DEVELOPING LEARNING ACTIVITIES FOR STATISTICS IN EVERYDAY LIFE COURSE USING AUTHENTIC PROJECT-BASED LEARNING APPROACH FOR UNDERGRADUATE STUDENTS AT A PRIVATE UNIVERSITY

A Thesis Submitted to

The Faculty of Education

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By

SURARAK ONPAN

In partial fulfillment

of the requirements for the Degree

Master of Education in Learning Management Science

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APPROVAL SHEET

This Thesis entitled, "Developing Learning Activities for Statistics in Everyday life Course using Authentic Project-based Learning Approach for Undergraduate Students at a Private University," prepared and submitted by SURARAK ONPAN, in partial fulfillment of the requirements for the Degree of Master of Education in Learning Management Science, is hereby recommended for acceptance and approval for oral examination.

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CERTIFICATE OF AUTHENTIC AUTHORSHIP

I hereby declare that this research paper is my own work and to the best of my knowledge, contains no materials previously published or written by another person which have been accepted for the award of any other degree or diploma at St Teresa International University or any other Higher Educational Institutions, except where due acknowledgement is made in this thesis. Any contributions made to the research by other authors such as the design, concept, framework, format, style, linguistic expressions, and others have been explicitly cited and acknowledged.

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ABSTRACT

TITLE: Developing Learning activities for Statistics in everyday life Course using Authentic Project based learning approach for Undergraduate students at a private university

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Summary:

The research objectives were (1) to develop Learning activities for Statistics in everyday life Course through Authentic Project-based learning (APBL) approach for Undergraduate students in a private university; (2) to compare the Learning achievement of Undergraduate students between before and after participating in learning activities for Statistics in everyday life Course through APBL approach; and (3) to compare between project skills and the criteria of 70% of Undergraduate students after participating in learning activities for Statistics in everyday life Course through APBL approach. The group of 97 first-year students in different majors of a private university who enrolled in Statistics in Everyday Life Course in the 1st semester, Academic Year 2023 was the sample for the study. 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 Project skills. Mean, standard deviation, t-test-dependent, and t-test-one sample were used for data analysis. The results were that (1) The five Lesson plans of Learning activities using the Authentic Project-Based Learning (APBL) approach were evaluated by three experts at the high level ($\overline{X}$= 4.38, S.D.=0.35). (2) Post-test of Learning achievement scores ($\overline{X}$= 24.40, S.D.= 3.43) were significantly higher than pre-test ($\overline{X}$= 10.53, S.D.= 5.60) at the level of .05. (t = 27.4), and (3) The scores of project skills ($\overline{X}$= 43.36, S.D = 3.04) was 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*

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INTRODUCTION

Background of the study

Statistics is an essential skill for students in today's data-driven world, providing invaluable tools for interpreting, analyzing, and making sense of data across various fields of study. The importance of statistics lies not only in its direct applications in academics and research but also in its broader impact on critical thinking, decision-making, and career opportunities. Understanding statistics equips students with the ability to approach problems analytically, interpret complex information, and make evidence-based decisions (Michigan Technological University, 2025).

One of the primary benefits of studying statistics is that it fosters critical thinking and problem-solving abilities. By learning how to analyze data, identify trends, and draw meaningful conclusions, students develop skills in logical reasoning and decision-making (Jobalope, 2024). According to a study by Watson and Johnstone (2017), students who engage with statistics perform better in tasks requiring logical reasoning and critical thinking because they can approach problems with a clear and structured framework. This skill is invaluable not only in fields like mathematics, science, and engineering, but also in disciplines like economics, psychology, and sociology, where data analysis is integral to research and real-world application.

Statistics also enables students to evaluate research findings effectively. In an age where data is prevalent in news articles, social media, and academic papers, students with a solid understanding of statistical methods are better equipped to critically assess the validity of the information presented (Wyzant, 2023). According to Cumming (2014), an understanding of statistical principles helps individuals distinguish between valid and invalid conclusions, a vital skill in avoiding misinformation and making informed decisions. Whether analyzing the results of a clinical trial or interpreting social science research, students can apply their statistical knowledge to assess the quality of the evidence.

For students pursuing careers in fields such as business, healthcare, technology, or marketing, statistics is directly applicable. In business and marketing, statistics is used to analyze customer data, track sales trends, and optimize marketing strategies. A study by Bagozzi and Dholakia (2002) shows that businesses that leverage statistical methods to analyze consumer behavior and preferences can improve customer retention and make data-driven decisions. In healthcare, statistical analysis is critical for evaluating the efficacy of treatments, understanding patient outcomes, and conducting epidemiological studies. According to Streiner and Norman (2015), statistics is fundamental for healthcare professionals to interpret clinical trials and research studies, which ultimately impact patient care. In technology, statistical methods underpin machine learning, artificial intelligence, and data science, where understanding patterns in large datasets is essential for innovation.

Moreover, statistics is a cornerstone for research skills. Many academic programs require students to conduct independent research, and statistical knowledge is essential for designing surveys, collecting data, and analyzing results. A study by Tufte (2001) highlights that statistical literacy is a key factor in producing reliable, valid, and credible research. By using statistical techniques, students can ensure their research findings are robust and well-supported by data, enhancing the credibility of their work and its contribution to their field.

In the classroom, statistical knowledge helps students organize and summarize information effectively. Techniques such as calculating averages, percentages, and standard deviations help simplify large volumes of data, making complex information more digestible. According to Garfield and Ben-Zur (2006), students who use statistical methods in their studies can present their findings in a clear, structured manner, improving communication and understanding. Whether analyzing test scores, summarizing survey responses, or interpreting experimental results, students can apply statistical techniques to make sense of the data at hand.

Finally, statistics plays a key role in personal decision-making. As students' progress in their lives, they will face situations where data and statistics can inform their choices, such as evaluating job offers, making financial decisions, or understanding

health risks. A study by Konold and Miller (2011), emphasizes that statistical literacy empowers individuals to make better decisions by enabling them to interpret data accurately and evaluate potential risks and benefits.

In conclusion, statistics is not just a valuable skill for academic success but also an essential tool for personal and professional development. It enhances critical thinking, supports effective research, improves decision-making, and equips students with the skills necessary to succeed in a world that increasingly depends on data. With research supporting the importance of statistical literacy in diverse fields—from academia to business to healthcare—erranding statistics is indispensable for students seeking to thrive in the modern world.

Statistic course with undergraduate students

As the importance of Statistics above, a statistics course is incredibly important for undergraduate students as it provides them with essential skills that are applicable across a wide range of academic disciplines and future careers. In today's data-driven world, statistical knowledge is not just useful—it is a fundamental tool that empowers students to analyze and interpret data effectively, make informed decisions, and engage in research across various fields. Statistics is foundational for research and academic success. Many undergraduate programs require students to conduct research, and statistical knowledge is essential for designing experiments, collecting data, and analyzing results. Understanding concepts such as hypothesis testing, correlation, and regression analysis allows students to ensure that their research findings are valid and reliable (Ali and Bhaskar, 2016). Tufte (2001) argues that statistical literacy is essential for producing credible research, as it helps students avoid biases and ensures their conclusions are backed by sound evidence. Without these skills, research can become misleading or unreliable, undermining academic integrity.

Additionally, a statistics course is vital for developing data literacy, which is an increasingly important skill in our modern world. Students today are constantly exposed to large volumes of data, whether in academic studies, media, or personal decision-making. A solid foundation in statistics enables students to interpret this data accurately

and critically. Cumming (2014) highlights that students with statistical literacy can evaluate data sources, detect biases, and discern whether conclusions drawn from data are well-supported. This ability is essential in a world where data can be manipulated to support various agendas, and being able to critically assess such information is an invaluable skill.

For students interested in pursuing careers in fields like business, healthcare, economics, or technology, statistics is indispensable. In business and marketing, statistical methods are used to analyze consumer behavior, identify market trends, and optimize strategies. Research by Bagozzi and Dholakia (2002) demonstrates that businesses that apply statistical techniques to understand customer preferences and behaviors make more informed decisions, leading to increased growth and profitability. In healthcare, statistics plays a key role in evaluating treatment efficacy, analyzing patient outcomes, and conducting clinical research. Similarly, in the technology sector, statistical methods are used to develop machine learning models and analyze large datasets, making statistical literacy crucial for students pursuing careers in data science, artificial intelligence, or software engineering.

A statistics course also enhances students' ability to make informed decisions in both their academic and personal lives. Whether choosing between job offers, evaluating financial investments, or making health-related decisions, students with a statistical background are better equipped to interpret data and assess potential risks. Konold and Miller (2011) emphasize that statistical knowledge empowers individuals to analyze data, understand probabilities, and make decisions based on facts rather than assumptions or biases. This ability to evaluate options systematically is crucial for success in both professional and personal contexts.

Furthermore, statistics plays a critical role in helping students communicate complex data clearly and effectively. Whether preparing research papers, presentations, or reports, students with a solid understanding of statistical methods can use graphs, charts, and tables to present their findings in a visually appealing and comprehensible way. According to Garfield and Ben-Zur (2006), students proficient in statistics are

better at presenting data in ways that resonate with different audiences, enhancing their ability to communicate their ideas effectively.

In conclusion, a statistics course is essential for undergraduate students as it provides valuable skills that support academic achievement and future career success. It fosters critical thinking, enhances research capabilities, improves data literacy, and empowers students to make well-informed decisions. With the increasing reliance on data in nearly every field, statistical knowledge is a powerful tool that prepares students to thrive in the modern world. By equipping students with the ability to analyze data, interpret research, and make evidence-based decisions, a statistics course is a crucial part of any undergraduate education.

Although, statistics is important and worth understanding, past research has identified certain statistics topics that were particularly difficult for students to understand, and has shown that many students struggle to develop a deep and flexible understanding of statistical concepts. Identifying commonalities in the topics that gave students the most trouble might help to identify underlying reasons for the difficulty. Another leading theory as to why students struggle to understand statistics was that they lacked the basic arithmetic and algebraic skills needed to carry out the computations. Indeed, students with poor math skills did tend to receive lower grades in statistics courses and this explanation has received support from many observers. The problem with this explanation was that students struggled even in statistics courses that had very little math. To make statistics content more accessible, several textbooks have been designed to focus on conceptual rather than formulaic presentations of statistical content. If poor math skills really were the reason behind students' poor understanding of statistics, reducing the needed to rely on math skills in statistics courses should make statistics easier. However, students still struggled in statistics courses, despite the recent trend toward using less mathematics in these courses. Although students' poor math performance might certainly contribute to students' difficulties in statistics, researchers have identified other skills that were also important for understanding statistics, such as inductive inference and problem-solving skills (Silva and Sarnecka, 2025).

Silva and Sarnecka (2025) surveyed statistics instructors about several aspects of conceptual understanding and problem solving–things that statistics students also struggled with–and how difficult instructors thought these aspects were for their students to master. The pattern of instructors' responses suggested that a contributing factor to students' difficulty in statistics was the highly abstract nature of many aspects of statistics.

Makwakwa et al. (2024) investigated first-year undergraduate statistics students' statistical problem-solving skills on the probability of the union of two events, conditional probability, binomial probability distribution, probabilities for x-limits using the z-distribution, x-limit associated with a given probability for a normal distribution, estimating the y-value using a regression equation, and hypothesis testing for a single population mean when a population standard deviation is unknown. The study was a descriptive case study and employed a mixed-method research approach. Data were collected through content analysis of a statistics course examination script of 120 first-year undergraduate students of statistics in an open distance-learning university in South Africa. Polya's Model of Problem Solving was used as the framework of analysis. The study revealed that the students, in general, had poor statistical problem-solving skills.

Kurniawan and Wahyuningsih (2018) analyzed the factors that caused difficulties or obstacles experienced by students in Statistics courses in the Mulawarman University Guidance and Counseling Study Program. This research was classified into qualitative descriptive research that seek to describe the analysis of student learning difficulties in statistical subjects. The subjects in this study were the fourth-semester students of 2018/2019 Mulawarman University. Research reveals things that were considered as a barrier factor for students in Statistics. In this study, the researcher collected information through documentation, tests, and interviews with students. The results of the analysis shown that the difficulties of students in studying Statistics basically lie in the weakness of the concept. The results of the research conducted by the researcher were the existence of errors in process skills, errors in understanding questions, and errors in using notation. The solution to overcoming these problems was:

for the eye teacher of Statistics to be able to develop learning strategies so that students can be more honed in their thinking skills and provide continuous problem training to students.

Problems on Statistics Learning of Undergraduate Students in a private university

Results of prior research about studying Statistic of the undergraduate students were found that some undergraduate students had poor statistical problem-solving skills, process skills, and learning strategies. About problems on Statistics learning of undergraduate students in a private university in Thailand, Statistics in everyday life Course was a basic course in a private university that all undergraduate students must study when they are studying in the first year of studying. The researcher has worked 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 were likely linked to ineffective teaching methods, as traditional approaches often emphasized theoretical concepts and fictional examples, which did not lead to positive educational outcomes. As a result, students tended to perform poorly experience and low motivation, developed 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. In addition to that the clarity of teaching materials could either facilitate or hinder the learning process. Many students mistakenly believed they must memorize content rather than cultivated statistical thinking skills. Instructors aimed for students to understand fundamental statistical concepts and critically evaluate quantitative information. The interactions among teachers, students, and instructional materials would 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."

Project based learning approach

Project based learning (PBL) is a student-centered teaching method that involves a dynamic classroom approach in which students gain knowledge and skills to explore and respond to an authentic and engaging problem or challenge. PBL focuses on different real-world subject matters that can sustain the interest of students, require student collaboration and autonomy, and at the same time, accommodate a purposeful and explicit focus on form and other aspects of language (Madoyan, 2015).

In the Project based learning approach, students are encouraged to work in small groups to solve some open-ended, context specific problems. They work together as active and self-directed problem-solvers while teachers serve as facilitators of this learning process. Some effects of implementing the problem-based learning approach are: increase of students' intrinsic motivation, improvement in their problem-solving skills, improvement of critical thinking, and more effective transfer of knowledge to different kinds of problems. Additionally, group collaboration makes students study regularly, while teachers/instructors who are cognitively and socially congruent and flexible stimulate them to develop mental models relevant to problems as well as to continue with learning. However, there are some shortcomings of this approach. The main one encompasses poor previous/background knowledge of some students who do not understand some basic concepts of a particular subject (i.e. statistics) and, because of that, are not able to apply their skills and knowledge to real problems. (Repišti, 2016)

The application of Project based learning approach into the process of teaching and learning statistics can be illustrated by the following example. Teachers split their class into e.g. four groups of five students in each. In each group, there is a student who understands statistical concepts properly and has a great level of practical intelligence. She/he can close ''theory-practice gap'' and to help other students to came up with their own ideas and options through the way of solving a particular problem. All students within all groups should participate in collaborative activities. The problems that are

given to students are, as much as possible, the real-life examples of statistics. Teacher monitors and supervises the work of each group and estimates their level of knowledge and relevant ideas while approaching to the solutions (XCL American School of Bangkok, 2023).

Isnani (2023) explored the effectiveness of implementing the PBL approach in improving critical thinking skills among elementary school students through qualitative analysis based on literature review and library research. The study investigated various aspects of PBL implementation, including its principles, strategies, and outcomes related to critical thinking development. Findings suggested that PBL provided students with opportunities to engage in authentic, inquiry-based learning experiences that promote higher-order thinking skills such as analysis, evaluation, and synthesis. Moreover, the collaborative nature of PBL fostered communication, teamwork, and problem-solving abilities among students. By immersing students in real-world projects, PBL encouraged active participation, creativity, and innovation, leading to a deeper understanding of concepts and issues. Additionally, the integration of technology and multimedia resources enhances the PBL experience, offering students diverse learning opportunities and increasing their motivation and engagement. The findings underscored the importance of well-designed PBL activities and supportive learning environments in maximizing the development of critical thinking skills. Overall, this research contributes to the existing literature by providing insights into the effectiveness of PBL in promoting critical thinking skills among elementary school students.

Authentic Project based learning approach

In education, the term authentic learning refers to a wide variety of educational and instructional techniques focused on connecting what students are taught in school to real-world issues, problems, and applications. The basic idea is that students are more likely to be interested in what they are learning, more motivated to learn new concepts and skills, and better prepared to succeed in university, careers, and adulthood if what they are learning mirrors real-life contexts, equips them with practical and useful skills,

and addresses topics that are relevant and applicable to their lives outside of school (The Glossary of Education Reform, 2013).

Authentic learning means learning which happens by participating and working on real-world problems, it engages learners by the opportunities of solving real-world complex problems and finding out solutions. In this way learners practice the skills and knowledge that are relevant and real to workplace situations and learn it at the same time. Authentic learning activities include role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice. The learning environment of authentic learning is multidisciplinary in nature, for example: designing a container for a specific purpose, setting rules, planning a budget, and solving a crisis. Authentic approach of learning differs greatly from traditional "lecture" classes, where teachers give students information and content of a subject discipline that students are expected to memorize and repeat on tests. It promotes understanding through discovery and doing. Authentic learning is recommended as the best way of learning for students. It is solidly grounded by the theories of learning and cognition, in a batch of theories so called the constructivist learning, which refers to the theory of cognitive development by Jean Piaget (1976), discovery learning by Jerome Seymour Bruner (1961), and constructivist learning by Vygotsky (1978) and Har (2013) (Guido, 2022).

Authentic Project based learning is based on a relevant and realistic context that connects to students' interests, needs, and experiences. It also involves a significant and purposeful product or outcome that demonstrates students' learning and addresses a real audience or situation. Authentic Project based learning can motivate students to apply their knowledge and skills to solve a problem or answer a question that matters to them and others (Sambeka et al., 2017)

Larmer (2012) defines four authenticity criteria for a project as follows:

1. The project meets a real need in the world beyond the classroom, or the products that students create are used by real people.

2. The project focuses on a problem, issue or topic that is relevant to students' lives, or on a problem or issue that is being faced by adults in the world students will soon enter.

3. The project sets up a scenario or simulation that is realistic, even if it is fictitious.

4. The project involves tools, tasks or processes used by adults in real settings and by professionals in the workplace.

Yildirim and Ortak (2021) explored the effects of Authentic Learning Approach on Academic Achievement and Attitudes in Social Studies Course. It was found that the academic achievement levels of the students in the experimental and control groups in the social studies course increased and differed significantly compared to the pre -experimental process.

Due to the benefits of Authentic Project based learning and the results of prior research, the researcher was interested in Authentic Project based learning approach and would like to conduct this approach to solve the problems of the Course of Statistics in Everyday life as can be seen, not only high grades matter, but also students' capacity to implement statistics in solving practical problems. In addition, a proper constellation of teachers' and students' qualities along with adequate teaching materials produces a high level of statistical literacy as well as very good to remarkable statistical reasoning skills. Additionally, methodological thinking should be taught together with statistical reasoning and it is being improved as course is progressing.

Statement of the Objectives

1. To develop Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university.

2. To compare Learning achievement scores of Undergraduate students between before and after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach.

3. To compare between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach.

Research Questions

1. How were the steps of learning activities on Statistics in everyday life Course through Authentic Project based learning approach for the Undergraduate students in a private university?

2. How were the differences testing scores of Undergraduate students before and after participation learning activities on Statistics in everyday life Course through Authentic Project learning approach?

3. How were the differences between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach?

Hypothesis

1. The post-test scores of Learning achievement of Undergraduate students after participation learning activities on Statistics in everyday life Course through Authentic Project based learning approach was higher than the pre-test scores.

2. The scores of Project skills of Undergraduate students after participation in Learning activities on Statistics in everyday life Course through Authentic Project based learning approach was higher than the criteria 70%.

Importance of the Study

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.

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.

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

4. 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.

Scopes of the Study

This study aimed to develop and evaluate Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university. The scopes of this study were as follows:

Scope of Content

This study focused on the content in Statistics in everyday life Course. The course content was about Basic Concepts of Probability and Counting Rules that separate into five subtopics, there were Basic Concept of probabilities, Calculating Probability, Multiplication Rules and Conditional Probability, Bayes' Rule, and Counting Rules

Scope of Population and Sample

This study focused on the effects of Achievement and Satisfaction of the 1st year students of a private university who registered the Course of 100 402 Statistics in Everyday Life in the 1st semester of Academic year 2023. The total of the students who registered the Course of 100 402 was 6 groups. The data collection was conducted by a group of the 1st year students who represented the population and the 97 students were selected to be the sample of this study.

Scope of Variables

The independent variable in this study was implementing Learning activities on Statistics in everyday life Course through Authentic Project based learning approach and the dependent variables were the scores of Learning achievement and the scores of Project skills of Undergraduate students in a private university.

Theoretical Framework

Steps of Authentic Project based learning approach

Nuntasukan and Yuthong (2014) articulated six steps in project-based researcher classify into five phases instruction management as given below:

Phases 1 Project Planning

Step-1 Preparation: The scope of the project and the sources of information are explained to the students by the instructors so that the students are motivated to seek the topics of the project.

Step-2 Topic definition and selection: The students identify the topics for the project-based learning by studying the possibilities of each topic for selection and submit the same for the approval of the faculty supervisor.

Phases 2 Project Launch

Step 3- Project layout: students study the project's scope and search for the sources of information and plan the project implementation in a group by agreeing on the tasks to be performed, intense roles and responsibilities of the group members and the duration of the project.

Phases 3 Project implementation

Step 4- Project implementation: The group members then carry out their tasks and responsibilities by mutually collaborating and sharing their knowledge while exchanging experiences under the guidance of the faculty supervisor.

Phases 4 Project conclusion

Step 5 – On completing the assigned tasks, the group collates their findings, prepares a report, and presents the project with the other groups.

Phases 5 Project Debrief

Step 6- Evaluation: The faculty supervisor evaluates the projects by applying varying assessment tools such as understanding the project, process of executing the project and attainment of learning outcomes.

Authenticity criteria for a project:

Larmer (2012) defines the following four authenticity criteria for a project:

1. The project meets a real need in the world beyond the classroom, or the products that students create are used by real people.

2. The project focuses on a problem, issue or topic that is relevant to students' lives, or on a problem or issue that is being faced by adults in the world students will soon enter.

3. The project sets up a scenario or simulation that is realistic, even if it is fictitious.

4. The project involves tools, tasks or processes used by adults in real settings and by professionals in the workplace.

The focus of context with real-world themes or issues provides the authenticity that instructors strive for, and students often appreciate. The tasks that the teacher assigns the students to carry out for the project must also be authentic. By an authentic task, we mean those tasks which enable learners to use the knowledge they have gained in the classroom to solve real-life problems.

Effectiveness of Authentic Project based learning approach

Learning achievements scores

Learning achievements scores was easiest to measure by having students taken a pre and post lesson assessment. The goal of Authentic Project based learning was to increase what students were taking away from lessons.

Chu et al. (2011) set out to find what effect Project based learning could have on reading and English language arts. By the end of the 10-week period, student retook the same pretest to show what they had learned from the unit.

Holthuis et al., (2018) that utilized pre and post tests to measure learning gains focused on the current project-based learning science curriculum NGSS over a 3-year period. This study also had a control group that learned by doing traditional science lessons. Rather than focus on the learning gains in science, they measured the pre and post test scores from standardized tests that focused on math and English language arts.

Martin (2021) stated that through doing the research titled “Does Project-Based Learning Have an Effect on Student Learning Gains?” He found several studies that were done with teachers using project-based learning and in all those studies the result was increased creativity, increased test scores, and increased overall motivation to learn and participate in school.

Sanjaya & Prasandy (2019) stated that the output of study should reflect competencies about what students should understand and capable after completing the study process. This output was called learning outcomes, that defined the knowledge and skills that graduates should possess. There were three (3) domains of behavior that could be specified by learning outcomes:

1. Cognitive which involves the process of thoughts,
2. Affective which involves feelings, social aspects, and attitudes, and
3. Psychomotor which involves the physical abilities

It can be concluded that learning outcomes were something obtained from activities that would change a person's identity, in the form of experience or knowledge that could provide value to the individual.

Performance evaluation on project skills

According to Boss (2012), performance evaluation that asks students to demonstrate, apply, and reflect on what they have learned is seen as the best way to assess what students can produce rather than what they can recall for a test.

Harmer (2014) expressed several ways for assessing students' performance through Problem-based learning approach as follows: the research project, the construction project, and the real-world project.

Barnes (2014) presented a new way of assessment which is called SE2R:"Summary, Explanation, Redirection and Resubmission". There is no room for numbers, percentages, or letter grades in SE2R. Instead, it provides students with narrative feedback in order to give them the opportunity for mastery learning.

Miller (2033) explains that evaluation on project skill is carried out with the aim to track the progress of a project and identify opportunities for improvement. Throughout the evaluation, you address some key questions like (1) Is the project on track to achieve its defined aims and objectives? (2) How many goals have been achieved? (3) What are the challenges being faced by the team? (4) How is each team member contributing to the project's overall performance

Conceptual framework

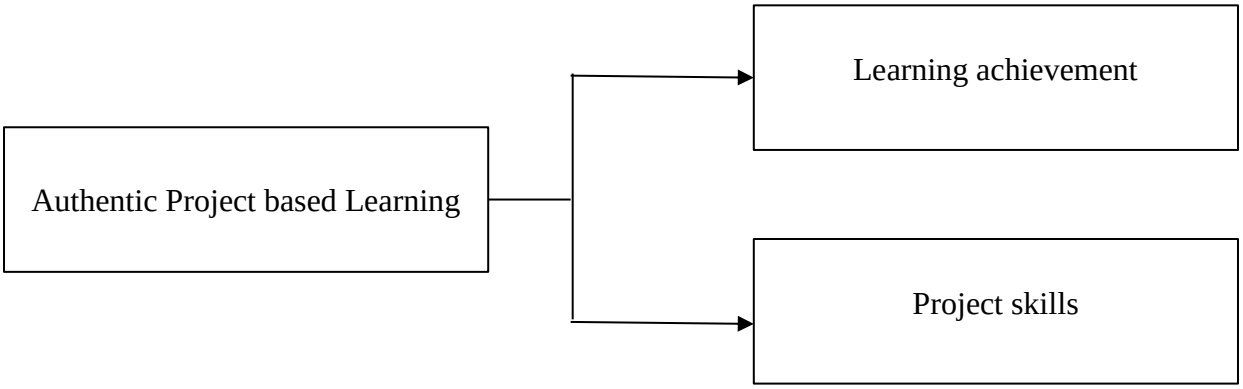

Figure 1: Conceptual framework

Definition of terms

Statistics in everyday life Course means a subject in the group of General Courses taught in a private university since Academic year 2021. For this study, the researcher selected only the content named Probability from Statistics in everyday life Course.

Authentic Project based learning approach means a teaching method that involves students working on real-world projects that are meaningful and relevant to them. For this study, the researcher used 5 processes of Authentic Project based learning

approach covered (1) Project planning: Tackle complex questions or problems, (2) Project Launch: Demonstrate skills through presentations or products, (3) Project Implementation: Engage with an authentic audience, (4) Project Conclusion: Make the contribution to the world, and (5) Project Debrief: Build personal connections to the work.

Learning activities on Statistics in everyday life Course through Authentic Project based learning approach means tasks and exercises that the instructor design to help students learn and understand knowledge, build new knowledge, and promote knowledge retention through Authentic Project based learning approach. For this study, the researcher constructed Learning activities on Statistics in everyday life Course through Authentic Project based learning approach to be the 5 Lesson plans. Learning activities in each Lesson plan were composed of five phases with six steps of Preparation, Topic definition and selection, Project layout, Project implementation, on completing the assigned tasks, and Evaluation as follows:

Phases 1 Project Planning

Step 1 Preparation: The scope of the project and the sources of information are explained to the students by the instructors so that the students are motivated to seek the topics of the project.

Step 2 Topic definition and selection: The students identify the topics for the project-based learning by studying the possibilities of each topic for selection and submit the same for the approval of the faculty supervisor.

Phases 2 Project Launch

Step 3 Project layout: students study the project's scope and search for the sources of information and plan the project implementation in a group by agreeing on the tasks to be performed, intense roles and responsibilities of the group members and the duration of the project.

Phases 3 Project implementation

Step 4 Project implementation: The group members then carry out their tasks and responsibilities by mutually collaborating and sharing their knowledge while exchanging experiences under the guidance of the faculty supervisor.

Phases 4 Project conclusion

Step 5 On completing the assigned tasks: The group collates their findings, prepares a report, and presents the project with the other groups.

Phases 5 Project Debrief

Step 6 Evaluation: The faculty supervisor evaluates the projects by applying varying assessment tools such as understanding the project, process of executing the project and attainment of learning outcomes.

Learning achievements scores means numeral values that represent how much students have mastered in the content of Probability from Statistics in everyday life course after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university. Learning achievements scores in this study were assessed by using the Learning achievement Test constructed by the researcher.

Project skills scores mean numeral values that represent how much students have mastered the skills and knowledge required to plan, execute, and complete a project. For this study, project skills scores based on the skills on (1) Project planning: Tackle complex questions or problems, (2) Project Launch: Demonstrate skills through presentations or products, (3) Project Implementation: Engage with an authentic audience, (4) Project Conclusion: Make the contribution to the world, and (5) Project Debrief: Build personal connections to the work after applying Learning activities on Statistics in everyday life Course through Authentic Project based learning approach. project skills scores were assessed by using project skills evaluation form constructed by the researcher.

Summary

Chapter I of this study discussed the importance of statistics education for undergraduate students, emphasizing its role in fostering critical thinking, research skills, and data literacy. Statistics equipped students with the ability to analyze data, interpret research, and made informed decisions, which was crucial in both academic and professional contexts, including fields such as business, healthcare, and technology. However, many students faced challenges in learning statistics, particularly when teaching methods were ineffective, such as the traditional "chalk and talk" approach. Poor prior knowledge in mathematics and unclear teaching materials further exacerbated these issues. The researcher, an officer in the Department of Registration at a private university, observed that many students struggled with the "Statistics in Everyday Life" course, resulting in low grades and negative attitudes toward the subject. To address these challenges, the researcher was interested in exploring the Project-Based Learning approach, which encouraged collaborative problem-solving in real-world contexts. Project-Based Learning approach has been shown to improve motivation, critical thinking, and knowledge transfer. However, it also faced challenges, such as students' insufficient background knowledge, which could hinder their ability to apply statistics to real problems. The study also highlighted the potential benefits of combining authentic learning with Project-Based Learning approach. Authentic learning involved solving real-world problems that were meaningful and relevant to students' lives, thereby enhancing engagement and practical application of knowledge. The researcher aimed to apply this authentic PBL approach to improve the teaching of statistics, particularly by addressing the gaps in students' statistical reasoning and methodological thinking. Through this approach, students could better understand and apply statistical concepts in solving practical problems, ultimately improving both their academic performance and project skills.

CHAPTER II
REVIEW OF RELATED LITERATURE

The objectives of this study were as follows: (1) to develop Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university; (2) to compare Learning achievement scores of Undergraduate students between before and after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach; and (3) to compare between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach. The researcher proposed related literature on topics of Statistics in everyday life Course, Project based learning, and Authentic Project based learning as follows:

Statistics in everyday life Course

Background of Statistics in everyday life Course

Statistics in everyday life Course was a course in the General Education program for undergraduate students in a private university in Thailand and the course of Statistics in everyday life was in the group of Science and Mathematics since 2021. The overall of content were practical concepts of statistics and the applications in problem solving by means of data gathering, frequency distribution, probability, hypothesis testing; interpretation of the tests, regression, and correlation analysis. Due to this study focused on the content of Probability, the researcher proposed only this content.

Learning objectives of the content "Probability" in Statistic in everyday life Course

This study identified only the content of Probability in Statistic in everyday life Course. The researcher presented only learning objectives of the content "Probability" in Statistic in everyday life Course. There were seven objectives in the topic Probability as the following:

1. To realize basic concepts about random experiments.
2. To obtain the space of events of a random experiment.
3. To find the probability of the events using the addition rules.
4. To find the probability of compound events using the multiplication rule.
5. To find the conditional probability of an event.
6. To apply the Bayes theorem to find probability of an events.
7. To find the probability of an event using counting rules.

The learning objectives for the topic "Probability" in the Statistics in Everyday Life course aimed to provide students with a comprehensive understanding of fundamental concepts and techniques in probability. These objectives guided students in mastering key concepts such as random experiments, event spaces, addition and multiplication rules, conditional probability, Bayes' theorem, and counting rules. By achieving these objectives, students were developed the necessary skills to apply probability concepts effectively in problem-solving and decision-making in real-life contexts.

Related research about Statistics in everyday life Course

Gordon (2004) explored issues surrounding university students' experiences of statistics drawing on data related to learning statistics as a compulsory component of psychology. Over 250 students completed a written survey which included questions on their attitudes to learning statistics and their conceptions of statistics. Results indicated that most students were studying statistics unwillingly. A minority of students acknowledged that statistics was necessary for psychology, but statistics was seen by many as boring or difficult.

Yotongyos et al. (2014) assessed the level of statistical literacy among undergraduate students in Thailand. The two-element model of statistical literacy by Gal (2004), knowledge component (comprised of five cognitive elements: literacy skills, statistical knowledge, mathematical knowledge, context knowledge, and critical questions) and a dispositional component (comprised of two elements: critical stance, and beliefs and attitudes), was used. A survey was administered to 103 undergraduate

students of Faculty of Education, Chulalongkorn University. The results revealed that the undergraduate students had moderate level of overall statistical literacy, knowledge component and a dispositional component. In the knowledge component, the students had high level of literacy skills and mathematical knowledge, moderate level of statistical knowledge and critical questions, and low level of context knowledge. Additionally, in the dispositional component, the students had moderate level of critical stance, and beliefs and attitudes. The practical implications for educators to improve students' statistical literacy were discussed.

Kurniawan and Wahyuningsih (2018) analyzed the factors that cause difficulties or obstacles experienced by students in Statistics courses in the Mulawarman University Guidance and Counseling Study Program. This research was classified into qualitative descriptive research that seek to describe the analysis of student learning difficulties in statistical subjects. The subjects in this study were the fourth-semester students of 2018/2019 Mulawarman University. Research revealed things that were considered as a barrier factor for students in Statistics. In this study, the researcher collected information through documentation, tests, and interviews with students. The results of the analysis shown that the difficulties of students in studying statistics basically lied in the weakness of the concept. The results of the research conducted by the researcher were the existence of errors in process skills, errors in understanding questions, and errors in using notation. The solution to overcoming these problems was: for the eye teacher of Statistics to be able to develop learning strategies so that students could be more honed in their thinking skills and provided continuous problem training to students.

Makwakwa et al. (2023). investigated first-year undergraduate statistics students' statistical problem-solving skills on the probability of the union of two events, conditional probability, binomial probability distribution, probabilities for x-limits using the z-distribution, x-limit associated with a given probability for a normal distribution, estimating the y-value using a regression equation, and hypothesis testing for a single population mean when a population standard deviation is unknown. The study was a descriptive case study and employed a mixed-method research approach. Data were

collected through content analysis of a statistics course examination script of 120 first-year undergraduate students of statistics in an open distance-learning university in South Africa. Polya's Model of Problem Solving was used as the framework of analysis. The study revealed that the students, in general, had poor statistical problem-solving skills.

Cujba and Pifarré (2024) investigated the effects of technology-enhanced, collaborative, and data-driven project-based learning on the students' attitudes towards statistics. This study distinguished itself from other PBL studies on statistics because researchers investigated a long-term intervention in real classrooms and integrated into one intervention the three pedagogical variables that previous research highlighted as relevant in statistics education: (a) the use of technological tools and affordances for analyzing and visualizing data, (b) enrichment of collaborative strategies and (c) project-based learning with a data analysis approach. Results indicated a notable positive shift in attitudes among the experimental group students following the intervention. The experimental group students decreased their anxiety after the intervention and, increased their affect and positive attitude toward using technology for learning statistics. By contrast, the Control group students do not show any positive effect on their attitudes. These findings underscore the potential of the innovative instructional design implemented in this project to not only foster practical statistical problem-solving skills but also cultivate positive attitudes crucial for statistical competence.

Silva and Sarnecka (2025) surveyed statistics instructors about several aspects of conceptual understanding and problem solving–things that statistics students also struggle with–and how difficult instructors thought these aspects were for their students to master. The researcher also asked instructors how relevant they thought each aspect was for succeeding in a statistics course. Each aspect was presented as a contrast (e.g., conceptual vs. procedural understanding, interrelated vs. isolated concepts, applied vs. simple recall problems). The pattern of instructors' responses suggested that a contributing factor to students' difficulty in statistics was the highly abstract nature of many aspects of statistics.

It may be concluded that Statistics in everyday life Course was a course in the General Education program for undergraduate students in a private university in Thailand and the course of Statistics in everyday life was in the group of Science and Mathematics since 2021. This study focused only the content of "Probability" that aimed to apply knowledge for finding probability of an events. The prior research found some problems of Statistics learning about students' negative attitude on Statistics, moderate level of statistical knowledge and critical questions and low level of context knowledge, difficulties of students in studying Statistics basically lied in the weakness of the concept, and application of technology-enhanced, collaborative, and data-driven project-based learning promoted problem-solving skills and the students' attitudes towards statistics.

Project based learning

Definition of Project based learning

Project based learning is a student-centered pedagogy used in the classrooms in which students acquire in-depth knowledge and skills by solving real-world challenges (Shabbir, 2020).

Project based learning (PBL) is a student-centered teaching method that involves a dynamic classroom approach in which students gain knowledge and skills to explore and respond to an authentic and engaging problem or challenge (Madoyan, 2015).

Project based learning is as student-centered and driven by the need to establish an end-product (Fried-Booth, 2002).

Project based learning is an instructional approach that contextualizes learning by presenting learners with problems to solve or products to develop (Moss & Van Duzer, 1998).

It may be said that Project-Based Learning (PBL) is a student-centered teaching approach that promotes deep learning by engaging students in solving real-world problems and producing tangible outcomes.

Importance of Project based learning

Project based learning (PBL) is vital in education as it fosters deeper understanding, critical thinking, creativity, and problem-solving skills among students. Through authentic, real-world projects, PBL engages students more effectively, enhances their motivation, and prepares them for the complexities of the real world. It cultivates collaboration, encourages lifelong learning, and promotes the retention of knowledge by tying learning to practical experiences. Additionally, PBL allows for diverse assessment methods, accommodates various learning styles, and empowers students to take ownership of their education, ultimately equipping them with the skills and attitudes needed for success in an ever-evolving society (American school of Bangkok, 2023).

Evenddy et al. (2023) states that importances of Project-Based Learning in Higher Education are as follows:

(1) Active engagement and student-centered learning: Project based learning in higher education offers numerous benefits, starting with active engagement and student-centered learning. PBL engages students in authentic, real-world projects that empower them to take ownership of their education. By actively involving students in their learning process, PBL fosters a sense of responsibility and autonomy, motivating them to become active participants in their educational journey.

(2) Interdisciplinary collaboration: Another significant benefit of PBL in higher education is the enhancement of teamwork and communication abilities through interdisciplinary collaboration. PBL provides a platform for students to engage in collaborative work across diverse disciplines, fostering valuable skills for their future endeavors. Collaborative projects require students to work together, developing their interpersonal skills and learning to communicate effectively. By working on interdisciplinary projects, students are exposed to different perspectives and approaches, enabling them to develop essential teamwork and communication
abilities.

(3) Authentic problem-solving: Project based learning in higher education provides a unique opportunity for students to bridge the gap between theory and practice through authentic problem-solving. This approach allows students to apply their knowledge and skills to real-world challenges, making their learning experience more meaningful and relevant. Engaging in authentic problem-solving helps students develop a deeper understanding of the subject matter and its practical applications. By working on real-world problems, students can connect theoretical concepts with real-life scenarios, gaining insights into the practical implications of what they are learning.

Background of Project based learning

Roots 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 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)

Constructivism: This theory, primarily associated with Jean Piaget and Lev Vygotsky, suggests that learners construct their own understanding and knowledge of the world through experiences and reflecting on those experiences. In PBL, students actively create their own knowledge by engaging in real-world projects rather than passively receiving information.

Social Constructivism: Vygotsky's theory emphasizes the social context of learning. According to this view, learning occurs through social interaction and collaboration. In PBL, students often work in groups, and knowledge is constructed

collectively as they share ideas, challenge each other's thinking, and build upon each other's understandings. (Thao, 2017).

Experiential Learning: Championed by David Kolb, this theory posits that knowledge is created through the transformation of experience. Experiential learning involves a cyclical process of concrete experience, reflective observation, abstract conceptualization, and active experimentation. PBL aligns with this by allowing students to learn by doing, reflecting, theorizing, and testing their ideas in real-world scenarios.

Inquiry Based Learning: This approach is rooted in John Dewey's philosophy that education begins with the curiosity of the learner. Students at the center of learning engage in inquiry, exploration, and problem-solving, with the teacher guiding and facilitating their learning journey. PBL is a form of inquiry-based learning where students pursue answers to questions that intrigue them.

Situational Learning Theory: Lave and Wenger's theory emphasizes learning as a social process wherein knowledge is co-constructed; the theory introduces the concept of communities of practice. In PBL, students often engage in authentic tasks in real-life contexts or simulations, becoming part of a community of learners who are engaged in common tasks.

Problem Based Learning: A subset of PBL, Problem-Based Learning focuses specifically on the use of complex real-world problems as a vehicle for learning. This approach encourages learners to develop problem-solving skills and apply their knowledge to real-world scenarios.

Zone of Proximal Development (ZPD): Vygotsky's concept of ZPD involves the difference between what a learner can do without help and what they can achieve with guidance and encouragement from a skilled partner. In PBL, teachers often facilitate and guide students to reach higher levels of understanding and skill than they would achieve independently (Bogler, 2024)

Multiple intelligence theory: Project based learning is consistent with Multiple intelligence theory, as proposed by Gardner. Gardner differentiated the intelligences of learners and highlighted that all humans possess eight types of intelligence that are

manifested in different skills and competencies; therefore, individuals learn differently to one another. Project-based learning accommodates different styles of learning by including different tasks (Scholarly Community Encyclopedia, 2021).

Project based learning Characteristic

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

Thomas (2000) stated that there are five key characteristics of the Project based learning as follows.

1. Projects related to the curriculum Students learn the target contents through the projects which are linked to the curriculum.

2. A driving question related to target content Questions, problems, or topics that the students need to work on must "drive" or lead the students to the target contents.

3. Constructive investigation Projects must allow students to investigate the topic or problem to build up new knowledge or skills related to the target content. This is possible through inquiry, planning, exploring, decision-making, problem solving, and reporting the findings.

4. Autonomy Project based learning should allow considerable amount of time for students to work on their own. Students are responsible for completing their projects under the supervision of their teacher.

5. Real-life application Projects must incorporate topics, tasks, products or performances that the students can encounter or use in real life situations.

Procedure of Project based learning

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 the Progress, 5) Assessment, and 6) Evaluate the Experience.

Jalinus (2017) found that there are 7 steps of Project based learning application: (1) the 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.

Related research about Project based learning

Rachmawati et al (2024) implemented Project based learning in higher education in Indonesia. The result of the study presented that the implementation of Project based learning was done in several ways and stimulated the development of the students' skills and covering the three main processes: preparation, implementation, and evaluation. The model implemented facilitated the students' problem-solving skills, critical thinking skills, communication skills, collaboration skills, and information literacy. As the students developed their life skills, the teaching through the Project based learning model could be done creatively depending on the learners' and teacher's characters and the learning facilities.

Tuan (2024) examined lecturers' attitudes and experiences regarding Project based learning in mathematics education programs by utilizing qualitative analysis of data from 9 lecturers teaching at four universities in Vietnam. Positive experiences of lecturers in Project based learning highlight its efficacy in nurturing critical thinking, problem-solving skills, and collaborative learning among students. However, negative experiences shed light on logistical challenges linked to Project based learning implementation, such as time constraints, resource limitations, and the need for additional training and support.

Eckardt et al (2020) determined the impact of Project based learning on student knowledge acquisition and students' and researchers' perceptions of the use of Project based learning as a pedagogical tool. It was found that Project based learning facilitated

a deep understanding of content knowledge and supportive learning communities was cultivated through productive academic struggle while engaged in Project based learning experiences.

Mohammed (2017) study the impact of Project based learning on student enrolled in the Emirati Studies course. A group of 62 female Arab students studying Emirati Sties at a federal higher institution in the UAE were involved in this classroom-based inquiry which took place over a 14-week semester. Data were collected using quantitative and qualitative methods to examine how effective the Project based learning approach was in engaging learners, in improving their skills and in helping them achieve the course learning outcomes. The result of the study showed that Project based learning was useful in helping students develop essential 21st century skills such as critical thinking, team work, problem solving, research skills, presentation skills, interpersonal communication skills, negotiation skills, creativity, and innovation. This research project helps to illustrate and provide evidence of how using Project based learning as a supplement to traditional lecturing can be a catalyst for an effective and efficient process-oriented quality education where students are active individuals managing their own learning and having fun in the process.

It was said that Project based learning is a teaching method that involves students working on real-world projects to develop skills and knowledge. Roots of Project based learning based on John Dewey. Other theoretical Background of Project based learning came from Constructivism, Social Constructivism, Experiential Learning, Inquiry-Based Learning, Situational Learning Theory, Problem-Based Learning, Zone of Proximal Development, and Multiple intelligence theory. About the procedures of Project based learning, there are 4 key processes of Project based learning by Boston University, and 6 steps by Shabbir and 7 steps by Jalinus. Several characteristics of Project based learning by educators, there are six characteristics as Krajcik & Shin or five key characteristics as Thomas. Additionally, the results of Project based learning from research in higher education were found that Project based learning model could be done creatively depending on the learners' and teacher's characters and the learning facilities.

Authentic Project based learning

Definition of Authentic Project based learning

Authentic Project based learning is a teaching method that uses real-world contexts and problems to motivate students to apply their knowledge and skills. Authentic Project based learning is a key feature of high-quality PBL and can help students become positive change makers (International Literacy Association, 2022).

Authentic Project-Based Learning is a teaching method where students actively engage in real-world problems and challenges through projects that are directly relevant to their lives or have a tangible impact on their community, allowing them to apply knowledge and develop skills in a meaningful, authentic way, rather than just completing hypothetical exercises, and students working on projects that feel real and impactful to them, mirroring real-world situations (Polman and Boardman, 2022).

Authentic Project-Based Learning (PBL) is an inquiry-based, student-centered approach that immerses students in real-world problems and connects them with their communities. By engaging in relevant, challenging projects, students apply content knowledge and develop skills needed for college and career readiness. Implementation involves teachers acting as facilitators, fostering a supportive environment, and integrating formative assessment throughout the learning process. Partnerships with community experts further enrich learning, making education meaningful and applicable beyond the classroom. To begin the steps of integrating authenticity in the classroom employ the suggestions from the Spectrum of Authenticity and brainstorm ideas with colleagues. PBL is an evolving practice that requires reflection, adaptation, and continuous learning to meet the changing needs of students and the world (New Tech Network, 2025).

Importance of Authentic Project based learning

Authentic project based learning allows students to engage deeply with real-world problems and contexts, fostering critical thinking, collaboration, and a deeper understanding of subject matter by applying knowledge to practical situations, ultimately preparing them for real-world challenges while increasing motivation and engagement through

relevant and meaningful projects. The importance of Authentic Project based learning are as follows: (Ed tech classroom, 2022; Centric learning, 2024; New Tech Network, 2025)

1. **Increased engagement**: Students are more motivated when they can see the practical application of their learning and feel a sense of ownership over their projects.

2. **Deeper understanding**: By actively solving real-world problems, students develop a more profound comprehension of concepts rather than just memorizing facts.

3. **Develops critical thinking skills**: Authentic based learning often involve complex problems with multiple solutions, requiring students to analyze, evaluate, and creatively approach challenges.

4. **Collaboration and communication skills**: Working on projects with peers encourages collaboration, communication, and the ability to work effectively as a team.

5. **Real-world relevance**: Connecting classroom learning to real-world issues makes education more meaningful and applicable to students' lives.

6. **Personalized learning**: Students can tailor projects to their interests and strengths, promoting ownership and agency in their learning journey.

7. **Promotes lifelong learning**: By fostering curiosity and the ability to tackle complex problems, authentic project-based learning encourages students to continue learning beyond the classroom.

Components of Authentic Project based learning

There are 5 components of Authentic Project based learning as follows:
(Berkman, 2024; Madoyan, 2025)

1. **Real-world problems:** Projects should address relevant issues or challenges that people face in their communities or the wider world.

2. **Authentic audience:** Students should present their work to a genuine audience, like community members or experts in the field.

3. **Multiple perspectives**: Projects should encourage students to consider different viewpoints and complexities surrounding a topic.

4. **Active research and investigation**: Students should actively gather information and conduct research to inform their projects.

5. **Meaningful reflection**: Students should reflect on their learning process, challenges, and successes throughout the project.

Clark (2017) states that there are four major components of Authentic Project based learning.

Firstly, working in groups is a key factor for a project to be considered Authentic Project based learning. Students must work together to solve a problem. Bender (2012) explains that when students work in collaborative groups they learn through social context and interaction with their peers. Students also increase their capacity and learning through shared cognition.

Secondly, student choice and voice are the second elements of Authentic Project based learning. Hickey (2014) states that students must be motivated to be independent learners, having a voice in a project, a natural motivator, and feeling more in control of their learning. In that situation, however, there needs to be a clear effort to allow students to have a meaningful choice and voice in major aspects of the project.

Thirdly, technology can be an important component to PBL that is recommended to be present in the project creation. Utilizing technology is a 21st century skill that is important to develop. Whether it is from using the Internet to research and gather information, using a video or image editing software, or creating blogs for reflection or collaboration, technology should be emphasized in the project.

Fourthly, projects are presented publicly in some way. This does not mean the project is presented solely to the rest of the class, it means that it is presented to the audience in which the problem and solution impacts. This could be a particular group within or outside of the school. Building a project and solution for an outside group and presenting it publicly also drives student motivation, where students feel a greater sense of ownership and responsibility.

Steps of Authentic Project based learning approach

Nuntasukan and Yuthong (2014) articulated six steps in project based learning management as given below:

Step 1 Preparation: The scope of the project and the sources of information are explained to the students by the instructors so that the students are motivated to seek the topics of the project.

Step 2 Topic definition and selection: The students identify the topics for the project-based learning by studying the possibilities of each topic for selection and submit the same for the approval of the faculty supervisor.

Step 3 Project layout: students study the project's scope and search for the sources of information and plan the project implementation in a group by agreeing on the tasks to be performed, intense roles and responsibilities of the group members and the duration of the project.

Step 4 Project implementation: The group members then carry out their tasks and responsibilities by mutually collaborating and sharing their knowledge while exchanging experiences under the guidance of the faculty supervisor

Step 5 On completing the assigned tasks, the group collates their findings, prepares a report, and presents the project with the other groups.

Step 6 Evaluation: The faculty supervisor evaluates the projects by applying varying assessment tools such as understanding the project, process of executing the project and attainment of learning outcomes.

Role of teachers and students in Authentic Project based learning

Role of teachers: The teacher's role in Authentic Project based learning is that of a facilitator. They do not relinquish control of the classroom or student learning, but rather develop an atmosphere of shared responsibility. The teacher must structure the proposed question/issue to direct the student's learning toward content-based materials. The teacher must regulate student success with intermittent, transitional goals to ensure student projects remain focused and students have a deep understanding of the concepts being investigated. The students are held accountable to these goals through ongoing feedback and assessments. The ongoing assessment and feedback are essential to ensure the student stays within the scope of the driving question and the core standards the

project is trying to unpack. The teacher uses the assessments to guide the inquiry process and ensure the students have learned the required content. Once the project is finished, the teacher evaluates the finished product and the learning that it demonstrates. (Beckett, 2019)

How to guide students in Authentic Project based learning: Herrmann (2021) states that there are six ways to guide students to do more authentic work in Project based learning as follows:

1. Support students to take on authentic roles, Project based learning has the potential to position students in other real and meaningful roles. Students could take on the role of a mathematician and create mathematical models to make predictions, or an investigative journalist to identify and vet sources as they piece together a puzzle and communicate a story

2. Promote student exploration of problems and questions, a complex problem, driving question, interesting puzzle, or perplexing dilemma drives Project based learning. When considering the authentic work of a historian, students may explore many problems.

3. Ensuring that students create authentic products, Project based learning empowers students to design, create, and produce which develops their knowledge and skills along the way. A typical Project based learning project may culminate in a presentation as a final product. When students take on the authentic practices of a scientist, they can produce an authentic scientific investigation with real scientific findings. As photojournalists, students can produce a photo essay that captures striking images that convey complex messages. As political activists, students can produce a real policy proposal for their student government.

4. Encourage students to make personal connections, Project based learning has the potential to allow them to bring their full selves to their work. Projects can create explicit opportunities for students to draw on their experiences, perspectives, and values. Even when students are exploring the same essential question and driving toward a common set of broad learning goals. Thus, students may choose a specific topic to explore or product to create, or use their project experience to examine their own beliefs and values on a particular issue or question. For example, in an English language arts

project focused on the creative use of figurative language, students may produce written works that are inspired by their own experiences and interests.

1. Promote impacts on authentic audiences, in a Project based learning driven class, students can create products that have real impacts on real communities.

2. Clarify the elements of the project, trying these various project aspects together can help students assess how well connected they are. How aligned are project goals with the question that students are exploring, the role that they are taking on, and the product that they are producing.

Role of students: The student's role is to ask questions, build knowledge, and determine a real-world solution to the issue/question presented. Students must collaborate, expanding their active listening skills and requiring them to engage in intelligent, focused communication, therefore allowing them to think rationally about how to solve problems. Authentic Project based learning forces students to take ownership of their success. (Bender, 2012)

Assessment of Authentic Project based learning

Assessment in Authentic Project based learning composed of assessment of student's ability to apply knowledge and skills to real-world situations (University of Bath, 2024). Additionally, Assessment of Authentic Project based learning can incorporate technology, for example, students' documentaries, podcasts, websites, digital music compositions, on-line journals, e-mail exchanges, and video conferences in Assessment, too (Heidi Hayes Jacobs (2010).

Basic methods of Assessment of Authentic Project based learning

Lewy (1996) and Fitriati (2016) state basic methods of assessment that can be employed to assess students' outcome through Authentic Project based learning approach as follows:

(1) Formative assessment: Formative assessments refer to tasks given to students throughout a unit of work to check progress and to help finetune the teaching approaches and learning arrangements for the students so that they remain on target.

Some tasks are Written and verbal work assignment, rubrics and feedback, and portfolio. Observation is a type of Formative assessment: Teacher may see a student synthesizing the information from the different resources or playing with experiments to find the solution for the project. Then teachers may offer some advises when students are facing difficulties. To be able to monitor students' progress, teachers can use multiple and systematic observations as one of the components of the assessment process.

(2) Summative Assessment: Summative assessments refer to task given to measures and records overall achievement in systematic manner. The evaluation approach is based on tasks or test. Although this method is typically used in traditional approach, applying it in project-based approach is also needed, as concerning that teachers also need to know about students' understanding of the work covered and how well they have learned the planned outcomes. Teachers may ask students several questions and the students provide the correct answer.

(3) Combination of formative assessments and summative assessment: A combination of formative assessments can be used in summative evaluation. Often a combination of formative (informal) assessments is more reliable about students' performance than summative (formal) assessments. Lewy (1996) proposed that assessment be based on a set of tasks, including oral responses, writing essays, performing data manipulations with technology-enhanced equipment, and selecting an alternative from a list of possible options. In the mid-nineties, multiple choice items and standardized test scores have been supplemented with new methods, such as portfolios, hands-on, performance assessment and self-assessment. Focusing on assessment that is based on projects carried out by students, students' assessment is closely related to alternative assessment. Projects are becoming an acceptable means for both teaching and assessment. Being a schoolwide endeavor, a project performance can serve to assess not only the individual student or student team, but also the school that designed and carried out the project. Formative and summative evaluations should provide information for project planning, improvement, and accountability Dori, 2003). As example of a combination of formative assessments and summative assessment is Assessing the

Project: Teachers can assess the project itself. Additionally, in all teaching, reflecting, and noting what is effective and what can be enhanced for next time leads to best practices. Having colleagues with whom to discuss the projects strengths, areas for strengthening, and future often produces best insights and plans. (Stirling, 2022)

Almy Education (2024) states some ways to assess Authentic Project based learning as follows:

1. Use formative and summative assessments: Formative assessments are conducted during the learning process, while summative assessments are completed after learning has occurred.

2. Provide clear goals and criteria: Define what success looks like for the project.

3. Use rubrics: Students can use rubrics to self-assess throughout the project. Teachers can also provide rubrics or checklists to each team.

4. Provide timely feedback: Provide actionable feedback to students.

5. Use multiple sources and perspectives: Consider multiple perspectives when assessing the project.

6. Use portfolios: Students can add their project outcomes to a portfolio throughout the course.

7. Use teacher narratives: Teachers can observe students and make notes of their accomplishments.

8. Use informal assessments: Teachers can listen to students talking and provide feedback to keep them on track.

9. Use formal assessments: Teachers can use exit tickets or checklists to assess students.

Advantages of Authentic Project based learning

Zimmerman (2012) summarizes the advantages of Authentic Project based Learning from the students' perspective: (1) project is relevant to student's life and personally meaningful; (2) project is an exploration into an authentic problem; (3) in project, students are having a voice in selecting the problem; (4) project is a learning strategy that encourages students to monitor their own progress; (5) project fulfills the

curriculum objectives; (6) project begins with driving question, and (7) project encourages students to revise their research and to reflect on their progress.

Disadvantages of Authentic Project based learning

Shamar (2022) presents the disadvantages of Authentic Project based learning as follows:

1. Time Consuming. An effective project-based learning design requires a large
2. Amount of time as it may take time to collect materials and information about the projects.
3. Lack of Interest. Sometimes it may happen that students feel a lack of interest in their project subject which might distract their minds from the project.
4. Needs a Dedicated & Hardworking Staff. To be honest, not teachers can be hard-working and completely dedicated to their students. But, the PBL approach really needs hardworking staff dedicated to the projects of their students.
5. Uncomfortable for Differently Abled Students. The project-based learning approach might be uncomfortable for differently abled students. They sometimes may not feel encouraged to finish their projects in the given period.

Differences between Project based learning and Authentic Project based learning

The main difference between Project based learning and Authentic Project based learning is that Authentic Project based learning allows students to address real-world challenges that are relevant to them (Te Kete Ipurangi, TKI, 2024).

Some other difference between Project based learning and Authentic Project based learning: (1) Purpose: In Authentic Project based learning, students have a clear "why" for their learning from the beginning, and they apply their learning throughout the unit; (2) Engagement: Authentic Project based learning can motivate students and improve the quality of their work; (3) Student choice: In Authentic Project based learning, students can choose an area of interest that is personally relevant to them, which can lead to higher engagement; and (4) Community connection: Authentic Project based learning can help connect with community members, alumni, and older students.

New Tech Work (2025) states that While Project-based learning (PBL) generally refers to students working on a project to learn content, Authentic project-based learning takes it a step further by ensuring the project directly addresses real-world problems, engages with a genuine audience, and produces a tangible outcome that has relevance beyond the classroom, making the learning experience more meaningful and connected to real-life situations; essentially, Authentic Project based learning emphasizes the realness and impact of the project beyond just completing a task.

Related research about Authentic Project based learning

Ayon (2021) investigated the extent to which Authentic Project based learning engaged students and hence provided a valid assessment of students' genuine performance and proficiency during online learning in EFL communication and Intensive English courses. Using a mixed methods design, the researchers employed the self-completion questionnaires and focus group interviews to collect their data from their 100-purposively – selected participants. The findings showed promising results in terms of engaging students in the learning process, curbing online cheating, and ensuring reliable and valid assessments of students' performance. These results were significant in providing a pedagogical approach to be adopted by EFL educators during and after the pandemic.

McKibben and Murphy (2021) conducted a quasi-experimental study to examine the effect of project authenticity on Project based learning. Agriculture students in Texas were sampled and assigned as a cohort to one of four treatment groups (N = 219). Fourteen cohort groups (class periods) were identified across five sites. Each cohort was randomly assigned to one of four project types to learn about electricity. The four project types varied in their degree of project authenticity. Analysis of covariance (ANCOVA) was used to test the effects of project authenticity on change scores in a pretest-posttest quasi-experimental design. Learning varied on authenticity. A test of project type groups yielded statistically significant results ($p < .025$) with small effect size ($\omega 2 = .04$). Pairwise comparisons revealed no differences between the most and least authentic projects but did reveal statistically significant differences between the two projects with medium levels of authenticity, and the other two (i.e., least authentic, and most authentic). The relationship

between learning and authenticity was not linear. We recommend that teachers and curriculum designers deliberately consider the importance of authenticity when designing project based learning opportunities for students.

Beier et al. (2018) studied the effect of authentic project-based learning on attitudes and career aspirations in STEM. The researcher examined the effect of engaging in at least one authentic, project-based course during the first four semesters of college on student STEM attitudes and career aspirations in a quasi-experimental study with a sample of (N = 492) natural science and engineering students. STEM self-efficacy and subjective task value variables (STEM attainment, intrinsic and utility value of STEM courses, and relative cost associated with engaging in STEM courses) were examined as mediators of the relationship between classroom project-based experiences and STEM career aspirations. Gender and underrepresented minority status were also examined. It was found that engaging in at least one project-based course during the first four semesters affected student perceptions of STEM skills, perceptions of the utility value of participating in STEM courses, and STEM career aspirations. Furthermore, it was found that the effect of project-based courses on STEM career aspirations was mediated by STEM skills and perceptions of course utility. The effect of Authentic Project based learning was not moderated by race or gender. It was highlighted areas of future research and the promise of Authentic Project based learning for engaging students in STEM professions.

Sastrikirana (2015) developed the Project based assessment model designed as formative, authentic, and holistic assessment. It was found that the proposed assessment model could be used when teachers think it was appropriate with the English learning goals. It also became an alternative model other than the one in curriculum 2013.

Koparan and Guven (2014) examined the effect of Authentic Project based learning on 8th grade students' statistical literacy levels. A performance test was developed for this study. After processing between the achievements of intervention group and control group there was a substantial difference statistically in favor of the intervention group. The results of the study revealed that the Authentic Project based learning increased students' statistical literacy levels in the intervention group.

It is said that Authentic Project-Based Learning (APBL) is a teaching approach that engages students in real-world problems to apply their knowledge and skills, fostering meaningful learning experiences. The process involves six key steps: preparation, topic selection, project planning, implementation, presentation, and evaluation. By working collaboratively and critically engaging with real-world contexts, students not only enhance their academic abilities but also develop essential skills like problem-solving, teamwork, and communication. This approach ultimately helps students become proactive change-makers in their communities. In Authentic Project-Based Learning (APBL), teachers act as facilitators, guiding students through structured inquiries, offering feedback, and assessing progress to ensure learning goals are met. Students take an active role in asking questions, collaborating, and solving real-world problems, ultimately taking ownership of their learning. This approach fosters critical thinking, collaboration, and practical problem-solving, preparing students for real-world challenges. The assessment of Authentic Project-Based Learning (APBL) involves diverse methods to evaluate students' ability to apply their knowledge in real-world contexts. This includes formative assessments, summative evaluations, and combination of formative assessment and summative assessment. By combining both informal and formal assessment strategies, teachers can effectively track students' progress, while also encouraging self-reflection and improvement.

Summary

The researcher studied related literature as follows: (1) Statistics in everyday life Course covered contents and objectives of the course, (2) Project based learning covered definition, theoretical background, procedure, and characteristic of Project based learning, and (3) Authentic Project based learning covered definition, major elements, how to guide students, roles of teachers and students, advantage, and disadvantage, and assessment of Authentic Project based learning. For this study, the researcher selected to apply the 5 steps of Authentic Project based learning with the participants, using Learning achievements scores test to assess the students' knowledge and implementing the project skills evaluation form to assess students' skill to real-world situations.

CHAPTER III
RESEARCH METHODOLOGY

The objectives of this study were as follows: (1) to develop Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university; (2) to compare Learning achievement scores of Undergraduate students between before and after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach; and (3) to compare between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach. For this chapter, the research methodology was presented focusing on research design, population and sample, research instrument, data collecting method and data analysis.

Research Design

This research design is One-group pretest-posttest design. The researcher used Pretest to measure students' previous knowledge then using Learning activities through Authentic Project based learning approach for Undergraduate students in a private university as a treatment and after that used Posttest to measure students' post knowledge (Pubrica-academy, 2022).

Table 1: Research Design

O_1	X	O_2
Pretest	Treatment	Posttest
	(Independent Variable)	(Dependent Variable)
	Learning activities through Authentic project-based learning	Learning Achievement score

The procedures of experimental research that used a group pretest and 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.

Context of the Study

The location of the study was a private university in Thailand. This study focused on the effects of Achievement and Satisfaction of the 1st year students of a private university who registered the Course of 100 402 Statistics in Everyday Life in the 1st semester of Academic year 2023. In the Statistics in Everyday Life course, researchers focused on the "Probability" topic to teach and conduct activities through Authentic Project-Based Learning.

Population and Sample

Population

The population of the study consisted of the first-year students from various majors at a private university who had enrolled in the course Statistics in Everyday Life in the first semester of Academic year 2023. The total number of students who registered for the course was estimated to be between 250 and 300, distributed across 5 to 6 groups.

Sample

The sample of the study was a group of the first-year students in different majors of a private university who enrolled on Statistics in everyday life Course in the 1st semester of Academic year 2023, there were 274. 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 major.

Variables

***Independent variable*:** Application of Learning activities on Statistics in everyday life Course through Authentic Project based learning approach.

***Dependent Variable*:**

1) Learning Achievement scores
2) Project skills scores

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 learning achievement test, and (3) an evaluation form of the project skills. The details of each instrument were as follows:

1. **Lesson plans of Learning activities on Statistics in everyday life Course through Authentic Project based learning approach**

The research created Lesson plans of Learning activities on Statistics in everyday life Course through Authentic Project-based learning approach as follows:

1.1 Studied many books, journals, and documents about learning theories, related research, and documents about Learning activities on Statistics in everyday life Course through Authentic Project based learning approach.

1.2 Identified the learning objectives: The researcher identified the learning objectives for the lesson plans. Learning objectives described what the students acquired or were able to do after the learning experience rather than what the students were exposed to do during the instruction. Typically, it was written in a language that was easily understood by students and clearly related to the program learning outcomes.

1.3 Planned the specific learning activities: For planning learning activities, the researcher considered the types of activities that students needed to engage to develop the skills and knowledge required to demonstrate effective learning in the course. Learning activities were directly related to the learning objectives of the course, and provided experiences that enabled students to engage, practice, and gain feedback on specific progress towards those objectives.

As creating learning activities, the researcher estimated how much time that the researcher spent on each, built in time for extended explanation or discussion, but also prepared to move on quickly to different applications or problems, and identified strategies that checked for understanding.

1.4 Planned to assess student understanding

The researcher planned to provide opportunities for students to demonstrate and practice the knowledge and skills articulated in the learning objectives.

1.5 Planned to sequence the lesson plan in an engaging and meaningful manner

Lesson plan 1:

Project Planning: Students took pretests; the students studied basic concepts of Probabilities. The scope of the project and the sources of information were explained to the students by the instructors so that the students were motivated to seek the topics of the project.

Topic definition and selection: The students identified the topics for the project-based learning by studying the possibilities of each topic for selection and submitted the same for the approval of the faculty supervisors.

Lesson plan 2:

Project Lunch: Student studied about how to Calculating Probability, students studied the project's scope and searched for the sources of information and planned the project implementation in a group by agreeing on the tasks to be performed, intended roles and responsibilities of the group members and the duration of the project.

Lesson plan 3

Project implementation: Students studied more on Multiplication Rules and Conditional Probability then the group members then carried out their tasks and were responsibilities by mutually collaborating and sharing their knowledge while exchanging experiences under the guidance of the faculty supervisors.

Lesson plan 4

Project Conclusion: Student studied on Bayes' Rule and Counting Rules **On completing the assigned tasks,** the group collates their findings, prepares a report, and presents the project with the other groups.

Lesson plan 5

Project Debrief: The instructor evaluated the projects by applying varying assessment tools such as understanding the project, process of executing the project and learning outcomes

1.1 Created a realistic timeline

The researcher listed prioritized learning objectives to make decisions on the spot and adjust lesson plans as needed.

1.2 Planned for a lesson closure

The researcher planned to close Learning activities by asking some students to reflect on what worked well and why, and what the researcher could have done differently. Identifying successful and less successful organization of class time and activities would make it easier to adjust to the contingencies of the classroom. If needed, revised the lesson plan.

Table 2: **Time table of Research Experiment Planning**

Week	***Day***	***Time***	***Duration***	***Activities***
1	Thursday	10.00-11.30	10.00-11.00	Pretest (30 items via Google form).
			11.00-11.30	Orientation about Project based learning: separate students into groups, 3 people/group.
	Friday	08.00-09.30	08.00-09.00	*Lesson plan 1*: Project Planning
			09.00-09.30	Student brainstorming about a project topic: seeking a problem or interesting thing that happened in their everyday life, how statistics and probabilities can help it and finalize it.
2	Thursday	10.00-11.30	10.00-11.00	*Lesson plan 2*: Project Launch
			11.00-11.30	Project progress: discussing with the teacher about project objective and project planning.
	Friday	08.00-09.30	08.00-09.00	*Lesson plan 3*:Project implementation
			09.00-09.30	Project progress: discuss more on planning that student set.
3	Thursday	10.00-11.30	10.00-11.00	*Lesson plan 3*: Project implementation
			11.00-11.30	Project progress: teacher observe on their project, their collaborate and guide them (if have any student have problem or

				struck on their project)
	Friday	08.00-09.30	08.00-09.00	*Lesson plan 4*: Project Conclusion
			09.00-09.30	Project due date: Paper project and getting project feedback for each group (Final version)
4	Thursday	10.00-11.30	10.00-11.00	*Lesson plan 4*: Project Conclusion
			11.00-11.30	Project presentation (assess them how students apply the knowledge to adept in their project and improve on their project after getting feedback from teacher.)
	Friday	08.00-09.30	08.00-09.00	*Lesson plan 4*: Project Conclusion
			09.00-09.30	Project presentation (assess them how students apply the knowledge to adept in their project and improve on their project after getting feedback from teacher.)
5	Thursday	10.00-11.30	10.00-11.30	*Lesson plan 5* : Project Debrief
	Friday	08.00-09.30	08.00-09.00	Posttest (30 items via Google form)
			09.00-09.30	Questionnaires Via Google form

1.8 Examined Validity

To examine the Lesson plans validity, all research instruments were validated by three specialists in the field to determine the appropriateness of the Lesson plans by using Lesson plan Evaluation Form with the Five points Likert scale. The validity value was at the high level ($\bar{X}$=4.38, S.D.=0.35). Then the researcher improved the Lesson plan as the opinions of the three specialists.

1.9 Tried out Lesson plans

The researcher tried out some Lesson plans with some first-year students who were not Sample and improved the Lesson plans after trying out the Lesson plans.

2. Learning achievement Test

The Learning achievement Test for this research was 30 items of Multiple-Choice Questions. The researcher wrote Multiple-Choice Questions of the Learning achievement Test based on The Revised Bloom's Taxonomy in the Test as follows:

2.1 Studied many books, journals, and documents about Multiple-Choice Questions based on The Revised Bloom's Taxonomy.

2.2 Considered all the Learning objectives in the Lesson plans.

2.3 Before writing items, the researcher created a test blueprint to ensure that it covered the appropriate topics and objectives through different levels of Bloom's Taxonomy. The blueprint identified the objectives and skills that were to be tested and the relative weight on the test given to each.

2.4 Began writing items well ahead of the time when they were used; allow time for revision.

2.5 Matched items to intended objectives at the proper difficulty level and Discrimination to provide a valid measure of the instructional objectives.

2.6 Examined Learning achievement test validity, it was validated by three specialists in the field to determine the appropriateness of language using an evaluation form—The Item-Objective Congruence Index (IOC). The items with score higher than or equal to 0.5 were selected and those with the score less than 0.5 are revised according to the suggestions. For this Learning achievement test, all items were during 0.2 to 0.8,

all items of Learning achievement test were selected.

2.7 Examined Difficulty value, discriminatory power value, and the reliability value, it was determined in the pilot study phase with a group of students who were not the participants of this study. The difficulty value of each item of the Learning Achievement test was between .20-.80 and the discriminatory power value of each item of the Learning Achievement test were upper than .20. Additionally, the Reliability value of the Learning Achievement test was analyzed by using Cronbach's alpha coefficient, the Reliability value was 0.74 The Cronbach's alpha value was higher than 0.70 which means the Learning Achievement test was strong enough to be employed in this study.

2.8 Prepared the complete Learning Achievement test for the experiment of Applying Learning activities of Authentic Project based learning with the target students.

3. Project skills evaluation form

3.1 To study many books, journals, related research, and documents about project skills evaluation form of Authentic project-based learning approach.

3.2 To create the test blueprints of a project skills evaluation form to ensure that it was covered the appropriate topics on project skills.

3.3 To create the project skills evaluation form. The project skills evaluation form was designed by the researcher to examine the students' Ability to do project work during the learning activities of Authentic project-based learning approach. It consisted of assessing students' Ability to do project work through a Project based learning approach as follows: the construction project, and the real-world project.

3.4 To examine the validity value of the project skills evaluation form, it was validated by three specialists in the field to determine the appropriateness of the project skills evaluation form by using an evaluation form of Likert - 5 level. The validity value of the project skills evaluation form was 4.66 Then the project skills evaluation form was revised according to the suggestions of the three specialists.

3.5 To examine the reliability value of the project skills evaluation from reliability,

it was determined in the pilot study phase with a group of students who were not the participants of this study. The data were analyzed using the Coefficient Cronbach's alpha. The reliability value of the project skills evaluation form was 0.79 The Cronbach's alpha value was higher than 0.70 which means the project skills evaluation form was strong enough to be employed in this study.

Data collection

Data collection was composed with:

1. Using a learning achievement test with the undergraduate students before applying Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university
2. Applying Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university for 5 periods or (7.5 hours).
3. Using a learning achievement test with the undergraduate students after applying Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university
4. Using an evaluation form for the project skills after applying Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university.

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

3. The qualitative data from the second part of the project skills evaluation form was analyzed by using the content analysis as the following procedures: 1) reviewed overall of the data, 2) categorized into three sections, 3) placed items into each section, and 4) summarized and analyzed the results. Then the data was discussed descriptively with a logical explanation.

Ethical Considerations

For this study all students were informed of the scope of objectives of the study during the first day of experiment. They perceived these activities and more understanding in the interim of knowledge of "Probability" topics of the Statistics in everyday life course and their information in this course they were all secure.

Summary

In Chapter 3, the researcher presented Research design, Respondents, Population and Sample, Variables, Instrumentation covered Lesson plans of Learning activities on Statistics in everyday life Course through Authentic Project-based learning approach, Learning achievement Test, and project skills evaluation form, Data collection, Data Analysis both Quantitative data and Qualitative data, as well as Ethical Considerations.

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CHAPTER IV
RESEARCH FINDING

The objectives of this study were as follows: (1) to develop Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university; (2) to compare Learning achievement scores of Undergraduate students between before and after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach; and (3) to compare between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach. The researcher proposed the results of this study as follows:

4.1 Developing Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university.

Table 3: The components of Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university.

Topic	Activities
Lesson Plan 1: Project Planning	Students are seeking to identify potential problems that may arise in their future careers and exploring how statistics can assist in addressing or solving these issues.
Lesson Plan 2: Project Launch	Students are engaging in discussions with their teacher and group members to finalize their project topic.
Lesson Plan 3: Project Implementation	Students are brainstorming further on their project plan and consulting with their teacher to address any questions they may have.

Lesson Plan 4: Project Conclusion	Students are meeting to prepare for their final oral presentations, and some groups have already completed their project presentations.
Lesson Plan 5: Project Debrief	Projects oral presentations.

Table 3 showed: The components of Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university, The activities involved both those that students participated in and authentic activities that students selected and undertook for their projects, which are related to their future occupations. And the examples of project outputs of learning activities were Empire Dress, Kayak Rental business service, Stationary Store, AIDS prevention, Fruit Drinks, Popular Airlines, Condo Bar, Chaewma Cafe and Coronary artery Disease

Table 4: 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.

Lesson Plan	**The 1^{st}Expert**	**The 2^{nd}Expert**	**The 3^{rd}Expert**	**S.D.**	$\overline{\mathbf{X}}$	**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 5: It was showed that 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 evaluated by the three experts was at the high level ($\overline{X}$=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 ($\overline{X}$=4.33, S.D.=0.42, $\overline{X}$=4.33, S.D.=0.29, $\overline{X}$=4.44,S.D.=0.45, $\overline{X}$=4.45, S.D.=0.27, $\overline{X}$=4.33, S.D.=0.36)

Table 5: The comparison of Pre-test and Post-test scores of Learning achievement of Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university.

	N	**$\overline{X}$**	**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 5 showed that Post-test score of Learning achievement ($\overline{X}$=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 ($\overline{X}$=10.53, S.D.=5.60) at the level of .05. (t=-27.4). The hypothesis was accepted.

Table 6: The Level of project skills 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 6 Showed that the level of project skills of Undergraduate students during participation in Learning activities on 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 project skills were 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 7: The comparison between the Scores of Project skills 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	97	35.00	0.00	21.47*	96	0.000
Student Score	97	43.36	3.04			

P<.05

Table 7 showed that the scores of Project skills 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).

CHAPTER V
SUMMARY, RECOMMENDATION AND CONCLUSION

The objectives of this study were as follows: (1) to develop Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university; (2) to compare Learning achievement scores of Undergraduate students between before and after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach; and (3) to compare between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach. The researcher proposed summary, findings, discussion, recommendation, and conclusion of this study as follows:

Summary of the study

The objectives of this study were as follows: (1) to develop Learning activities on Statistics in everyday life Course through Authentic Project based learning approach for Undergraduate students in a private university; (2) to compare Learning achievement scores of Undergraduate students between before and after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach; and (3) to compare between the scores of Project skills and the criteria 70% of Undergraduate students after participation Learning activities on Statistics in everyday life Course through Authentic Project based learning approach. The sample of this study was 97 undergraduate students of a class of Statistics in everyday life Course in the 1st semester of Academic year 2023 by using Cluster sampling. The research instrument created by the researcher included five lesson plans of Learning activities on Statistics in everyday life Course through Authentic Project based learning approach evaluated by the three experts at the high level ($\overline{X}$=4.38, S.D.=0.35), the Learning achievement test with reliability value of 0.75 by using Coefficient of Cronbach's alpha, and the project skills of Undergraduate students after participation Learning activity with reliability value of

0.79 by using Coefficient of Cronbach's alpha. The hypothesis of this study was as follows: the Post-test scores of Undergraduate students after participation learning activities on Statistics in everyday life Course through Authentic Project based learning approach is higher than the Pre-test scores.

Finding

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 ($\overline{X}$= 4.38, S.D.=0.35).

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

Lastly, the scores of Project skills of Undergraduate students after participating in Learning activities on Statistics in everyday life Course through Authentic Project based learning approach ($\overline{X}$=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.

Discussion

The researcher discussed the research results as follows:

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 ($\overline{X}$=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.

2. It was found that the post-test score of Learning achievement ($\overline{X}$= 24.40, S.D.= 3.43) of Undergraduate students after participation learning activities on Statistics in everyday life Course through Authentic Project based learning approach was significantly higher than the pre-test score of Learning achievement ($\overline{X}$= 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 the researcher implemented learning activities on Statistics in everyday life Course through Authentic Project based learning approach. Polman and Boardman (2022) stated that Authentic Project-Based Learning is a teaching method where students actively engage in real-world problems and challenges

through projects that are directly relevant to their lives or have a tangible impact on their community, allowing them to apply knowledge and develop skills in a meaningful, authentic way, rather than just completing hypothetical exercises, and students working on projects that feel real and impactful to them, mirroring real-world situations. Additionally, New Tech Network (2025) explained the importance of Authentic Project-Based Learning as follows: (1) increased engagement: students are more motivated when they can see the practical application of their learning and feel a sense of ownership over their projects; (2) deeper understanding: by actively solving real-world problems, students develop a more profound comprehension of concepts rather than just memorizing facts; (3) develops critical thinking skills: Authentic based learning often involve complex problems with multiple solutions, requiring students to analyze, evaluate, and creatively approach challenges; (4) collaboration and communication skills: working on projects with peers encourages collaboration, communication, and the ability to work effectively as a team;(5) real-world relevance: connecting classroom learning to real-world issues makes education more meaningful and applicable to students' lives; (6) personalized learning: students can tailor projects to their interests and strengths, promoting ownership and agency in their learning journey; (7) promotes lifelong learning: by fostering curiosity and the ability to tackle complex problems, authentic project-based learning encourages students to continue learning beyond the classroom. Hence, after the researcher implemented learning activities on Statistics in everyday life Course through Authentic Project based learning approach, the post-test score of Learning achievement was significantly higher than the pre-test score of Learning achievement. The result of this study was related to the prior research: Koparan and Guven (2014) examined the effect of Authentic Project based learning on 8th grade students' statistical literacy levels. A performance test was developed for this study. After processing between the achievements of intervention group and control group there was a substantial difference statistically in favor of the intervention group. The results of the study revealed that the Authentic Project based learning increased students' statistical literacy levels in the intervention group. Additionally, Yildirim and Ortak (2021)

explored the effects of Authentic Learning Approach on Academic Achievement and Attitudes in Social Studies Course. It was found that the academic achievement levels of the students in the experimental and control groups in the social studies course increased and differed significantly compared to the pre-experimental process.

Earle (2020) who states that Authentic Project-based learning 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.

3. It was found that the scores of Project skills of Undergraduate students after participating in Learning activities on Statistics in everyday life Course through Authentic Project based learning approach ($\overline{X}$=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) states that Projects within an academic discipline should be central to student learning and drive this learning though 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 to 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.

Moreover, the researcher acted as facilitators, guiding students through structured inquiries, offering feedback, and assessing progress to ensure learning goals were met. Students took an active role in asking questions, collaborating, and solving real-world problems, ultimately taking ownership of their learning. Roles of the researcher were related to How to guide students of Herrmann (2021) who stated that there were six ways to guide students to do more authentic work in Authentic Project based learning as follows: (1) Supported students to take on authentic roles, Authentic Project based learning had the potential to position students in other real and meaningful roles, students could take on the role of a mathematician and created mathematical models to make predictions, or an investigative journalist to identify and vet sources as they pieced together a puzzle and communicate a story; (2) Promoted student exploration of problems and questions, a complex problem, driving question, interesting puzzle, or perplexing dilemma drives Project based learning when considering the authentic work of a historian, students might explore many problems; (3) Ensuring that students created authentic products, Authentic Project based learning empowered students to design, created, and produced which developed their knowledge and skills along the way, a typical Project based learning project might culminate in a presentation as a final product when students took on the authentic practices of a scientist, they could produce an authentic scientific investigation with real scientific findings, as photojournalists, students could produce a photo essay that captured striking images that conveyed complex messages, as political activists, students could produce a real policy proposal for their student government; (4) Encourage students to make personal connections, Authentic Project based learning had the potential to allow them to bring their full selves to their work, projects could create explicit opportunities for students to draw on their experiences, perspectives, and values, even when students were exploring the same essential question and driving toward a common set of broad learning goals, thus, students might choose a specific topic to explore or product to create, or used their project experience to examine their own beliefs and values on a particular issue or question, for example, in a mathematics project focused on the creative used of

measurement, students might produce measurement works that were inspired by their own experiences and interests; (5) Promote impacts on authentic audiences, in a Project based learning driven class, students can create products that have real impacts on real communities; and (6) Clarify the elements of the project, trying these various project aspects together could help students assess how well connected they were, how aligned were project goals with the question that students were exploring, the role that they were taking on, and the product that they were producing. Due to the roles of researcher to guide the students, after the researcher implemented learning activities on Statistics in everyday life Course through Authentic Project based learning approach, the score of project skills was significantly higher than the criteria of 70%.

Limitations

The limitations of this study were students who registered for Statistic in everyday life courses that researchers focus on Probability topics of undergraduate at a private university which may not fully represent the larger population. As a result, the findings may not be generalizable to other populations, such as students from different universities or non-student groups. Additionally, the study relied on self-reported data, which may introduce biases such as social desirability bias or inaccurate recall, potentially affecting the validity of the results.

Recommendation for students

This research proposes recommendations for students as follows:

Students are encouraged to embrace authentic project-based learning, which involves solving real-world problems using the concepts and skills learned in class. This approach helps students see the practical value of their studies, making the material more relevant and engaging. Working collaboratively in teams is also key, as it enhances critical thinking and teamwork skills that are essential for both academic and professional success. Additionally, students should take ownership of their learning by exploring solutions, seeking additional resources, and applying their knowledge to complete

projects. This fosters independence and deeper learning. After completing a project, students should reflect on their experiences and the knowledge gained, which helps solidify their learning and identify areas for improvement. Finally, while independence is encouraged, students should actively seek feedback and guidance from instructors throughout the process to ensure they are on the right track and make necessary adjustments. By fully engaging in authentic project-based learning, students can develop practical skills, enhance problem-solving abilities, and better prepare for future academic and professional challenges.

Recommendation 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 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.

Recommendation for Institutions

This research proposes recommendations for institution as follows:

Institutions should prioritize the integration of authentic project-based learning (PBL) into their educational programs, recognizing its effectiveness in helping students develop critical, real-world skills. To facilitate this approach, institutions should provide necessary resources, including access to industry professionals, real-world case studies, and tools that promote collaboration and innovation. Faculty members should also receive training to effectively guide students through PBL, ensuring they are able to balance student autonomy with structured support.

Regarding student assessment, institutions need to move beyond traditional testing methods and implement more holistic evaluation techniques that reflect the skills developed through PBL. Assessment should focus not only on the final project outcome but also on the process, such as teamwork, problem-solving, research, and application of knowledge. Rubrics that assess a wide range of competencies—including communication, creativity, and reflective thinking—should be developed to provide a comprehensive view of student achievement. Additionally, incorporating peer evaluations and self-assessments can offer valuable insights into individual contributions and growth.

Institutions should also emphasize continuous feedback throughout the project, allowing students to receive guidance and improve their work progressively. By adopting these strategies, institutions can create an environment that supports authentic project-based learning while establishing assessment methods that more accurately reflect students' achievements and overall development.

Recommendation for Further Study

This research proposes four recommendations for further study as follows:

Firstly, the application of an Authentic project based learning 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 Authentic project based learning 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.

Conclusion

In conclusion, the Authentic Project-Based Learning approach was an effective method for enhancing undergraduate students' learning achievement in a Statistics in Everyday Life course. The well-structured learning activities, including project planning, launch, implementation, conclusion, and debriefing, were highly rated by experts, indicating their relevance and quality. The significant improvement in students' learning achievement, as evidenced by the higher post-test scores, confirmed that this approach successfully enhanced their understanding of the course content. Furthermore, the substantial increase in students' skills to carry out project work, surpassing the 70% criteria, highlighted the practical skills developed through the approach. These findings were consistent with previous research that emphasized the positive impact of projects based learning on students' academic performance and practical abilities. According to Thomas (2000), projects based learning enhanced students' problem-solving skills, critical thinking, and application of knowledge in real-world contexts. Additionally, studies by Bell (2010) had shown that project based fostered deeper learning, increased student engagement, and better prepared students for professional challenges. Therefore, this study contributed to the growing body of evidence supporting the use of Authentic Project-Based Learning as an effective teaching strategy for improving both academic and practical competencies in higher education.

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