CHAPTER I
INTRODUCTION

This chapter provides general information about the study, such as its background, research objectives, purpose, scope, and significance, as well as definitions of important words and the state of the art.

1.1. Background of the Study

In this contemporary world, scientific literacy has become the objective of global scientific education (Istyadji & Sauqina, 2023). Thus, it is widely seen as a crucial component in education. Furthermore, in the rapidly evolving 21st century there is a pressing need for educational methods that transcend traditional content knowledge. It is expected that higher education, especially in teacher training programs like the English Language Education Study Program (ELESP), equip pre-service teachers with the scientific literacy and critical thinking skills necessary to tackle difficult social and educational issues in addition to teaching pedagogical content. In this context, scientific literacy refers to the capacity for critical information evaluation, evidence-based reasoning, and informed decision-making, skills that are vital for both researchers and language teachers (Bybee, 1997, OECD, 2017).

The infusion of scientific literacy into the research methodology course is particularly crucial. This course serves as a foundation for pre-service teachers in understanding the nature of inquiry, formulating research problems, and analyzing data systematically. However, many students perceive research methodology as abstract, difficult and disconnected from real-life teaching practices (Alwasilah, 2002., Erlinda, et al., 2023). As a result, there is a pressing need to adopt pedagogical approaches that make research concepts more meaningful, contextual, and transformative.

Scientific literacy plays a pivotal role; it not only equips students with the essential critical-thinking skills to navigate an increasingly complex world but also fosters a deep appreciation for the scientific process and its role in shaping our

understanding of the universe. Scientific literacy, as defined by the Program for International Student Assessment (PISA), is the capacity to address science-related issues, use scientific knowledge, identify difficulties, and formulate judgments based on available evidence (OECD, 2019). Scientific literacy encompasses not only the comprehension of science but also the grasp of scientific processes and information applicable to everyday decision-making (Haerani et al., 2020). Students with a robust foundation in scientific literacy are more adept at making informed decisions across several issues, including personal health, environmental matters, and political and economic policy. (Rubini et al., 2019., Khaleyla et al., 2020, Kelp et al.,2023).

Scientific literacy is very advantageous for both individuals and society as a whole. Scientific literacy enables individuals to comprehend natural events, particularly those in their environment, and to analyze them using their knowledge and factual information such as when individuals witness flooding during heavy rains, extreme heatwaves, earthquakes, or plant disease outbreaks in agriculture, scientific literacy enables them to Recognize the underlying causes (e.g., climate change, deforestation, or tectonic activity), assess the reliability of information (e.g., distinguishing between scientific facts and misinformation), take informed actions (e.g., supporting sustainable land use or disaster preparedness), and communicate these issues effectively in their community.

In addition, current technology advancements undeniably influence multiple domains. These technological advancements often present challenges in the ecological, social, and economic spheres. Individuals possessing scientific literacy abilities can address challenges in their environment using scientific principles (Bagasta et al., 2018).

However, numerous research indicates that students' scientific literacy skills in Indonesia remain comparatively low (Hartono et al., 2023). The scientific literacy skills of students globally are evaluated by the PISA (Program for International Student Assessment) assessment, which was done every three years. In 2009, Indonesian students achieved a literacy score of 383, ranking 57th out of 65 countries evaluated. By 2012, Indonesia's rank fell to 64th out of 65 countries, with

a score of 382 (Astuti, 2017). In 2015, Indonesia's PISA score rose to 403 points, placing it 62nd out of 72 nations that participated in the survey (Tohir, 2016). It was still significantly lower than the average PISA score of 500. Ranking 62nd out of 72 participating nations, this indicates the significant hurdles confronting the Indonesian education system in enhancing students' science literacy (OECD, 2023).

As of 2018, Indonesia's average score has declined to 379. Nonetheless, the count of participating nations rose to 78, while Indonesia's rating fell to 71st position. The decline in scores indicates the necessity for assessment and enhancement of science education and comprehension in schools (Salamah, 2024). In 2022, Indonesia achieved an average score of 383 once more. Despite a marginal improvement in this score relative to the prior year, the total PISA average has declined to 485, indicating that Indonesia continues to face challenges in achieving international standards (Kamal et al., 2024). In 2024, Indonesia ranks 67th among 81 participating nations, indicating that despite advancements, significant efforts are required to enhance the quality of science education (Yang et al., 2024). This results from causes including non-contextual learning and students' inadequate reading proficiency (Hartono et al., 2023). This suggests that the education systems in Indonesia have not effectively guided students to attain sufficient scientific literacy. Several reasons contribute to the low scientific literacy in Indonesia, including a lack of enthusiasm in science (Ustun et al., 2022), pedagogical methods (Bellová et al., 2018), and inadequate facilities that hinder the development of scientific skills.

However, in the 21st century, higher education is expected to produce graduates who are not only proficient in academic knowledge but also equipped with critical thinking, creativity, collaboration, communication, and scientific literacy (OECD, 2018). Within English Language Education Study Programs (ELESP), courses such as Research Methodology serve as a cornerstone for equipping pre-service teachers with the competencies to conduct scientific inquiry, evaluate scholarly works, and contribute to the academic community (Creswell & Creswell, 2018). However, despite the theoretical importance of research

methodology, many students often perceive it as abstract, fragmented, and disconnected from real-world problems (Altrichter & Posch, 2021).

Fostering scientific literacy in a research methodology course is crucial because it equips students with the critical thinking skills, understanding of the scientific process, and the ability to evaluate evidence and make informed decisions. Scientific literacy enables learners to comprehend research design, methodology, data analysis, and the interpretation of results, which are foundational for conducting rigorous research and for engaging with scientific information responsibly. This foundation supports not only academic success but also informed citizenship in a society increasingly shaped by science and technology (Miller, 2016; National Research Council, 2012).

Furthermore, studies demonstrate that incorporating scientific literacy into language teaching might improve students' overall academic performance and engagement (Zohar & Nemet, 2002). By creating an environment that encourages students to critically analyze scientific texts and express their comprehension via research methodology course, educators can develop a generation of informed citizens equipped to tackle complicated scientific issues.

The Research Methodology course is a foundational component in higher education, particularly in undergraduate and postgraduate programs across disciplines, including the English Language Education Study Program (ELESP). This course is designed to equip students with essential knowledge, skills, and attitudes necessary to conduct academic research systematically and ethically. This is consistent with Kothari (2004) who stated that research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically.

Additionally, Cresswell (2014) stated that a good research methodology course not only teaches methods but also helps students to develop critical thinking, analytical reasoning, and ethical awareness. So, it is clearly understood that basically, research is not just a technical ability but also an intellectual and moral activity that equips students to be responsible, considerate academics and

professionals. The value of a research methodology course goes beyond simply teaching students how to conduct research. According to Creswell, an effective course should also foster critical thinking which may encourage students to question assumptions, evaluate evidence, and make reasoned judgments about research design and findings, build analytical reasoning which may equip students to interpret data, identify patterns, and draw logical conclusions from their research and promote ethical awareness which may instill an understanding of ethical principles such as honesty, confidentiality, and respect for participants.

Due to the necessity of attaining research methodology course, the higher education students are required to possess research skills. Nevertheless, research is not an easy skill to do, especially for EFL students, most students find research methodology to be demanding and difficult (Erlinda, et al., 2022). Therefore, the teachers are supposed to use appropriate methods or approaches for teaching research methodology.

Utilizing suitable and novel learning models as a strategy to enhance scientific literacy and cognitive learning results is necessary. Thus, Project-based Learning (PjBL) can be applied in teaching and learning processes. The Project-based Learning (PjBL) approach offers a direct and learner-centered experience. It enables students to acquire information and skills through participation in project conception and execution. Projects with intricate tasks will motivate students to develop, resolve issues, make judgments, and present outcomes (Kulsum et al., 2020; Nugraha, 2022). Irfan (2019) stated that with the PjBL approach, students can articulate and actualize their ideas to generate a positive impetus for discovering new concepts.

Numerous studies have proven the efficacy of employing the PjBL model in education. Nuraini and Waluyo (2021) determined that the use of the PjBL model significantly enhances students' learning outcomes. This fits with what Hamidah et al. (2021) found, which is that using the PjBL model to learn leads to very different results in how much knowledge is gained. Anggreni et al. (2020) and Hasbie et al. (2018) showed that the PjBL paradigm affects students' scientific literacy.

Besides the learning model, an approach also affects learning quality. One scientific approach that can improve scientific literacy and learning outcomes is transformative learning, in which critical reflection and conceptual shifts may occur. The rise in popularity of transformational learning theory (TL) over the past few decades is demonstrated by the need to comprehend extremely influential learning experiences. Similarly, project-based learning has gained popularity as a high-quality teaching method in recent decades (Song, 2023). Through a dynamic, student-centered educational paradigm, this method gives students the opportunity to interact with real-world issues and hone a variety of critical skills, such as collaboration, communication, problem-solving, and creative thinking. (Zhang and Ma, 2023). However, concerns have been raised regarding the success of project-based learning in fostering student-centeredness among the students in the Research Methodology course, as well as the demand for the integration of Education for Sustainability (EfS) or Education for Sustainable Development (ESD) into the educational settings.

A hybrid model of learning that integrates project-based and transformative learning approaches may offer a viable solution. Transformative learning, which emphasizes critical reflection and the transformation of existing frames of reference, can complement project-based learning by providing a structured framework for scaffolding language development and supporting learners in the process of engaging with complex, open-ended tasks. (Sevilla-Pavón & Nicolaou, 2017).

Project-Based Learning (PjBL) is presented as a revolutionary method in the education setting. PJBL, which has its roots in constructivism, moves the emphasis from passively absorbing information to actively examining real-world issues from the perspective of the learner (Halim et al., 2023). PjBL encourages deeper understanding and the development of critical skills by involving students in group projects that call for critical investigation, reflection, and practical application. PJBL has the ability to turn theoretically abstract material into exciting, hands-on learning experiences in the context of linguistics education, preparing aspiring teachers for the challenges of contemporary classrooms.

The ultimate goal of introducing this revolutionary PJBL paradigm is to reframe the study of languages as a dynamic, practice-based discipline that equips aspiring teachers to become flexible, creative, and reflective instructors. In addition to addressing the pressing need for pedagogical innovation in teacher preparation programs, this study adds to the expanding corpus of research on PJBL and language Education.

Project-based learning (PJBL), which emphasizes student-centered, inquiry-based learning experiences rooted in real-world situations, has become a well-known instructional technique in the field of education (Thomas & Mergendoller, 2019). PJBL has gained popularity recently in a number of academic fields, including English language teaching (ELT), since it can improve student application of knowledge, critical thinking abilities, and engagement (Johnson, 2014; Li, 2017; Smith & Brown, 2020).

The foundation of project-based learning is rooted in constructivist learning theories, which hold that students actively create meaning and knowledge via real-world activities and experiences (Wang & Hannafin, 2017). In contrast to conventional teaching approaches that place more emphasis on isolated skill practice and rote memorization, PjBL involves students in group projects that call for them to use discipline knowledge, research challenging issues, and provide concrete results (Brown & Larson, 2013). According to Thomas and Mergendoller (2019), PJBL seeks to develop profound comprehension, critical thinking, and problem-solving skills by placing learners in real-world settings. According to Richards and Rodgers (2014), the use of PJBL in ELT is consistent with the tenets of communicative language teaching (CLT), which place a strong emphasis on the value of authentic communication and meaningful language use. Language skills are integrated in contextually appropriate ways through PJBL projects that frequently entail realistic language production, such as conducting interviews, making presentations, or resolving real-world language issues (Li, 2017; Smith & Brown, 2020).

Additionally, PJBL is essential to helping students develop their capacity for self-directed learning. According to Bagheri et al., (2013) and Evenddy et al.,

PJBL teaches students how to take ownership of their education, make goals, and efficiently manage their time. Students have the capacity to autonomously direct their education, make wise judgments, and efficiently manage their time and resources by participating in project-based learning activities.

Recently, there have been many studies conducted by many researchers related to project-based learning. According to the previous studies (Rachmawati, et al, 2024), project-based learning was implemented in a variety of ways to encourage students' skill development. The three primary phases of preparation, implementation, and assessment were covered by the several approaches used to apply the model. Students' critical thinking, communication, teamwork, problem-solving, and information literacy are all enhanced by the model that is used. Depending on the personalities of the students and teachers as well as the available resources, project-based learning allows for unique instruction as the students gain life skills.

In addition, a study conducted by Riyanti, D. (2023) pertinent to students and lecturers' perspectives on PjBL, found that PjBL is seen as helpful for both instructors and students in enhancing the development of 21st century skills. The students specifically believe that PjBL offers them several advantages, including broadening their knowledge, encouraging teamwork, encouraging creativity, and strengthening their critical thinking abilities. Despite its benefits, PJBL has many drawbacks, such as being time-consuming and causing conflict among group members since they have different opinions about how to approach the project. With regard to PJBL, the instructors' opinions differ slightly from those of the students. Although PJBL is regarded by the lecturers as an effective teaching strategy, particularly during the pandemic, there were difficulties in tracking students' progress and evaluating the final result.

The literature review on project-based learning (PjBL) in English language teaching (ELT) conducted by Sedubun & Nurhayati, (2024)., highlights several key themes. In terms of benefits, it emphasizes the enhancement of communicative competence (Li, 2017; Smith & Brown, 2020)., promoting critical thinking and problem-solving skills through authentic tasks and projects (Thomas &

Mergendoller, 2019; Wang & Hannafin, 2017). PJBL also enhances students' ability to communicate effectively in English, preparing them for real-world challenges. It also increases student motivation and engagement in language learning, as projects that are relevant and meaningful to them lead to higher levels of participation, persistence, and enthusiasm for language learning tasks (Thomas & Mergendoller, 2019; Wang & Hannafin, 2017).

Despite its benefits, implementing PjBL in ELT settings faces challenges such as curriculum time constraints, assessment difficulties, and teacher readiness (Walker & Leary, 2018; Wang & Qi, 2022). Despite these, PjBL has the potential to transform English language teaching by integrating authentic, student-centered experiences. To maximize its benefits, comprehensive teacher training programs (Smith & Brown, 2020)., innovative assessment strategies (Wang & Qi, 2022)., and strategic integration of PJBL into ELT curricula are recommended (Zhang et al., 2021). These measures ensure alignment with learning objectives and cater to diverse learner needs.

Furthermore, Yusri et al. (2024) conducted a systematic literature review regarding research trends, methods, elements, and framework of PJBL. The research findings indicated that some of the active PjBL researchers include Yulia Muchnik-Rozanov, Afriana, Ai-Jou Pan, Akhsanul In'am, Alexander MacDonald, Alison Boardman, Anazifa, Ashley Seidel Potvin, Booyuel Kim, Cheng-Huan Chen, Chin-Feng Lai, Dewi, Dian Safitri, Dina Tsybulsky, Djukri, Dustin Van Orman, Dwi Listyorini, and Eliana. The literature review's findings also reveal that PjBL frequently employs the following research methodologies: quantitative research, qualitative research, descriptive research, mixed methods, action research, and development research. The most frequently used method was quantitative research, while the least is development research. Subsequently, the main components or skills that PjBL can foster include motivation, problem-solving, creativity, collaborative critical thinking, communication, concept understanding, inventive thinking, and self-assurance. The literature review also revealed five frameworks for implementing PjBL. The literature review results suggest a new framework.

An earlier study by Pan et al. (2019) looked at learning transformation in project-based learning processes using Lewin's (1951) change theory as a lens to analyze the project-based learning curriculum at UNI-X. They discovered that they could utilize Lewin's change framework to understand the reasons behind students on project teams abandoning their initial ideas and embracing new ones collectively. The framework, a helpful analytical model, divides the learning transformation process into three phases: unfreezing, changing, and refreezing. Finally, Pan at al advocates that educators can use the framework in project post-mortem analyses to come up with practical ways to support learning transformation during the PjBL process.

Subsequently, the main components or skills that PjBL can foster include motivation, problem-solving, creativity, collaborative critical thinking, communication, concept understanding, inventive thinking, and self-assurance. Additionally, five frameworks for implementing PjBL were discovered in the literature review. A new framework is suggested based on the results of the literature review.

In order to better prepare students for success in the twenty-first century, transformative learning is thought to be a more successful strategy. This is due to the fact that transformative learning motivates students to pursue lifelong learning and helps them to acquire abilities that are applicable in a workplace that is always changing (Fisher-Yoshida et al., 2005). Saputra (2025) stated that transformative learning can enhance critical thinking through processes of dialogue, discussion, and deep reflection that help students assess diverse perspectives. Mezirow asserts that transformative education transpires when an individual undergoes profound reflection on their assumptions, resulting in a substantial shift in viewpoint and behavior. Transformative learning emphasizes critical reflection, dialogue, and rational discourse, rendering it particularly pertinent for the enhancement of critical thinking skills (Mezirow, 1991).

The advocates of learning transformation M. Tennant (1991), D. Boud (Boud, Keogh, Walker, 1985), P. Race (2006), J. Mezirow (1991, 2003), E.W. Taylor (2007), E.W. Taylor and P. Cranton (2013), S. Merriam (2004), J. Stepanova

(2017), and others stress the value of experience, critical reflection, and reflective discourse in the learning process. According to the writers previously mentioned, a learner's subjective analysis of their experience generates meaning, which results in a paradigm shift, beliefs, worldview, and behavior changes. A person who engages in transformative learning goes beyond simply absorbing information and goes through a complex process of deliberate change, reevaluating their values, beliefs, and presumptions as well as critically analyzing many viewpoints to act more effectively. Thus, it is crucial that adult learners analyze, evaluate, and reevaluate their experiences, either alone or in collaboration with others.

Mezirow claims that transformative learning entails a fundamental change in viewpoint that results in fresh approaches to comprehending and engaging with the outside world. This change typically happens in a number of steps, such as identifying underlying presumptions and beliefs, evaluating those presumptions and beliefs critically, investigating opposing viewpoints, and finally creating a new, more critical, action-oriented perspective.

Integrating Transformative Learning (TL) with Project-Based Learning (PjBL) is essential to enhance students' deep understanding, critical thinking, and personal growth. While PjBL focuses on real-world, inquiry-based tasks which it often lacks the reflective component needed to challenge learners' assumptions and worldviews, transformative learning fills this gap by encouraging students to critically reflect on their experiences, values, and beliefs. TL adds a reflective dimension that encourages learners to question assumptions, develop autonomy, and engage with ethical and social issues. This integration fosters not only cognitive skills but also emotional, moral, and civic competencies, making learning more meaningful and empowering. As supported by Mezirow (2000), Taylor (2007), and Brookfield (2009), such integration helps students become more self-aware, socially responsible, and motivated to apply their knowledge in transformative ways.

There are several reasons why the researcher conducted this study. One of which is to enhance students' scientific literacy in research contexts. Many English Language Education Study Program (ELESP) students often lack the ability to

critically evaluate and apply research findings in real-world contexts due to limited exposure to scientific reasoning and literacy. While according to Bybee (2010), scientific literacy empowers students to "engage with scientific issues, apply scientific knowledge to personal and social decisions, and communicate effectively about science." This is particularly relevant for pre-service English teachers who need to understand and conduct educational research.

Secondly, to respond to the demands of 21st-Century education. Modern education demands that students master higher-order thinking skills such as critical thinking, collaboration, and problem-solving, all of which are embedded in both Transformative Learning Theory and Project-Based Learning (PBL) as stated by Trilling & Fadel (2009), 21st-century learners need to be literate not only in content knowledge but also in "learning and innovation skills" like critical thinking and collaboration, which are foundational in PBL and transformative education.

Thirdly, to improve engagement and learning outcomes in the Research Methodology Course. The Research Methodology course is often seen as abstract and difficult by ELESP students. Embedding projects with real-world relevance and scientific literacy can increase motivation, engagement, and understanding. Pertaining the mentioned reason, Thomas (2000) emphasized that project-based learning increases students' motivation and helps them construct deeper understanding by engaging in real-world tasks.

Fourthly, to encourage transformative learning through critical reflection. Transformative learning encourages students to reflect critically on their beliefs and practices. Infusing scientific literacy into TPjBL encourages students to challenge assumptions and make evidence-based decisions. According to Mezirow (2000), transformative learning involves "transforming problematic frames of reference to make them more inclusive, discriminating, and reflective."

Next, is to align with the goals of scientific literacy and teacher education in Indonesia. Indonesia's education curriculum increasingly emphasizes the development of scientific literacy in teacher education, including English teacher preparation. As OECD (2019) highlights that developing scientific literacy is a key

aspect of quality education and is essential for teachers who guide students in inquiry-based learning.

Lastly, is to innovate and improve existing learning models in ELESP. The integration of scientific literacy into TPjBL represents a needed innovation for ELESP curriculum, where research methodology is often taught with traditional, lecture-based approaches that do not foster deep understanding or active engagement. Bell (2010) states that effective project-based learning promotes self-directed inquiry and authentic assessment, aligning well with research methodology and scientific inquiry goals.

However, based on the previous studies it is still little known about infusing scientific literacy into transformative project-based learning in English Language Education program especially for the research methodology course. In addition to the method in conducting the research that employed development research is still little. Therefore, the purpose of this study is to develop a Transformative project-based learning model infused with scientific literacy specifically for research course in English language education study programs.

1.2. Research Questions

The focus of this study was to develop a transformative project-based learning model and scientific literacy infused in the Research Methodology course of the English Language Education Study Program. Accordingly, there were four questions made by the researcher during the study. They were:

1. To what extent have the existing transformative project-based learning models infused with scientific literacy in the Research Methodology course of the English Language Education Study Program?
2. How are the procedures to develop the model of transformative project-based learning model infused with scientific literacy in the Research Methodology course of the English Language Education Study Program?
3. How is the development of a transformative project-based learning model infused with scientific literacy in the Research Methodology course of the English Language Education Study Program?

4. How are the validity and employability of transformative project-based learning models infused with scientific literacy in the Research Methodology course of the English Language Education Study Program?

1.3. Objectives of the Research

Based on the research question above, the objectives of this study were:

1. To analyze the existing transformative project-based learning models infused with scientific literacy in research methodology courses of the English Language Education Study Program.
2. To elaborate the procedures of developing a transformative project-based learning model infused with scientific literacy in the Research Methodology course of the English Language Education Study Program.
3. To develop a model of transformative project-based learning infused with scientific literacy in the Research Methodology course of the English Language Education Study Program.
4. To measure the validity and employability of a transformative project-based learning model infused with scientific literacy in the Research Methodology course of the English Language Education Study Program.

1.4. Scope of the Research

The focus of this study is on developing the transformative project-based learning model and scientific literacy infused in the Research Methodology course of the English Language Education Study Program. Therefore, research and development is used as a method in this study.

1.5. Significance of the Research

According to the previously stated study objectives, it is envisaged that this research will help teachers in providing more instruction in the teaching and learning of English and that students will become more motivated to learn the language.

a. Theoretically

Theoretically, this study contributes to the advancement of knowledge in the fields of educational pedagogy, particularly in the integration of Transformative Learning Theory (Mezirow, 2000) with Project-Based Learning (Thomas, 2000), and the infusion of Scientific Literacy (OECD, 2016, 2018, 2023) into higher education curriculum design. While each of these components has been studied separately, their integration into a cohesive learning model provides a novel framework for developing students' critical thinking, research skills, and scientific reasoning in language education contexts.

This study deepens the understanding of how transformative learning can be implemented through project-based strategies that focus on real-world, meaningful problems, thereby facilitating epistemological transformation among learners (Taylor, 2007). Furthermore, it expands the theoretical discourse on the role of scientific literacy in non-science domains specifically in English Language Education, highlighting its relevance in developing research-oriented and critically conscious graduates (Yacoubian, 2018).

b. Practically

Practically, the research provides a pedagogical solution to the recurring challenges faced in teaching the Research Methodology course, such as students' lack of engagement, limited research literacy, and difficulties in translating theoretical knowledge into practical research activities (Sari et al., 2022). By employing a Transformative Project-Based Learning (TPjBL) model infused with scientific literacy, this study offers a student-centered, inquiry-driven instructional design that promotes active participation, reflection, and knowledge construction.

The practical relevance of the research is expected to emerge from educators utilizing a transformative project-based learning model infused with scientific literacy in the Research Methodology course of the English

Language Education Study Program. Moreover, it is anticipated that students will exhibit increased engagement and critical thinking in the classroom. Furthermore, to facilitate future researchers in progressing the study.

1.6. Definition of Key Terms

In order to prevent misunderstandings, the technical terms used in this work are defined as follows:

1. **Model of learning:** known as designs that illustrate classroom activities and their resources. It is defined as a strategy that may be applied to develop educational resources, shape curricula, and direct instruction in classrooms and other contexts (Joyce et al, 2011).
2. **Project-based learning**: Project-based learning (PJBL) model is a form of situated learning that arises from constructivism (Krajcik & Blumenfeld, 2006) that learners achieve deeper understanding about a subject matter when they actively construct their by working with and using ideas. PJBL allows learners to inspect questions, propose hypotheses and elaborations, discuss and encounter their and other people's ideas, and try out the new ones.
3. **Transformative learning**: Transformative learning involves learning through direct experience and reflection on that experience. In this context, individuals learn through their life experiences and from others through dialogue and reflection on their experiences (Mezirow & Taylor, 2010).
4. **Scientific literacy**: the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen (OECD, 2019)
5. **Research Methodology Course:** a foundational subject typically offered in undergraduate and graduate programs, especially in fields such as social sciences, education, health sciences, business, and humanities. In the context of an English Language Education Study Program (ELESP), this course equips students with the knowledge and skills to conduct academic research relevant to language teaching and learning.

6. **English Language Education Study Program (ELESP)** is an educational institution where language learners gather. ELESP is a bachelor's degree for prospective English teachers.

1.7. State of the Art

The growing complexity of modern education necessitates creative instructional frameworks that enhance students' academic proficiency, scientific literacy, and transformative abilities. Within English Language Education Study Programs (ELESP), the Research Methodology course is essential for developing students' critical thinking, research skills, and capacity to address real-world issues through inquiry and reflection. Nonetheless, conventional teaching methods frequently do not effectively engage students in higher-order skills (Hidayat et al., 2023; Marzulina et al., 2022).

Transformative Project-Based Learning (TPjBL) has emerged as a viable method to address these deficiencies. Grounded in constructivist and transformative learning theories, TPjBL emphasizes student-centered inquiry, collaboration, reflection, and real-world application (Mezirow, 2000; Thomas, 2000). In contrast to traditional Project-Based Learning (PjBL), the transformative variety incorporates a critical-reflective element that pushes learners to question assumptions and implement change through their learning projects (Mandinach & Cline, 2013).

Accordingly, scientific literacy is acknowledged as an essential skill of the 21st century, involving the capacity to apply scientific knowledge to personal, societal, and global challenges; to critically assess information; and to make informed decisions (OECD, 2018; Yore et al., 2007). Scientific literacy is crucial in teacher education, since it equips prospective educators with the ability to think critically, solve problems, and engage in research-oriented inquiry (Ratnasari et al., 2022). Research indicates that numerous higher education students in Indonesia, particularly those in ELESP, continue to demonstrate inadequate scientific literacy and limited critical research awareness (Rahayu et al., 2020; Astalini et al., 2019).

Recent research has promoted the incorporation of scientific literacy into inquiry-based and project-based models to enhance student engagement and performance in methodology courses (Hapsari et al., 2021; Liliawati et al., 2022). Nevertheless, the majority of models fail to incorporate transformative learning principles, which are crucial for promoting student agency and reflective practice There is currently a gap in the development of instructional models that intentionally integrate scientific literacy and transformational learning within a project-based framework, particularly in the realm of English Language Education research courses.

Therefore, this study seeks to contribute to the novelty or state of the art by developing a model that infuses scientific literacy into Transformative Project-Based Learning (TPjBL) for the Research Methodology course in ELESP. This model is designed not only to enhance students' cognitive and methodological skills but also to foster their ability to become reflective, research-informed, and socially responsible future educators

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