at the level of .05. ($t = -27.4$). The hypothesis was accepted.

Table 3: The Level of the Abilities of project work of Undergraduate students during Participation learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach for Undergraduate students in a private university evaluated by the three experts.

Phase	The 1 st Expert	The 2 nd Expert	The 3 rd Expert	S.D.	\bar{x}	Level
Work1: Project Planning	5	5	4	0.57	4.67	Excellent
Work2: Project Launch	4	3	5	1.00	4.00	Good
Work3: Project implementation	5	5	5	0.00	5.00	Excellent
Work4: Project Conclusion	4	5	5	0.57	4.67	Excellent
Work5: Project Debrief	5	5	5	0.00	5.00	Excellent
Average	4.60	4.60	4.80	0.42	4.67	Excellent

Table 3 showed that the level of Abilities of project work of Undergraduate students during participation in Learning activities in Statistics in Everyday Life Course through Authentic Project-based learning approach evaluated by the three experts was at the excellent level ($\bar{x} = 4.67$, S.D. =0.42)

The level of Abilities of each project work was as follows: Work 2: Project Launch was at good level ($\bar{x} = 4.00$, S.D. = 1.00); Work 1: Project Planning, Work 3: Project implementation, Work 4: Project Conclusion, and Work 5: Project of Debrief were at the excellent level ($\bar{x} = 4.67$, S.D.=0.57, $\bar{x} =5.00$, S.D.=0.00, $\bar{x} =4.67$, S.D.=0.57, $\bar{x} =5.00$, S.D. =0.00.)

Table 4: The comparison between the Scores of Abilities of project work and the Criteria of 70% of Undergraduate students during participation learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach.

	N	\bar{x}	S.D	t	df	sig
Criteria 70% of Project work	97	35.00	0.00	21.47*	96	0.000
Mean Score of Project work	97	43.36	3.04			

P<.05

Table 4 showed that the scores of Abilities of project work of Undergraduate students after participating in Learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach ($\bar{x} = 43.36$, S.D = 3.04) was significantly higher than the Criteria of 70% at the level of .05 ($t = 21.47$, $p<0.05$).

10. Findings

The findings of the study were as follows:

Firstly, the components of learning activities on Statistics in Everyday Life Course through Authentic Project-based learning approach for Undergraduate students in a private university were Lesson Plan 1: Project planning, Lesson Plan 2: Project Launch, Lesson Plan 3: Project Implementation, Lesson Plan 4: Project Conclusion, and Lesson plan 5: Project Debrief. These learning activities on Statistics in Everyday Life Course through Authentic Project-based learning approach were evaluated by the three experts at the high level ($\bar{x} = 4.38$, S.D.=0.35).

Secondly, the post-test score of Learning achievement ($\bar{x} = 24.40$, S.D.= 3.43) of Undergraduate students after participation in learning activities on Statistics in Everyday Life Course through Authentic Project-based learning approach was significantly higher than the pre-test score of the Learning achievement ($\bar{x} = 10.53$, S.D.= 5.60) at the .05 level ($t = -27.4$). The hypothesis was accepted.

Lastly, the scores of Abilities of project work of Undergraduate students after participating in Learning activities on Statistics in Everyday Life Course through Authentic Project based learning approach ($\bar{x} = 43.36$, S.D. = 3.04) was significantly higher than the Criteria of 70% at the level of .05 ($t = 21.47$). The hypothesis was accepted.

11. Discussion

The researcher discussed the research results as follows:

11.1 It was found that the quality level of learning activities on Statistics in Everyday Life course through the authentic project-based learning approach was evaluated by the three experts at the high level ($\bar{x} = 4.38$, S.D.= 0.35). The reason for this finding may be due to the process of creating learning activities. The researcher created learning activities through the authentic project-based learning approach steps by steps as follows: (1) studying related books and

documents, (2) Identify the learning objectives, (3) Planning the specific learning activities through steps of authentic project-based learning approach, (4) Planning assessment student understanding, (5) Sequencing the lesson plan in an engaging and meaningful manner, (6) Creating a realistic timeline, and (7) Planning for a lesson closure. These processes were related to Lesson planning of Centre for Teaching Excellence, Singapore Management University (2024) that states the process of Lesson planning covered (1) Identify the learning objectives, (2) Plan the specific learning activities, (3) Plan to assess students' understanding (4) Plan to sequence the lesson in an engaging and meaningful manner, (5) Create a realistic timeline, and (6) Plan for a lesson closure. In addition, the results of this research are consistent with the research of Eckardt et al (2020) who created the lesson plans to study the impact of project-based learning on student content knowledge in an undergraduate, teacher preparation, Foundations of Education Course and their lesson plans evaluated by the experts at the high level.

11.2 It was found that the post-test score of Learning achievement ($\bar{x} = 24.40$, S.D.= 3.43) of Undergraduate students after participation in learning activities on Statistics in Everyday Life Course through the Authentic Project-based learning approach was significantly higher than the pre-test-score-of-Learning-achievement ($\bar{x} = 10.53$, S.D.= 5.60) at the .05 level ($t = -27.4$, $p<0.05$). The reason for this finding may be due to Earle (2020) who states that Project-based learning (PBL) provides the kind of education that is proving most useful in maximizing student knowledge and doing so within a framework that is experiential, hands-on, and student-directed and Earle (2020) found that projects, from the perspective of both participating students and teachers, often are much more effective in increasing achievement and attitudes towards the science of statistics, especially in the secondary educational years.

11.3 It was found that the scores of Abilities of project work of Undergraduate students after participating in Learning activities on Statistics in Everyday Life Course through Authentic Project-based learning approach ($\bar{x} = 43.36$, S.D = 3.04) was significantly higher than the Criteria of 70% at the level of .05 ($t = 21.47$). The reason for this finding may be due to Koparan and Guven (2014) stating that Projects within an academic discipline should be central to student learning and drive this learning through focused exploration of rigorous and challenging questions within collaborative groups, resulting in maximized performance. Project-based learning has a multitude of benefits, ranging from bridging the gap between knowledge and skill to motivating and engaging traditionally underperforming and apathetic students and finally boosting collaboration and communication skills. Project-based learning, then, is best used when it enhances course content through investigation and thus should not be used to teach basic skills. That said, these skills should be taught by the teacher first, but once learned, the instruction should become student-centered, where students apply prior knowledge through investigation and skill under the umbrella of inquiry and project-based learning. Additionally, Westwood (2006) found that projects promoted meaningful learning and connected new knowledge to prior experiences, increasing motivation and self-direction.

12. Recommendation

12.1 For instructors

The results and conclusions of this research study led to the implementation of the two recommendations.

The first recommendation is the implementation of guidance when using project-based learning. Project-based learning can be very effective. However, using project-based learning instructional methods has been the lack of teacher control over the instruction. Using project-based learning is appealing, but it can have reduced effectiveness due to this lack of guided instruction. The use of guidance in this research study was found to be beneficial to students in introductory statistics courses. The results of this study suggest the use of guidance can increase the effectiveness of project-based learning without limiting its appeal. Statistics instructors can implement guided instruction in conjunction with project-based learning in introductory statistics courses to improve students' attitudes and academic performance.

The second recommendation is the inclusion of a guided project in all introductory statistics courses. Too often students in introductory statistics courses are required to learn statistics without any concrete examples showing the ways various topics connect or the ways statistics can be used outside of the classroom. Without comprehending the applied nature of statistics through authentic learning experiences, students tend to value statistics less and lose interest in studying or using it which leads to them to seeing statistics as simply a class they need to pass to graduate. Statistics educators need to do all they can to keep this from happening. Part of the solution is to include at least one guided project in the introductory course.

12.2 Recommendation for Further Study

This research proposes four recommendations for further study as follows:

Firstly, the application of an APBL approach to instruction in other subject areas to improve students' attitudes and academic performance. One subject area which might benefit from such an approach is mathematics. Mathematics courses have traditionally been mentioned as lacking in appeal. The results of this research suggest that students may maintain interest and come to value mathematics when studied through an APBL approach. This leads to the recommendation that a research study be conducted in a college-level general education introductory mathematics course to see if guided project-based learning can improve students' attitudes and academic performance.

Secondly, Long-Term Impact Assessment: Future research should examine the long-term effects of the Authentic Project-Based Learning approach on students' ability to apply statistical concepts in various real-world contexts. This could involve conducting follow-up studies to assess how well students retain and utilize the knowledge and skills acquired through Authentic Project-Based Learning over extended periods.

Thirdly, Comparison with Traditional Methods: To better understand the relative effectiveness of the Authentic Project-Based Learning approach, it would be beneficial to conduct comparative studies between Authentic Project-Based Learning and traditional instructional methods. This comparison could provide insights into the specific advantages and limitations of Authentic Project-Based Learning in different educational settings and subject areas.

Fourthly, Broader Sample and Contexts: Expanding the sample size and including participants from diverse academic backgrounds, institutions, and educational levels could enhance the generalizability of the findings. This broader scope would help determine whether the benefits observed with the current sample are applicable to other populations.

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