Predictors of Statistical Literacy among Teacher-Education Graduate Students

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ABSTRACT

Statistical literacy is critical for educators because it allows them to evaluate data effectively, make educated decisions, and create data-driven learning environments. In a world where data impacts educational policy and classroom practices, providing teachers with good statistical reasoning abilities ensures that they can critically evaluate study findings and use statistical principles effectively. The research evaluated teacher-education graduate students' statistical literacy together with research literacy and AI literacy profiles for the academic year 2024-2025. The research used descriptive and inferential statistics for statistical literacy assessment while examining research literacy dimensions, including awareness, attitude, skills, and use, as well as AI literacy dimensions with affective, behavioral, cognitive, and ethical aspects, and determined substantial statistical literacy predictors. The research used descriptive-predictive methods for analyzing literacy levels and predicting important literacy through multiple linear regression. Graduate students within the Master of Arts in Teaching (MAT), Master of Arts in Education (MAED), and Master of Science in Teaching (MST) programs at Saint Mary's University formed the respondents sample, which consisted of 42 students. The study findings demonstrate that students excel at descriptive statistics but struggle with inferential reasoning. Student performance on research literacy tests demonstrates average accuracy, but they require improvement in their ability to execute and share research, while AI literacy assessments reveal positive attitudes combined with challenges in advanced engagement along ethical duties. The results demonstrate no meaningful effect of research literacy or AI literacy on statistical literacy, which shows that basic numerical skills, together with teaching methods and educational planning, dominate statistical understanding development. The research demonstrates the vital importance of using active learning techniques with statistical software tools and real-world examples to overcome statistical thinking deficits. Programs that teach AI literacy within research training will give future educators better abilities for data-driven decision-making. New research directions should determine extra predictors alongside using sophisticated statistical modeling methods to optimize teacher education instruction.

Keywords: AI Literacy, Data-driven Decision Making, Graduate Students, Multiple Linear Regression, Research Literacy, Statistical Modeling

INTRODUCTION

Rationale

According to the Commission on Higher Education (CHED), tertiary institutions in the Philippines generate a considerable number of master's and doctorate graduates who are crucial in many industries across the country. As it stands, the Commission on Higher Education (CHED) in the Philippines' Memorandum Order No. 15, Series of 2019 specifically specified updated policies, standards, and guidelines for graduate programs. Perhaps one of the most important aspects of this memorandum is that, as a condition of graduation, graduate students are required to publish their research in peer-reviewed journals. In particular, master's students are expected to get their research published in refereed journals, while doctoral candidates are obliged to publish it in nationally or internationally indexed journals (CHED, 2019). With CHED Memorandum Order (CMO) No. 15, Series of 2019, these graduates must demonstrate statistical literacy in addition to technical knowledge in their field of concentration. Graduate students must be able to perform educational research. It is also necessary to be an

expert in data management, trend analysis, result interpretation, and results dissemination to a wider audience through academic publications, seminars, industry reports, or policymaking (Quinto, 2022).

In today's data-driven global environment, where decision-making and solving problems are mainly based on the ability to interpret and use statistical concepts (McMaster, 2022), being statistically 'literate' is critical as the core competency (Hoffrén, 2021). Graduate students should acquire such skills because, as graduate students, they are expected to design methods of handling complex data sets with appropriate methodology to create new knowledge and evidence-based practice. Statistical literacy as it is applied in statistical education in this context also falls in tune with the general objective of CHED on developing the research competencies of graduate professionals at the graduate level in areas such as education, healthcare, economics, and science. Statistical literacy also helps these graduates perform with the integrity that is needed in their research findings (Chou & Lee, 2022). In particular, this is important for a modern problem where interpreting data leads to mistaken conclusions or decisions on policy. A need exists for innovations across various industries if graduate programs will empower a more research-literate and analytically capable workforce in embedding robust statistical training.

While data accessibility has increased the demand for statistical literacy as a life skill, many educational systems still struggle with providing students with the means to use data effectively. Although encouraging, the majority of the countries have lagged in implementing reforms focusing on statistical literacy, while the rate of adapting the curriculum is still slow. To thus address this, a thorough teaching module is needed to deepen students' statistical literacy and to provide educators with methodologies that allow for the integration of statistical concepts across disciplines. This approach will better equip students to read data and entertain viable decisions, echoing our current transnational move toward evidence-based reasoning in a data-ubiquitous world (Ridgway, Nicholson & Mccusker, 2011).

Research heavily relies on statistics to assist in data analysis and interpretation, enabling informed conclusions (Sirisilla, 2023). With technological advancements, AI has emerged as a strong tool that improves research by automating data analysis, pattern detection, and even producing new insights, emphasizing the significance of integrating AI literacy with statistical and research literacy in contemporary education (Ng, Leung, Chu & Qiao, 2021). Incorporating these literacies provides individuals with the abilities required to manage complicated data, use AI for novel research solutions, and make data-driven decisions, all of which are critical in today's quickly changing technology context.

Research literacy has a vital role in academic and professional achievement as it is in conducting research. Despite the increased availability of research results and enhanced assessment techniques for determining students' reading comprehension, students are unable to read, comprehend, and apply research findings due to complicated technical language and data interpretation abilities (Caraig & Quimbo, 2022).

Researchers have noted that research literacy should be improved through the development of more effective tools, which reduce the size of the material required to back them up, provide adequate assistance in understanding empirical data, and help people see the connection between research and their personal and professional development (Joyce & Cartwright, 2020). Encouraging student engagement with research might have a more research-informed populace, one able to make contributions in many sectors.

This comes at a time when artificial intelligence (AI) has pushed forward rapidly, with the importance of AI literacy as an integral part of modern education getting validated. In today's technology-saturated world, people need to be AI literate, meaning they can understand, understand, and critique AI technologies (Chiu, 2021). Given AI's potential to fundamentally change the nature of how things get done in education—from personalized learning to automating administrative functions—students and educators need to learn to be AI-competent (Luckin et al., 2022).

Yet, due to a lack of common understanding of what AI literacy is and how AI concepts are to be integrated into nontechnical spaces, achieving widespread AI literacy is difficult (Pinski & Benlian, 2024). Thus, to prepare the students to navigate an increasingly data-centered society, investing time to develop curricula enriched with statistical, research, and AL literacies becomes very important.

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This study sought to evaluate graduate students' competency in three crucial literacies: statistical literacy, research literacy, and AI literacy. These abilities are critical for managing the data demands of today's professional and academic settings. The study evaluated not just the graduate student's capacity to process and comprehend statistical data, but also how research literacy and AI literacy may supplement and even increase statistical literacy.

Statistical Literacy

Statistical literacy is the ability to understand, interpret, and critically analyze statistical information (Yuniawatika, 2018). It is a basic requirement for living in the modern world since it helps people make sense of data woven into media and research in daily life. Considering the advances in technology that are producing so much data, this need for statistically literate people has never been greater. This need is further pressed upon by the fact that statistical concepts have been incorporated into many diverse professions, such as healthcare and economics, making statistics truly interdisciplinary. Although statistical literacy plays a very great role, traditional mathematics education has accorded it a low profile.

Many students are known to have a poor understanding of statistics due to the conceptual nature of some topics in statistics coupled with less than adequate exposure and instructional strategies (Dumale & Gurat, 2023). This educational gap that may be created may result in a citizenry less able to analyze data critically, consequently affecting their ability to participate in informed decision-making processes. Learning statistics involves a range of challenging ideas, including statistical ideas, views, and dimensions of reasoning, all of which can be misconceived. It follows, then, that support for teachers needs to go beyond the individual concept and skill levels to encourage a deeper awareness of how these components might fit within a wider structure (Dani & Al Quraan, 2023).

Enhancing statistical literacy in students is one of the core elements of developing skills related to critical reasoning and making informed decisions in mathematical education. Understanding and applying statistical concepts in learners' lives is indispensable, as data gradually dominates the world. A study showed that though the students improved their skills in statistics, there were still significant problems in some important areas: formulating appropriate research problems, interpretation of results, data gathering, and analysis (Obrial & Lapinid, 2020). Specific findings included that students often had problems with generating quantitative questions, sometimes encountered issues with collecting data related to respondents, and seemed limited in depth of data analyses and interpretation.

The implementation of two years more into the basic education curriculum, formerly known as the K-10 curriculum and now commonly called the K-12 program, has introduced some transformation in the education system of the Philippines. One major change is the addition of statistics as part of the required mathematics curriculum from preschool, grades 1-11, more precisely embraced under the Science, Technology, Engineering, and Mathematics (STEM) track in Senior High School. In the past, courses such as statistics were not compulsory, so one did not find it as part of the curriculum in high school or any higher learning institution (Dizon et. al., 2019).

The students' statistical literacy on matters to do with confidence intervals, their understanding of the same to be highly inadequate (Refugio, 2017). If that was not enough, while the students were able to recognize appropriate procedures and even compute effectively, they did not understand how to contextualize the results. The student's learning in statistics needs to have a closer association with events taking place outside the classroom. In this way, the understanding and the application of the concepts will be better realized in real-life situations.

The students experience some confusion in understanding certain topics in statistics due to the lack of proper guidance from teachers (Repedro & Diego, 2021). Consequently, it may mean that examination must be given to the experiences that students go through in their learning of statistics, which may give a lead toward how teaching methodologies and strategies can be improved. Research into students' learning experiences can provide rich insight into where the instructional gaps are and how educators might better help students understand statistical concepts. An examination of such challenges would provide teachers with opportunities to adopt more

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effective student-centered pedagogies, which create a better learning environment for deeper comprehension by making the learning more interactive, using more real-life applications, and offering personal feedback.

The study entitled 'Utilization of Statistical Software Applications and Its Influence on Students' Attitude and Performance in Statistics' (Benedictos, 2022) investigated how statistical software influences student attitude and performance. In addition, this study found no gender or device differences (either a phone or a laptop) in attitudes or performance among students. This indicates that the inclusion of statistics software in class may improve students' attitudes and academic performances irrespective of demographic factors. This work also advocates for the inclusion of statistical programs within the main subjects to promote positive interaction with students and consequently better exam results in statistics.

Research literacy

In most countries, there is a growing demand that teachers should incorporate research into teaching. This is due to the increasing awareness of the importance of research activities in developing the teaching profession (Padillo et al., 2021). Carrying out a given research entails that students and teachers go through numerous empirical studies and thus the writings are dense with technical terms, specialist language, quantitative data, and information mass, which is presented in the form of tables and figures. Reading of this kind may be irritating and confusing for many, thus, it contributes to the minimization of the number of resources students are willing to read of an empirical nature. Studies pointed out factors that hinder students when it comes to reading and comprehending research articles (Suwanaroa, 2021; Chan, 2024).

Several perceived challenges affect the ability of students to read research articles adequately (Darling-Hammond et al., 2019). Some of these are time constraints, psychological and physical conditions, lack of association between the article and the student's field of study, lack of adequate statistical expertise, and language and ease of access to the articles. Having good reading skills is paramount for doctoral students so that they can competently manage to analyze empirical research studies. This skill does not only improve their academic achievements, but it equally directly contributes to their capacity to be informed researchers. However, some factors like time constraints, psychological factors, and limited statistical background can greatly affect this process, thus calling for better interferences due to the need to promote reading development in graduate programs.

Difficulties such as too complicated content, difficulties in selecting articles, time consumption, and access issues were also described (Belcher, 2019). The use of academic journal articles in learning is particularly important in higher education since it enables the students to develop the ability to critically evaluate and apply advanced research. However, many students cannot effectively use such resources because of different barriers, including the difficulty of reading journal articles, problems in finding articles, and uncertainty regarding the use of academic search utilities (Mason & Warmington, 2024). This shows why it is important to target these challenges as early as possible in the students' academic trajectories to enhance their research skills. Through such specific treatments as self-help guides and tutorials, the students can enhance their abilities to search and utilize the journal literature, thus establishing the overall stone for success (Archila, Ortiz & Truscott de Mejía, 2024).

What determines students' attitudes toward research most is the perceived importance of conducting research in personal and professional life (Repedro & Diego 2021). The importance accorded by students to how research fits into their perception dictates the level of involvement and investment they put into the same. Those who perceive research as important tend to be more positive in outlook and invest more in scholarship. This realization has raised the necessity for creating a culture that would impact the individual's importance of research to career growth and development. This may involve encouraging the students on the wide implications of research for education, innovation, and societal development that will increase participation and commitment to knowledge development. Students should be given the opportunity by institutions to identify how research relates to their everyday lives and their interest in giving meaning to their actions (Finch, 2023; Li & Wang, 2024).

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AI Literacy

Today, given the rather fast development of Artificial Intelligence (AI), it seems to penetrate different spheres of life and is employed in various fields, including medicine and literature (Laupichler et al., 2023; Secinaro et al., 2021). In the past few years, the application of AI in teaching and learning practices in educational systems has demonstrated effectiveness in improving students' literacy. In such a context, higher education institutions need to seize a chance and improve students' critical skills and their knowledge of AI.

Higher education needs to respond to this changing, constantly demanding world, and one way of being able to do this is by ensuring that students are well-equipped with AI literacies as a form of academic literacy (Luckin et al., 2022). AI ideas have, in the past, been offered mainly in universities and, as such, pass through the computer science and engineering disciplines (Kong et al., 2023). It has brought about hurdles toward the indulgence of the general public in AI literacy (Long & Magerko, 2020). Also, the interest in AI literacy has increased during the last 5 years, though there is no commonly shared definition of AI literacy up to date (Secinaro et al., 2021; Laupichler et al., 2023).

People need to master such technologies concerning usage efficiency and proper moral and ethical requirements (Chiu, 2021), as well as the possible implications of related technology adoption. As a disadvantage, technology might be employed in the wrong hands by criminal-minded people. For this reason, it becomes the responsibility of every group to ensure that technology is well observed no matter the type of use it is being put into.

Because 'artificial intelligence' –the term and the concept– is multifaceted and consequential, it tends to stun most of the librarians (Cox & Mazumdar, 2024). When John McCarthy defined AI at the first conference in the year 1956, he defined it as 'the science and engineering of making intelligent machines. This is far from the modern-day definition of AI. Due to the numerous problems that are investigated by the AI concept and the interdisciplinary character of the area, there are a lot of definitions of the term AI.

Some definitions of AI are rather simplified and contain the reflection of people's prejudices; for example, excluding 'human intelligence'. AI literacy is clearly defined, with an interdisciplinary review that highlights key AI competencies (Ng, Leung, Chu & Qiao, 2021). A set of skills called AI literacy empowers individuals to thoughtfully analyze AI technology, interact with AI responsibly, and harness AI as a utility in a range of situations, including in online forums, homes, and professional settings (Long & Magerko, 2020). AI stands as one of the triggers of innovation in education, opening new routes of development and growth.

According to UNESCO (2024), AI can serve as a real game-changer -from school administration to pedagogic practices- provided it is implemented with much care and ethical consideration. Although the complete potential of AI in education is still being explored, some of the current strands of its application include providing support for students around the clock through chatbots, decreasing administrative work by educators, and enhancing online learning platforms. The extensive incorporation of AI into various aspects of daily life has emphasized the critical need for not only understanding but also optimizing the use of these technologies across different sectors. This growing presence in everything from education and business to healthcare and entertainment highlights the importance of developing strategies for their effective application, ensuring that the benefits are maximized while addressing potential challenges (Chiu et al., 2024; Kong et al., 2024; Laupichler et al., 2023).

AI-powered technologies support instruction effectively (Dela Torre et al., 2024). Positive observations of this study underpin the contribution of AI to modern education, noting that it has the potential to promote both teaching efficiency and learner engagement. AI-assisted tools offer personalized learning experiences and standardized language support, catering to diverse learning needs but also contributing toward bridging literacy gaps, especially in students with special needs such as dyslexia or impaired vision.

AI can also automate administrative-related functions in higher educational institutions, including keeping records of students, managing class scheduling, monitoring student attendance, and evaluating student performance (Llego, 2023). In fact, by automating these activities, AI helps improve interaction among teachers, parents, and students by updating the latter on timely events at school and their academic performance (Seo, Tang, Roll, Fels & Yoon, 2021). It aligns with the Basic Education Development Program 2030 by DepEd to

ensure that AI will be a tool to assist in decision-making processes at schools. AI can help provide various insights and recommendations through the data gathered that will benefit the institution in making precise decisions regarding resource allocations, curriculum development, and student support programs. The government of the Philippines has embraced AI for its potential to transform everything from education to tourism (DepEd, 2022).

The significance of statistical literacy in decision-making processes in today's complex society cannot be overemphasized, particularly with the globalization of data and information in various disciplines (Idoko, 2024). The difficulties experienced by learners in obtaining sufficient statistics, research, and AI skills reveal crucial deficiencies in today's educational models. With these literacies, people can cope with life's situations in contemporary society, and hence, incorporating them in curricula is prudent. The argument arises that there is a requirement for better and more effective, particularly through developing students' learning skills in understanding and critically analyzing statistical data and AI information along with critical scrutiny of the existing research literature (Zhai, Wibowo & Li, 2024).

Although it is one of the core components of education, traditional mathematics education has often excluded statistical literacy, leading to many students' poor statistics knowledge. This problem is worsened by the conceptual difficulties associated with statistical areas and the limited contact and pedagogy employed by today's education systems. Not only does the lack of statistical education hinder students' analytical capacity when it comes to data analysis, but it also curtails their capability to be active members of decision-making processes (Apino et al., 2024).

In the same way, students struggle a lot with research comprehension, especially when it comes to using technical and specialized languages, formatted empirical studies, and data representations. Also, the recent increased area of coverage of Artificial Intelligence (AI) and its application in different disciplines has necessitated AI literacy (Seo et al., 2021). But this literacy is again limited to these selected fields, and hence the general public is mostly uninformed or certainly poorly informed about AI, and this in any case hinders students from being able to read AI, that is, navigate, use, and evaluate them.

In any case, from the point of view of statistical literacy, research literacy, or AI literacy, data literacy is regarded as a fundamental pillar. Implementation of the HFD Data Literacy Framework across educational programs refers to how statistical literacy will enrich the knowledge of collecting, analyzing, and interpreting data skills that are very crucial in AI literacy. Literacy research information supplements that center on critical thinking and the ability to appraise information—supplements these competencies in facilitating navigation and assessment of the rise of AI technologies in society (Schüller, 2022).

There remains a gap in current research regarding an integration of statistical literacy, research literacy, and AI literacy in an instructional framework for teacher education. Given these deficits, it is necessary to develop systematic teaching and have a study that explores these literacies, focused on strengthening statistical reasoning, effective application of AI tools, and enrichment of research capabilities among educators. Examines intervention research on instructional strategies, active learning strategies, and AI-driven tools to enhance these literacies, as well, to discover other predictors of statistical literacy proficiency in preparing teachers (Friedrich et al., 2024).

This study investigated the graduate students' levels of statistical literacy, research literacy, and AI literacy and determines factors affecting statistical literacy. Addressing these gaps is critically important so students can develop the logical reasoning skills needed to interpret, process, and apply data to inform useful decisions, which is a key component in a data-driven society. This study investigated how research and AI literacy intersect with statistical understanding to inform the development of curriculum and instructional strategy for an educated, statistically literate, and data-savvy population to make sense of and prosper in a data-driven society.

Integrating research literacy as a set of skills required for critically examining scholarly work and grasping the research methodology, there can be a more holistic take on the meaning of statistical findings. By the same token, AI literacy, defined as understanding AI technologies and their applications, can introduce graduate students to new data analysis and decision-making tools. Toward that end, this study aimed to better understand

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how these two literacies contribute to statistical literacy so it may be used to identify gaps in education and inform curriculum development, and in doing so, prepare graduate students to be successful in increasingly data-centric environments.

The importance of this study lies in its implications for educational institutions, practitioners, and policymakers. Academic institutions can use the findings to enrich the curricula and introduce statistical, research, and AI literacies to address the current need for data-driven decision-making skills. It could help curriculum developers design interesting modules, especially in STEM fields, and encourage interdisciplinary cooperation to produce well-rounded graduates.

The study offers new strategies for educators to teach complex statistical, research, and AI concepts and provide professional development and instructional improvement. The insights contribute to better preparation of students with the critical thinking and problem-solving skills needed in the information-dense world of today.

The study can be of interest to policymakers who can use its findings to reform education and allocate available resources in such a way that these literacies are given priority in national standards. By doing so, it prepares students to enter into careers that relate in some way to numbers like healthcare, economics, and technology, creating a more data-satisfied workforce.

Theoretical Framework

This study is guided by Constructivist Learning Theory, Situated Learning Theory, Bloom's Taxonomy, Zone of Proximal Development, Critical Pedagogy, and Technological Pedagogical Content Knowledge (TPACK).

According to constructivist learning theory developed from the works of Jean Piaget and Lev Vygotsky (Chand, 2023), learners acquire new knowledge through modification of what they already know in their minds. This also states that learning is an active process whereby information is assimilated and accommodated into the learner's knowledge base. This is well demonstrated in statistical literacy, in which students are taught how to analyze data and make conclusions on the back of known concepts and new concepts they are learning (Sharma & Shukla, 2023). Students' knowledge of general statistical facts or concepts broadens if they can link those ideas in some way to realistic examples, including their assessments of obtained data (Koskinen & Pitkäniemi, 2022). They recommend the use of instructional techniques, exploring the relationship between content and application to enhance real learning.

According to Situated Learning Theory by Jean Lave and Etienne Wenger, learning occurs through the social interactions of a person with his environment (Patel, 2017). This approach has direct applications in teaching research and statistical literacy, including implications for learning through the use of genuine research papers and data tools. It was found that students who engaged with real-life activities in research were more interested and had a better understanding of statistical procedures (Marley, Siani, & Sims, 2022). Although technical language and complicated data presentation cause learning difficulties (Bargagliotti & Gould, 2022). To address these limitations, building effective learning settings that imitate real-world research situations is vital for students to develop critical evaluation abilities, which are required for assessing empirical results.

Applying Bloom's Taxonomy helps classify learning outcomes and is committed to the use of higher-order thinking skills, such as analysis, evaluation, and creativity (Main, 2023). These are important abilities that one must have while dealing with AI. The current growth of AI presents a challenge that while students are only proficient in AI literacy, they have to shift to becoming analytical to understand how these systems work and their effects on society. The above competencies are essential in an institution of higher learning since these educational institutions equip learners to work in environments characterized by rapid technological advancement.

Understanding the Zone of Proximal Development (ZPD) is vital if you want to understand the ways that learners develop from tasks they can do independently to ones they need assistance with containing Lev Vygotsky's ZPD (Cherry, 2023). In the context of teaching statistical and AI literacy, educators can use these scaffolding techniques to structure the paths of support for students as they work through complex, unimagined concepts.

Guided learning experiences have been shown to significantly improve students' abilities in statistical reasoning and AI application (Wang et al., 2024). Educators can provide the support students need to gain independence and mastery of increasingly challenging material by slowly reducing assistance as students gain confidence.

Freire's Critical Pedagogy appeals to education as a form of social transformation that aims to create a critical consciousness among students (Uddin, 2019). This theory fits well with promoting statistical and AI literacy among students to allow them to critically engage with data and participate in informed democratic processes. Encouraging students to analyze and critique data representations and understand the social and political implications of statistical information leads students to become more skilled at navigating complexities in contemporary society (Darling-Hammond et al., 2020).

The TPACK framework consists of three key components: pedagogical knowledge (PK), technological knowledge (TK), and content knowledge (CK) (Ning et al., 2024). Thus, in the context of this study, CK component refers to the knowledge of statistical methods, research processes, and AI technologies; PK component refers to effective instructional strategies that engage students with these concepts; and TK component refers to the integration of technology, such as statistical software and AI tools, into teaching practice. Further research indicates that the implementation of TPACK can enable students to direct their theoretical knowledge to practical applications to bridge gaps in their statistical, research, and AI literacy (Celik, 2023). It fits in this framework that helps provide a range of ability-based teaching modules that can handily blend these literacies and equip students with those skills to survive in a data-driven world.

This study is supported by educational theories that together constitute an approach for enhancing statistical, research, and AI literacy. Constructivist Learning Theory suggests that new knowledge is built by incorporating the new knowledge in the existing cognitive structures; therefore, it requires active engagement of the learner in learning statistical concepts. The Situated Learning Theory supports learning through real, context-rich experiences and, for that reason, favors research experiences in which students are involved in actual world research. Bloom's Taxonomy offers insight into addressing the development of higher-order thinking skills such as analysis, evaluation, and creativity when it comes to understanding and using complex data. This highlights the rationale for using scaffolding techniques, as they help students transition gradually from guided learning to independent problem-solving. Education, as articulated by Critical Pedagogy, transforms itself to allow for students to critically engage with data and with society through various issues. Finally, the TPACK includes content, pedagogical, and technology knowledge and makes certain that teaching strategies will employ modern tools and methods in the process of teaching. These theories together develop a comprehensive framework that supports the development of a multi-dimensional literacy essential for navigating today's data-driven world.

Conceptual Framework

There are three main variables in the study, namely, *research literacy, AI literacy*, and statistical *literacy*. Research literacy has four domains, which are research awareness, attitude toward research, research skills, and research use. AI literacy also has four domains, namely, affective learning, behavioral learning, cognitive learning, and ethical learning. Statistical literacy has two domains in this study: descriptive and inferential.

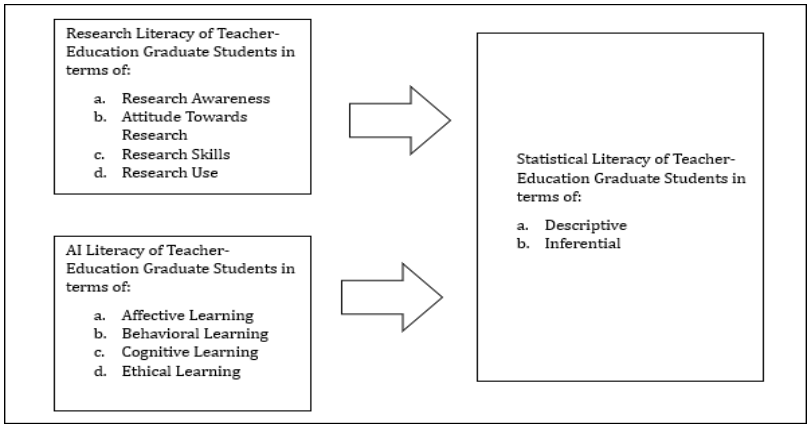

Figure 1. Research Paradigm of the Study

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Research literacy (RL) is defined as the capacity to grasp completely research's functions and operation in different contexts. It includes the ability to find, interpret, discuss, and critically evaluate various kinds of research. Also, research literacy involves communicating of research findings in an effective manner and applying these insights for academic, professional, and practical use. Research literacy is a part of teachers' effectiveness and their professional identity (Kazancı & Sezgin, 2023). Research literacy is the extent to which educators, such as teachers and institutional leaders, are current with different research methods, research findings, and studies and the consequences of these studies for day-to-day teaching practice and also on the larger work of education policy and practice (Li, 2022). This definition underlines the need to bring research knowledge into everyday decision-making in educational practice.

Research awareness looks at a teacher's prior knowledge and experience in doing and reading research. It focuses on their familiarity with research processes and the importance of being informed by existing studies. *Attitude toward research* assesses teachers' attitudes towards the use of research in the teaching profession. It examines how much practitioners believe such research would better serve them in the areas of professional growth and development, and the extent to which practitioners believe educators—such as teachers—should use research in their practices. *Research skills* are made up of many kinds of literacy. It encompasses information/technological literacy; that is, the ability to locate, access, assimilate, analyze, organize, and critically evaluate information on a research topic within a field of study; verbal literacy relating to the discussions that can be had about a piece of research; and visual literacy, the ability to appropriately read visual representations of information in the form of tables or figures within a piece of research. *Research use* involves its application to support teachers' professional and pedagogical development. Some of the research here includes student and teacher reading research for personal growth, integration of the knowledge gained from the research into daily teaching practices, and the use of research to inform decisions made in the classroom (Kazancı and Sezgin, 2023).

Research literacy is measured using a questionnaire adapted from Tinmaz and Sezgin's Research Literacy Scale for Teachers. It was comprised of statements that assessed various aspects, such as identifying the necessary information for research, familiarity with research topics and sources, and the capacity to critically evaluate study designs and interpret data, that respondents indicated their agreement on each statement on a four-point Likert scale, providing a quantifiable measure of their research literacy.

AI literacy is the ability to understand the concepts in AI, be familiar with AI tools, evaluate AI technologies critically, and interact with them ethically and societally. It includes how knowledge about the collection, manipulation, and analysis of data by AI systems; how knowledge is used for practical applications; and knowledge about the broader impacts of AI (Ng et al., 2021; Long & Magerko, 2020).

Affective learning is where students are emotionally attached to a given topic; for example, how interested, motivated, confident, and how they feel toward that particular topic. It shows how learners emotionally make sense of AI literacy, creating a net positive on the motivational end of the spectrum—curiosity and self-efficacy might drive deeper engagement. Observable and measurable actions and performance, including active participation, course completion, collaboration, and engagement in learning tasks, constitute *behavioral learning*. This could be in AI literacy in students' active use of AI tools, collaboration on AI-related tasks, and engagement in related outcomes. Superficially, *cognitive learning* might be characterized as knowledge acquisition and thinking skills, from the basic level to the critical evaluation level. It refers to students understanding some core AI concepts, learning about how AI systems work, and second-order thinking on how to use AI systems. The *ethical learning* aspect emphasizes learning moral principles toward responsible use of technology. This includes knowledge about AI ethics, privacy, social responsibility, and digital rights in AI literacy so that students can use AI technologies responsibly, taking into account societal impacts (Ng et al., 2021).

AI literacy was measured using a survey questionnaire from Ng et al.'s paper, assessing the level of learning in every area. The survey contains statements that reflect affective responses towards AI, usage frequency of AI tools, familiarity with AI concepts and applications, and views regarding ethical matters such as data privacy and bias. Every statement is scored on a four-point Likert scale, providing a measurement of students' proficiency in AI literacy.

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Statistical literacy means being able to interpret and evaluate statistical information critically and to communicate in the statistical language. It includes the understanding of basic known statistical concepts like variability, correlation, and probability and how to apply them in real-world problems. Technical skills are only a part, of this since they include the ability to assess data source credibility, to analyze data in context, and to come to decisions based on the use of statistical reasoning (Ozmen & Baki, 2021).

Statistical literacy in this research was assessed using a 15 multiple-choice questions modified from Yusof et al. (2018). These questions address the fundamental statistical ideas, such as measures of central tendency (mean, median, mode), variability, hypothesis testing, and data analysis methods. By choosing the right answers among the options, students' proficiency in using statistical concepts is quantitatively measured.

Descriptive statistics summarize the data using measures like central tendency (mean, median, mode) and variability (range, variance, standard deviation). They help organize and present data types visually through graphs or charts. Inferential statistics, on the other hand, involves making predictions about a population based on a sample. This includes hypothesis testing, using p-values to assess statistical significance, and applying parametric (e.g., t-tests, ANOVA) or non-parametric techniques for data analysis, helping conclude the immediate dataset (Yusof et al., 2018).

As a result, this study contributed to identifying the primary characteristics that encouraged literacy in statistics learning, which achieves the study's objectives. In addition, this framework emphasized the relationships between different literacies in assisting educators in dealing with the data-driven settings of today's learning environments.

Statement of the Problem

This study aimed to determine the predictors of teacher-education graduate students' statistical literacy during the school year 2024-2025 and evaluated the graduate student’s research literacy and AI literacy profiles.

Specifically, this study answered the following questions.

1. What is the level of statistical literacy of the graduate students in terms of

a. Descriptive

b. Inferential

2. What is the profile of Teacher Education graduate students in terms of

a. Research Literacy

a.1 Research Awareness

a.2 Attitude toward Research

a.3 Research Skills

a.4 Research Use

b. AI Literacy

b.1 Affective Learning

b.2 Behavioral Learning

b.3 Cognitive Learning

b.4 Ethical Learning

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3. Which among the profiles significantly influences the statistical literacy of the Teacher Education graduate students?

Statement of Null Hypothesis

In this study, the null hypothesis is formulated to determine the influence of profile variables on the statistical literacy of Teacher Education graduate students.

H_0: There is no significant influence of any profile variable on the statistical literacy of Teacher Education graduate students

METHODOLOGY

Research Design

The descriptive-predictive research method was used in this study to determine research literacy, AI literacy, and statistical literacy of the teacher-education graduate students and used it to predict the statistical literacy of the graduate students. The descriptive-predictive research method combines the qualities of descriptive and predictive research (Ma, 2020). Descriptive research begins with a study that details a phenomenon, and answers the "what, who, where, and when" (Sirisilla, 2023). Data were collected and analyzed in this phase to draw the current picture. It then followed and included predictive research, which predicted future outcomes from information extrapolated using data and answers to the question of 'how' and 'why' (Cote, 2021). This method integrated these phases and gave researchers an understanding of what is currently happening in addition to informing predictions for the future. The descriptive part involved analyzing and sorting out the students' literacy levels in every chosen domain. At the same time, the predictive component aimed at defining which of the literacies analyzed predicts the subject in question – statistical literacy.

Research Environment

This research was conducted at Saint Mary's University, Bayombong Nueva Vizcaya, which enjoys Autonomous Status granted by the Commission on Higher Education (CHED), the study was specially conducted at the School of Graduate Studies whose Teacher Education and Business Programs are Level III accredited by Philippine Accrediting Association of Schools, Colleges and Universities (PAASCU). With numerous graduate programs in areas such as education, business, and the sciences, the university setting is ideal for conducting further research and identifying graduate competencies in statistics, research, or AI literacy.

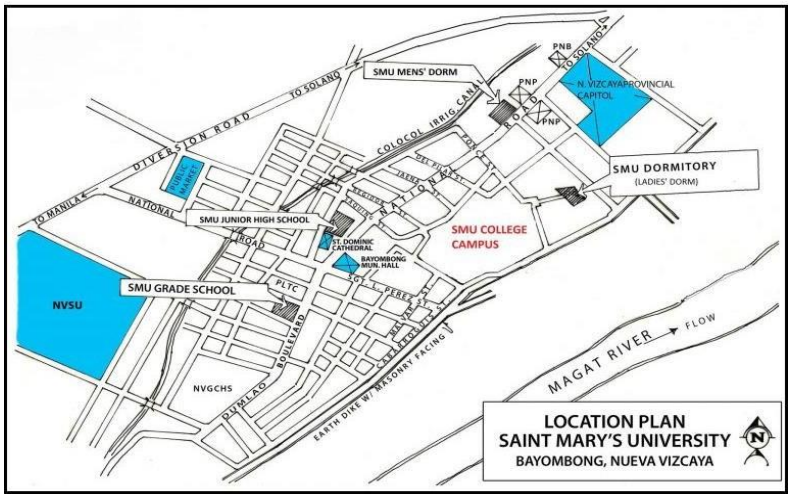

Figure 2. Research Locale

Source: https://smu.edu.ph/smu-saint-marys-university/maps-and-directions/

In furtherance of its mission to produce competent and ethical professionals, SMU incorporates the practice and generation of research and innovation into the curriculum to enhance critical thinking skills, data analysis, and

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technological capabilities. The School of Graduate Studies of the University aims to offer post-graduate education and train students to become skilled in research techniques, analysis of data, and preparation for their careers. Having employed libraries, online databases, and research tools, SMU graduate students have the opportunity to do academic and data research.

By analyzing the research literacy, AI literacy, and statistical literacy of Teacher Education graduate students, this research maximized their ability for critical inquiry and evidence, in line with Saint Mary's University School of Graduate Studies' vision and mission to "continuously challenge professionals to explore and pursue relevant, innovative, and breakthrough ideas through research and development." (SMU SOGS Student Handbook), professionals who acquire these competences are better suited to contribute to knowledge growth, inspire educational innovation, and address relevant concerns in their respective disciplines. This study illustrates the university's dedication to producing professionals who are not just academically prepared but also make meaningful, research-based contributions to society.

Respondents of the Study

The respondents of the study were teacher-education graduate students at Saint Mary's University. In particular, the research focused on the graduate students who pursued their studies in Teacher Education and Humanities (TEH) under the programs Master of Arts in Teaching (MAT), Master of Arts in Education (MAED), and Master of Science in Teaching (MST). According to the university registrar, in the first semester, the enrollment numbers were as follows: MAT had 77 enrollees, MAED had 83, and MST had 35, while in the second semester, MAT had 55 enrollees, MAED had 73, and MST had 37.

Inclusions/Exclusion Criteria

The inclusion criteria for selecting respondents of the study are as follows: students who are enrolled in SGS under TEH and those who finished the Research Methodology and Educational Statistics courses under the three programs (MAT, MAED, and MST).

The exclusion criteria include students taking the Research Methodology and Educational Statistics courses under the three programs (MAT, MAED, and MST) during the school year 2024-2025.

For this study, the use of purposive sampling with total enumeration is pursued to ensure all respondents from the TEH under MAT, MAED, and MST programs at Saint Mary's University in the school year 2024-2025. The advantages of this approach are that you can select people who fulfill the unique criteria required for assessing statistical, research, and AI skills in these departments. Here, by selecting students with these pertinent characteristics, the study obtained relevant data concerning the context of the study, which helped the study gain a comprehensive view of how these influenced statistical literacy.

The benefits of purposive sampling are especially evident in this case because it allowed the researcher to focus on selecting a specific group of respondents who specifically bear on the research questions and goals. Total enumeration is used ensuring all eligible graduate students are considered and it allows a greater depth and efficiency of probing into the research questions presented in this study. The respondents were in a well-analyzed state when this method was used.

To maintain respondents' privacy and guarantee data confidentiality, the study took strict measures. The responses were anonymized and were not associated with any of the respondents. The researchers were authorized to use respondents' data after completing an ethical and institutional review, properly archiving it, securing it in a protected format, and ensuring that only the researcher had access. The data will be disposed of after one year in case a follow-up is necessary. Following university approval, each respondent was informed about the study and was asked to provide informed consent before it began; the respondent received a clear explanation of the study's aims, benefits, risks, and voluntary nature. When responding to a program, respondents had the chance to ask questions before consenting to participate so that participation fits within an informed and comfortable environment for them all.

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Instrumentation

This study used a questionnaire and survey to gather the data. The material consisted of three parts. The first part included the respondents' demographic profile, including course, gender, and age, and a questionnaire to measure the research literacy of the respondents. The second part was a survey to measure the respondents' AI literacy. The third part was a test questionnaire of their statistical literacy.

The material in measuring their research literacy was based on the questionnaire made by Tinmaz and Sezgin (2023).

Research Literacy Measurement

The Research Literacy Scale for Teachers by Tinmaz and Sezgin assessed four key dimensions: Research Awareness, Attitude toward Research, Research Skills, and Research Use. Research Awareness evaluated teacher education graduate students understanding of research fundamentals, while Attitude toward Research measured their perceptions of its importance in their profession. Research Skills examined practical abilities like conducting literature reviews and interpreting data, and Research Use explored how teachers apply research in their work.

The convergent and discriminant validity, along with the reliability, of the Research Literacy Scale were also rigorously examined. It was confirmed by a study that the convergent validity was fulfilled since all the values for Average Variance Extracted (AVE) and Composite Reliability (CR) are adequately beyond a threshold. Specifically, the Average Variance Extracted and Composite Reliability values for the Awareness factor were .56 and .83, respectively; for the Attitude factor, .50 and .75; for the Skills factor, .54 and .87; and for the Research Use factor, .56 and .90. All the values are more than the minimum required, which indicates that the scale effectively measures the constructs it seeks to assess (Tinmaz & Sezgin, 2023).

Discriminant validity was established by assessing whether the Average Variance Extracted values were greater than the squared correlations between factors. In general, the Average Variance Extracted values were larger than the squared correlations, so discriminant validity was confirmed. There were, however, three occasions when the squared correlations were more significant than the Average Variance Extracted for the corresponding factors: Research Use-Skills (.59), Skills-Awareness (.55), and Attitude-Research Use (.52). Despite this, the overall results support the discriminant validity of the scale since most correlations among the factors were small.

The reliability analysis of the Research Literacy Scale proved strong internal consistency. The item-total correlations ranged from .48 to .72, and the reliability coefficients for all measures were fairly satisfactory. Cronbach's alpha for the entire Research Literacy Scale was .94, but sub-factors included Skills at .88, Research Use at .90, Attitude at .83, and Awareness at .83. Spearman-Brown coefficients and Guttman's Lambda-1 values were high, while McDonald's Omega values ranged from .75 to .90, thereby having an excellent composite reliability. More precisely, Theta, calculated at .93, expresses even more about the internal consistency of the scale.

The Research Literacy Scale attains rather strong convergent validity while exhibiting generally satisfactory discriminant validity. Convergent validity was established by checking the Average Variance Extracted (AVE) and Composite Reliability (CR) for every sub-factor while the discriminant validity was checked by comparing the Average Variance Extracted values for every factor with the squared correlations between the factors Moreover, the scale affords high reliability, thus proving to be a robust tool for the intended measurement of research literacy in the context of this study.

Table 1. Items for Research Literacy

Component	Item Number	Total Items
Research Awareness	1,2,3,4	4
Attitude Toward Research	1,2,3	3

Research Skills	1,2,3,4,5,6	6
Research Use	1,2,3,4,5,6,7	7
	Total Items	20

Source: Tinmaz and Sezgin (2023)

Table 1 provides a breakdown of the items used to assess different components of research literacy. It highlights the distribution of items across four domains, which are Research Awareness that has 4 items, Attitude Toward Research that has 3 items, Research Skills with 6 items, and Research Use with 7 items, for a total of 20 items.

For the AI literacy of the respondents, the material used was based on the study of Davy Tsz Kit Ng, Chee Wei Tan, and Jac Ka Lok Leung (2023).

AI Literacy Measurement

The dimensions in the AI Literacy Questionnaire measured the different learning outcomes are four in number: Affective, Behavioral, Cognitive, and Ethical learning. These were essential dimensions in the evaluation of students' understanding, engagement, and ethical consideration of AI. Below is an overview of each of these dimensions and the corresponding measured learning outcomes.

The Affective Learning dimension gauged intrinsic motivation, self-efficacy, career interest, and confidence in learning about AI. It measured satisfaction with the activities about AI, belief in one's ability to succeed, interest in the use of AI for future careers, and comfort with AI technologies. Behavioral Learning measured how much the student engaged with AI activities, intended to continue learning the subject, and thus being involved. Proactive learning strategies involved time management, collaboration with co-students, and the drive to try new technologies in AI. Cognitive Learning involved both lower and higher-order thinking; it ranges from knowing basic concepts about AI to the application, analysis, and creation of AI-driven solutions. Ethical learning focused on AI ethics, such as fairness, transparency, accountability, and the social impact of AI understood by students themselves, and sets the thinking of ethical issues and responsibilities.

Table 2. Internal Consistency of AI Literacy Questionnaire

	Cronbach's alpha (α)	McDonald's omega (ω)
Affective learning	.88	.90
Behavioral learning	.88	.89
Cognitive learning	.91	.93
Ethical learning	.84	.86

Source: Davy Tsz Kit Ng, Chee Wei Tan, and Jac Ka Lok Leung (2023)

Table 2 above presented the reliability of the dimensions of the instrument, which was determined through Cronbach's alpha (α) and McDonald's omega (ω). Reliability results using these were all high, thus: Affective Learning (α = .88, ω = .90); Behavioral Learning (α = .88, ω = .89); Cognitive Learning (α = .91, ω = .93); and Ethical Learning (α = .84, ω = .86). These high-reliability scores of the dimensions of the instrument indicate a highly consistent and dependable instrument used to measure Affective, Behavioral, Cognitive, and Ethical Learning. Thus, these results present that the tool was reliable in the measurement of such different aspects of the AI literacy of students, ensuring stability and accuracy of the measured outcomes.

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The researcher emailed or wrote to the respective authors requesting formal approval to use the research instruments. To start with, the researcher went through this process by getting permission to write and giving a very brief overview of this study that is being done to respect their intellectual property.

Table 3. Items for AI Literacy

Component	Item Number	Total Items
Affective Learning	1,2,3,4,5,6,7,8,9,10	10
Behavioral Learning	1,2,3,4,5,6,7,8	8
Cognitive Learning	1,2,3,4,5,6	6
Ethical Learning	1,2,3,4,5,6,7,8	8
	Total Items	32

Source: Davy Tsz Kit Ng, Chee Wei Tan, and Jac Ka Lok Leung (2023)

Table 3 provides a breakdown of the items used to assess different components of AI literacy. It highlights the distribution of items across four domains, which are Affective Learning that has 10 items, Behavioral Learning that has 8 items, Cognitive Learning with 6 items, and Ethical Learning with 8 items, for a total of 32 items.

Lastly, for the statistical literacy of respondents, the material was based on the study of Yusof et. al. (2018).

Statistical Literacy Measurement

This research instrument aimed to ascertain the respondent's total statistical literacy by evaluating their archival familiarity with statistical concepts and ideas used in data analysis. The tool comprised 15 items that belonged to sub-test areas which are; central tendency, variability-dispersion, hypothesis testing p-value, measurement data type, parametric and non-parametric statistical techniques, and data analysis by numerical tabular or graphical means.

A high Cronbach's Alpha score of 0.85 for this research instrument provided strong internal consistency for this research instrument in measuring statistical literacy. Moreover, a kappa value of 0.89 represents high agreement in response, thus, supporting the dependability of the instrument. These reliability indicators, together, confirm that the tool does indeed capture reliable, consistent, and accurate measures of students' understanding of important statistical concepts. The present instrument helped assess statistical literacy since it assesses understanding and reasoning processes as well as practical skills involved in statistical literacy with high validity and reliability.

Table 4. Item Distribution According to Statistical Literacy Components

	Item Number	Total Items
Descriptive	3,4, 8,13	4
Inferential	1,2,5,6,7,9,10,11,12,14,15	11
	Total Items	15

Source: Yusof I. J., Abdul Latif A., Amin N. F., Hassan A. M., Arsat M., Musta'amal A. H. (2018)

Table 4 shows the distribution of the items according to various aspects of statistical literacy. The instrument comprised fifteen total items, each of which corresponded to particular statistical ideas. There were four items

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in descriptive and eleven for inferential. Under descriptive three items are designated for the measurement of central tendency and they are item 8, variability/ dispersion item 3, and two content area items address types of measurement data (Items: 4; 13). Inferential on the other hand has five items included in the aspects of both parametric and non-parametric statistical methods (Items: 2; 5; 7; 9; 12), five items are related to the data analysis (Items 1, 6, 11, 14, 15) and test of hypothesis using p-values, item 10 making it a potent instrument to measure statistical literacy in all segments of a course.

Data Gathering Procedure

The data collection began after the completion of the questionnaire and survey, testing for clarity, and approval by the adviser, panel members, and the Saint Mary's University Research Ethics Board (SMUREB). The researcher first wrote a formal letter to the Dean of the SGS. The research portion of this letter formally asked permission to get to the university and distribute the surveys to the target respondents, who were graduate students enrolled in TEH under the MAT, MAED, and MST programs at SMU.

Once the relevant authorities approved, the researcher worked with the SGS on a suitable timeline for administering the questionnaires and surveys, which were administered in February 2025. Before starting the survey distribution, the researcher prepared all the required documentation, including an informed consent form, informing the informants about the study purpose, the voluntary nature of their participation, and the rights related to privacy and confidentiality.

Surveys and questionnaires were administered personally during designated free periods or after class hours to maximize participation and avoid class disruptions, and for those who are already in the thesis writing stage and do not have face-to-face classes, the survey was given through Google Forms to participate. Another point is that the researcher made sure that the survey and questionnaire were given ample time, which is 1-2 hours, to be filled in so they do not answer haphazardly. All respondents were provided with clear, concise instructions and the researcher was available to address questions or concerns as the survey process unfolds.

After receiving all the questionnaires, the researcher carefully sorted and coded the data to the extent that it could be analyzed. It is with meticulous organization in place that the researcher was able to smooth out an efficient analysis of the data while maintaining data integrity and quality. The researcher followed ethical standards throughout the data collection process; namely, the rights of the respondents were respected, and care was taken to handle the collected data with respect. Not only did the respondents suffer no harm and were free to withdraw participation at any time if they chose to, but the reliability and validity of the research were also enhanced through this ethical approach.

Treatment of Data

In this study, the quantitative research approach was used to analyze and interpret data collected from the validated questionnaires and surveys using software such as Excel and SPSS. This treatment of data systematically addressed the research questions and showed how graduate students' research literacy, AI literacy, and statistical literacy are related, and how the other literacies assessed could be used to predict the statistical literacy of the respondents.

Descriptive measures such as means, medians, standard deviations, and percentages were calculated for every aspect of the research and AI literacy for students' awareness, attitudes, skills, and incorporation of research and affective, behavioral, cognitive, and ethical perspectives of AI. In addition, to analyze the data, frequency distributions and percentages were also calculated. The findings of the analysis provided respondents general views about research literacy and AI literacy, as well as compare the results of their performance in different components.

The questions in the Statistical Literacy Test were formatted in such a way that they are objective questions, and each question has only one correct answer, thus, the respondents get 1 mark for each correct answer. The total score gave the measure of the literacy level of the respondent in statistics. Table 5 below shows the Rasch measurement model of the literacy level thresholds for allocating the respondent's literacy level. These threshold

values are expressed in logits concerning Mean and Standard Deviation where the value of M represents the mean and SD depicts one standard deviation from the mean thereby representing the standard measures of the degrees of mastery.

Table 5. Levels of Statistical Literacy

Statistical Literacy Level	Z-scores	Description
Very Low	≤ -1.24	Indicates a significant deficiency in statistical understanding and skills.
Low	- 1.24 < Low < -0.62	Reflects below-average statistical skills, with some understanding of concepts.
Moderate Low	-0.62 ≤ ML < 0. 00	Shows a basic level of statistical literacy, capable of handling simple analyses.
Moderate High	≤ MH < 0.62	Demonstrates a solid understanding of statistical concepts and ability to analyze data effectively.
High	0.62 ≤ High < 1.24	Indicates strong statistical skills, with the ability to interpret complex data confidently.
Very High	≥ 1.24	Represents exceptional statistical proficiency, capable of advanced analysis and interpretation.

Source: Yusof I. J., Abdul Latif A., Amin N. F., Hassan A. M., Arsat M., Musta'amal A. H. (2018)

Table 5 classified statistical literacy levels into six distinct categories: Very Low, Low, Moderate Low, Moderate High, High, and Very High. These categories were categorized with the help of distinct parameters. The classifications made by respondents relied on their personal measure z-score values as obtained from measurement using SPSS. Individuals with a z-score value of ≤ -1. 24 are considered to possess Very low Research literacy and those who are ≥ 1. 24 are considered to possess Very high Research literacy. This method was consistently applied to categorize respondents into the remaining levels: There are five levels of intensity, including Low, Moderate Low, Moderate High, and High. To measure the overall statistical literacy, the median will be used as a treatment of data. the median will help identify the central tendency of the data, providing a more accurate assessment of overall statistical literacy across respondents.

Table 6. Likert scale interpretation for Research Literacy in terms of Research Awareness

Likert Scale	Description	Value Allocation	Qualitative Description
4	Fully Aware	3.50-4.00	Respondents have a strong and confident understanding of the research concept.
3	Moderately Aware	2.50-3.49	Respondents have a fair understanding but may need additional guidance.
2	Slightly Aware	1.50-2.49	Respondents have minimal awareness but lack a clear understanding.
1	Not at all Aware	1.00-1.49	Respondents have no knowledge or awareness of the research concept.

Source: Vagias, Wade M. (2006)

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Table 6 displays the 4-point Likert-type response format ranging from "Not at all Aware" to "Fully Aware" for the scale measurement. The scale established the level of research awareness that respondents believe they possess. The evaluation constituted a 4-point scale that measured their understanding of some of the basic concepts of research, including identifying the information that is needed, research topics, scientific research, and how published research is known. It is a bit unsettling to respondents and leads them to a true self-assessment of their research awareness, hopefully to more accurate reflections of what they know and understand.

Table 7. Likert scale interpretation for Research Literacy in terms of Attitude Towards Research.

Likert Scale	Description	Value Allocation	Qualitative Description
4	Highly Positive	3.50-4.00	Respondents feel very positively about the statement.
3	Positive	2.50-3.49	Respondents feel positively about the statement.
2	Negative	1.50-2.49	Respondents feel negatively about the statement.
1	Highly Negative	1.00-1.49	Respondents feel very negatively about the statement.

Source: Vagias, Wade M. (2006)

The scale consisted of a 4-point Likert-type response format, ranging from "Highly Positive" to "Highly Negative", which is represented in Table 7. It provided a measure of the extent of the teacher's attitude toward each of the statements. Surprisingly, no reverse-coded items have been included in this scale, so it is easy to respond and minimize the response biases. With this format, the respondents were driven either towards a positive or negative attitude with the statement, which may have reflected more authentic estimates of their attitude, belief, or behavior.

Table 8. Likert scale interpretation for Research Literacy in terms of Research Skills.

Likert Scale	Description	Value Allocation	Qualitative Description
4	Highly Competent	3.50-4.00	Respondents are confident and proficient in research tasks.
3	Moderately Competent	2.50-3.49	Respondents can perform research tasks with some guidance.
2	Slightly Competent	1.50-2.49	Respondents have basic knowledge but struggle with research tasks.
1	Not at all Competent	1.00-1.49	Respondents have no ability or confidence in performing research tasks.

Source: Vagias, Wade M. (2006)

The scale consists of a 4-point Likert-type response format, ranging from "Not at all Competent" to "Highly Competent," as presented in Table 8. It evaluated respondents' subjective skill level on various research-related skills, like conducting a literature review, analyzing research data, interpreting statistical results, and writing academic papers. It gave a scale of their confidence and capability of being able to complete critical research tasks. This approach provided a better evaluation of research literacy because it identified areas where further training or support would be appropriate.

Table 9. Likert scale interpretation for Research Literacy in terms of Research Use.

Likert Scale	Description	Value Allocation	Qualitative Description

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4	Always	3.50 - 4.00	Respondents fully integrate scientific research into their professional activities and decision-making.
3	Sometimes	2.50 - 3.49	Respondents frequently use scientific research in their professional activities but may not rely on it consistently.
2	Rarely	1.50 - 2.49	Respondents occasionally refer to scientific research but do not actively integrate it into their practice.
1	Never	1.00 - 1.49	Respondents do not use scientific research in their professional activities.

Source: Vagias, Wade M. (2006)

Table 9 presents this scale as a 4-point Likert-type response format (Never—Always). It provided an index of how much respondents made use of scientific research in doing their professional work. Such uses of research included planning for things done daily, like professional development, preparing for a course, evaluating teaching practices, and communicating with parents. There was no neutral option on the scale, making the respondents choose: whether they are at the high level of research utilization or not, but not sparingly. This design allowed for capturing the actual frequency of research use in professional settings and making more reliable self-assessments.

Table 10. Likert scale interpretation for AI Literacy.

Likert Scale	Description	Value Allocation	Qualitative Description
4	Very High	1.00-1.49	Respondents consistently apply AI concepts, tools, and ethical considerations in their professional and academic activities.
3	High	1.50-2.49	Respondents frequently engage with AI concepts and tools but do not integrate them consistently.
2	Low	2.50-3.49	Respondents have limited engagement with AI concepts and tools, using them only occasionally.
1	Very Low	3.50-4.00	Respondents do not engage with AI concepts, tools, or ethical considerations in their professional and academic activities.

Source: Vagias, Wade M. (2006)

Table 10 shows the scale 4-point Likert type of response format ranging from “Very High " to “Very Low”. It offered the allocation of value against each category as a measure that quantifies how well students are in AI literacy. AI literacy has four dimensions: affective learning, behavioral learning, cognitive learning, and ethical learning. Affective learning captured students' attitudes and motivation towards AI, behavioral learning measured their actual use and interaction with AI tools, cognitive learning measured their knowledge of AI concepts and applications, and ethical learning measured their awareness of ethical concerns about AI.

The 4-point Likert scale responses to the questions about AI literacy and research literacy were used to analyze overall trends in respondent attitude, belief, and behavior to generalize the results for AI literacy and research literacy. There are no reverse-coded items, so the responders’ answers were anticipated to be straightforward, reducing response biases and being clearer in understanding the willingness of responders to both accept research and AI. The study captured a broad view of literacy levels across the sample by calculating average scores for each domain (affective, behavioral, cognitive, and ethical learning for AI literacy; research awareness, attitude, skills, and use for research literacy). The researcher interpreted the findings as representative of trends among a similar population of teacher education graduate students by making this approach generalizable regarding the respondents' AI and research literacy group levels.

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To identify the level of dependency between research literacy, AI literacy, and statistical literacy and quantify the nature of the dependency, a correlation analysis was performed. The correlation coefficients of Pearson were calculated to analyze the linear relationships of the variables. To examine whether statistical literacy is more predicted by research or AI literacy, a multiple regression analysis was conducted with statistical literacy as the outcome variable. By calculating regression coefficients, the relative impact of variables such as research literacy and AI literacy was determined. The model's R-squared value indicated the proportion of variance in statistical literacy explained by these combined literacy variables. This approach helped identify the most significant components of literacy, either individually or in combination, that influenced statistical literacy.

Ethical Considerations

The study was submitted for ethics review to Saint Mary's University Research Ethics Board (SMUREB) with address and contact information at 2nd Floor, Rev. John Van Bauwel Hall, SMU Main Campus, Ponce Street, Don Mariano Marcos; Bayombong, 3700 Nueva Vizcaya, Philippines (email: reb@smu.edu.ph; cellphone: 09177053041).

Conflict of Interest

In conducting this study, the researcher declared that there are no conflicts of interest that may affect the integrity of the results. There were no personal gains or financial incentives associated with this research that could compromise its objectivity or validity. Furthermore, I had no direct personal or professional relationships with the study population or the study site that could influence the outcomes of the research.

Privacy, Confidentiality, and Data Protection

Several measures were implemented to ensure the privacy of respondents and the confidentiality of the data collected in this study. Respondents' responses were kept confidential; specifically, the list of respondents and their corresponding answers were maintained separately to prevent any linkage between individuals and their responses.

Specifically, respondents' answers were kept confidential as the list of respondents was kept apart and their responses were not linked. For additional respondent privacy protection, the dataset contained unique identification codes in place of personal identifiers, and pseudonyms in the report or publication would refer to individuals.

All data collected during this research were stored securely, with access restricted solely to the researchers involved in the project. Digital data was encrypted to safeguard against unauthorized access and breaches of confidentiality. Throughout the study, the handling of personal information was strictly guided by ethical standards and institutional policies.

The collected data were retained for a year following the completion of the study to facilitate any necessary follow-up analyses or reporting. After this retention period, all data were securely disposed of, either by permanently deleting electronic files or by shredding any physical documents to ensure that no identifiable information remained.

Additionally, under no circumstances was any sensitive information obtained during this research be shared with third parties without explicit consent from the respondents. This commitment to maintaining confidentiality was communicated to all respondents before data collection begins, reinforcing the trust and integrity essential to the research process.

Management Vulnerability

In this study, the respondents were graduate students above 18 years old; therefore, parental consent is unnecessary. Instead, the respondents' consent was sought to ensure their autonomy in the decision-making process. Before data collection, the study's purpose and other pertinent details were communicated to the students. This transparency was crucial in ensuring they fully understood their participation.

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Consent forms were provided for the students to sign, affirming their voluntary participation in the study. Participation is voluntary, and students were assured they would not be compelled or pressured to join. To further protect against any potential vulnerability, the recruitment procedures were designed to minimize any undue influence, such as authority dynamics or peer pressure.

To avoid peer pressure and power dynamics, recruitment was done in private settings to address concerns about undue influence in face-to-face data gathering. The researcher also informed the respondent that participation would be voluntary, would not influence academic standing, and would be confidential. The study's participation was optional for graduate students - neither school authorities nor their peers could force them to participate. Respondents had enough time to review and sign the consent forms and ask questions independently. In data collection, the power dynamics will be kept neutral and professional, giving voice to respondents' autonomy.

Risk/Benefit Ratio

This study posed some risks to respondents, including potential emotional or psychological discomfort when discussing their statistical literacy, research literacy, or AI literacy skills. However, these risks were minimal and were carefully managed by providing thorough information about the study's nature and purpose before obtaining consent, ensuring respondents could make informed decisions. No rewards were offered for participation, and students did not face disadvantages for opting out, as their academic performance and grades remained unaffected. The benefits of this research extended beyond the individual, as the findings informed educational practices and curricula, ultimately enhancing the academic environment at Saint Mary's University and contributing to the development of competent professionals. By prioritizing respondents' well-being and implementing measures to address any discomfort, the potential benefits of this study significantly outweigh the minimal risks involved.

Informed Consent

The informed consent process was conducted before data collection, ensuring that respondents fully understood the purpose and scope of the study. Initially, the informed consent form was presented to the relevant administrative offices of Saint Mary's University to secure institutional approval for the research. Once this approval was obtained, the consent forms were distributed directly to the graduate students participating in the study.

During this phase, the researchers explained the study's objectives, potential risks and benefits, and the voluntary nature of participation. Students had the opportunity to ask questions and clarify any concerns before signing the consent form. The individuals involved in this process included the researcher and the respondents themselves.

Given that all respondents were graduate students aged above 18 years old, parental consent is not required. Informed consent was sought directly from the respondents, ensuring they voluntarily agreed to participate in the study. This process took place in a setting that allowed for open dialogue, ensuring respondents felt comfortable and informed about their involvement. The informed consent forms were collected and securely stored, maintaining the confidentiality of all respondents.

Terms of Reference

This study was conducted without external funding or insurance involvement. As per the policies of Saint Mary's University (SMU), the ownership of intellectual property rights for the research results was governed by university guidelines. While the research output, including any thesis or dissertation produced as a result of this study, was owned by the university, the student researchers will retain authorship rights, acknowledging their contributions to the work.

To effectively disseminate the findings of this research, a dedicated one-class session will be organized for students enrolled in the Educational Statistics course within the Graduate School. This session will serve as a platform to share the results and discuss their implications, fostering engagement and collaborative learning

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among peers. This dissemination plan aims to enrich the academic community's understanding of the study's findings and encourage further discourse on the topic.

RESULTS AND DISCUSSION

Section 1. Level of Statistical Literacy of the Graduate Students

Table 11 presents the overall statistical literacy levels of Teacher Education graduate students, categorized into descriptive statistics, inferential statistics, and overall statistical literacy.

Table 11. Overall Statistical Literacy of the Teacher Education Graduate Students

	Median	Description
Descriptive Statistics	0.141	Moderate Low
Inferential Statistics	-0.088	Low
Statistical Literacy	0.007	Moderate High

*Note: ≤ -1.24=Very Low, -1.24<Low<-0.62, -0.62≤ Moderate Low<0.62, 0.62≤ High<1.24, ≥ 1.24=Very High

The median value for descriptive statistics is 0.141, placing students in the "Moderate Low" category, indicating a basic understanding of this area but with potential gaps in more advanced applications. In inferential statistics, the median is -0.088, classified as "Low," suggesting that students struggle with statistical inference, which may require further instructional support. Meanwhile, the overall statistical literacy median is 0.007, categorized as "Moderate High," reflecting a relatively strong general statistical literacy among the students.

Students displayed inadequate statistical understanding across different domains, and they specifically showed negative feelings toward both cognitive understanding and problem difficulty in statistics. The studied difficulties in inferential statistics provide evidence that students need specialized educational approaches to master this topic (Repedro and Diego, 2021).

The advancement of descriptive statistics achievement level for students depended on statistical reasoning instruction. Students demonstrated conceptual errors regarding measures of central tendency and dispersions during the study, which corresponded to the statistical classification of "Moderate Low" in descriptive statistics (Tirangkoor & Chaiyasang, 2020).

However, this is unlike what a study has revealed, which suggests that graduate students tend to have a very high statistical literacy due to conducting research during undergraduate study (Umar & Yakubu, 2023).

Targeted pedagogical interventions are necessary because the results point towards the presence of graduate students in the Moderate Low category in all three classifications. A research recommends integration of technology, simulation, and hands-on data analysis of statistical understanding (Chance et. al., 2007). To improve comprehension and retention of statistical concepts, universities and educators may have to adopt more interactive and applied learning strategies, like case-based learning, data storytelling, AI-assisted statistical tools, etc.

Table 12 presents the frequency distribution of graduate students at different levels, which are Very High, High, Moderate High, Moderate Low, Low, and Very Low. The descriptive and inferential statistics of students are also reflected in the data, and it offers other insights about graduate students' statistical literacy.

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Table 12. Level of Statistical Literacy of the Graduate Students

Levels	Descriptive		Inferential		Overall	
	F	%	f	%	f	%
Very High	0	0%	6	14.29%	6	14.29%
High	18	42.86%	4	9.53%	10	23.81%
Moderate High	10	23.80%	10	23.80%	5	11.90%
Moderate Low	0	0%	6	14.29%	10	23.81%
Low	6	14.28%	10	23.80%	3	7.14%
Very Low	0	0%	6	14.29%	6	14.29%

In descriptive statistics, the highest percentage was in 'Moderate High' (66.66%). It indicates that most graduate students can summarize, organize, and interpret the data using the mean, median, mode, and standard deviation. However, inferential statistics show a 52.38% of the graduate students showed a 'Moderate Low' level. This distribution suggests there is a large difference in graduate students' ability to carry out inferential techniques such as hypothesis testing, confidence intervals, and regression analysis. It means that a few of them have a stronger grasp of inferential statistics than descriptive statistics. For the Overall statistical literacy, the distribution is even, with 50% in the 'Moderate High' level. The even distribution indicates that while many respondents demonstrate a solid understanding of statistical literacy, there is a balanced representation across other levels as well, with fewer respondents falling into the extremes of very low or very high literacy.

The results show that most graduate students have higher competencies in Descriptive statistics than in Inferential statistics. This is in concordance with a study finding that students tend to engage with inferential reasonings because of misperceptions of probability and sampling distributions (Findley and Lyford, 2019). A study also highlights the need for using more active learning strategies and real-world applications in graduate education because they are not able to develop inferential thinking as much as traditional instruction methods (Cardino & Ortega-Dela Cruz, 2020).

The research outcomes match earlier studies that measured statistical literacy among mathematics education students; a substantial number of students faced difficulty in comprehending statistics because most students were placed in the non-literate category (Apino et al., 2024). The reason for this discrepancy could be that students bring different backgrounds in statistical methods or that students are from different curriculum emphases.

The statistical literacy levels of items in the Statistical Literacy Test are presented in Table 13, together with the frequency distribution and Z scores. Some of these also include the number and percentage of correct responses and standardized Z-scores of item difficulty. With these values, each item is placed within six literacy levels from Very Low to Very High where schools can make inferences regarding the statistical concepts that graduate students are proficient in.

Table 13. Frequency Distribution, Z-score and Quantitative Description of per Item of Statistical Literacy Test

Test Items	Item #	F (Correct Answers)	%	Z-score	Description
Identifies which research competency component shows a significant difference between	1	23	54.76	-0.126	Moderate Low

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undergraduate and postgraduate students. (Inferential)					
Determines the appropriate statistical test to analyze the mean difference in Information Literacy between two study levels. (Inferential)	2	29	69.05	0.906	High
Assesses knowledge of standard deviation (SD) and its role in measuring data variability. (Descriptive)	3	35	83.33	1.938	Very High
Identifies the type of variables used in the study. (Descriptive)	4	32	76.19	1.422	Very High
Determines the most appropriate research question based on the statistical analysis shown in the table. (Inferential)	5	20	47.62	-0.642	Low
Evaluates which statistical conclusion about the choice of compulsory courses is correct. (Inferential)	6	19	45.24	-0.814	Low
Tests understanding of correlation analysis and misconceptions about correlation coefficients. (Inferential)	7	28	66.67	0.734	High
Identifies the appropriate statistical measure for nominal scale data. (Descriptive)	8	29	69.05	0.906	High
Selects the appropriate statistical test for comparing anxiety levels of the same group of teachers at different time points when the data is not normally distributed. (Inferential)	9	20	47.62	-0.642	Low
Examines correct interpretations of the p-value in statistical hypothesis testing. (Inferential)	10	20	47.62	-0.642	Low
Interprets statistical results from a graph related to hypothesis testing and sample size. (Inferential)	11	14	33.33	-1.674	Very Low
Determines the correct statistical test for analyzing changes in Statistics scores over three time periods. (Inferential)	12	26	61.90	0.390	Moderate High
Identifies the types of variables used in the study. (Descriptive)	13	22	52.38	-0.298	Very Low
Evaluates which statistical interpretation is correct based on significant results and post-hoc tests. (Inferential)	14	19	45.24	-0.814	Low
Assesses the correct interpretation of post-hoc test results comparing different student groups. (Inferential)	15	20	47.62	-0.642	Low

*Note: ≤ -1.24=Very Low, -1.24<Low<-0.62, -0.62≤ Moderate Low<0.62, 0.62≤ High<1.24, ≥ 1.24=Very High

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Results on the 15 test items demonstrate a good spread of performance, with many test items on the easier side and other test items that are difficult due to low student mastery of statistical concepts. Item 3 (83.33%, Z = 1.93847) and Item 4 (76.19%, Z = 1.42231) were considered 'Very High' as most graduate students found the questions relatively easy, that is, they showed strong statistical proficiency.

Figure 3 shows item 3 in the statistical literacy test of this study.

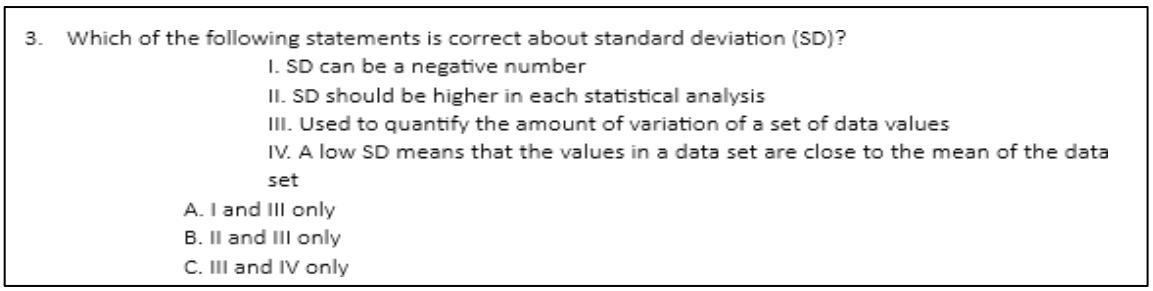
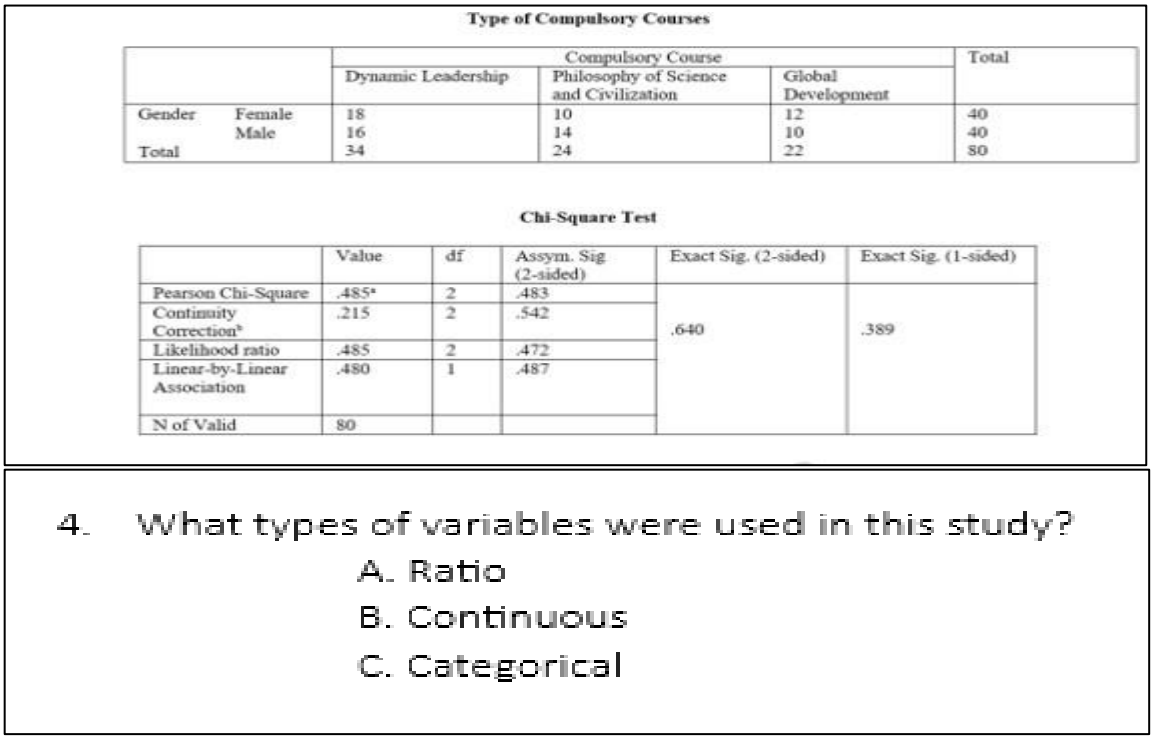


Figure 3. Item 3 in the statistical literacy test.

Figure 3 presents Item 3, which tested the students' standard deviation (SD) knowledge. The question presents four possible statements regarding SD along with their correctness about (I) negative SD, (II) improved statistical analysis through elevated SD, (III) the quantitative nature of SD for data variation, and (IV) how low SD indicates concentrated data near the mean. The correct response is C. III and IV only because standard deviation is always non-negative and does not need high values yet measures data spread while low values indicate mean-centered data clusters.

Figure 4 shows item 4 in the statistical literacy test of this study.



Type of Compulsory Courses

		Compulsory Course			Total
		Dynamic Leadership	Philosophy of Science and Civilization	Global Development	
Gender	Female	18	10	12	40
	Male	16	14	10	40
Total		34	24	22	80

Chi-Square Test

	Value	df	Assym. Sig (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.485[a]	2	.483	.640	.389
Continuity Correction[b]	.215	2	.542		
Likelihood ratio	.485	2	.472		
Linear-by-Linear Association	.480	1	.487		
N of Valid	80				

Figure 4. Item 4 in the statistical literacy test.

Figure 4 presents Item 4, which contains two parts: a table, which is reference data, that displays compulsory course enrollment by gender, and a Chi-Square Test results table followed by Item 4. Item 4 is about determining the variables that appeared in the analysis. The item offers three variable choices which are Ratio, Continuous, or Categorical. The correct answer in Item 4 is C. Categorical, the study includes gender variables classified as categorical because males and females form distinct groups, and types of compulsory courses are also

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categorized as non-numerical variables. This question evaluates statistical content knowledge by testing different variable categories encountered in analytical research.

Further, the percentages composed in Items 2, 7 and 8 (ranges from 66.67% to 69.05%) and Z scores within the range from 0.73410 to 0.90615 were classified as 'High', which means that graduate students generally answered these questions well, and had a solid grasp of the corresponding statistical concepts.

Figure 5 shows item 2 in the statistical literacy test of the study.

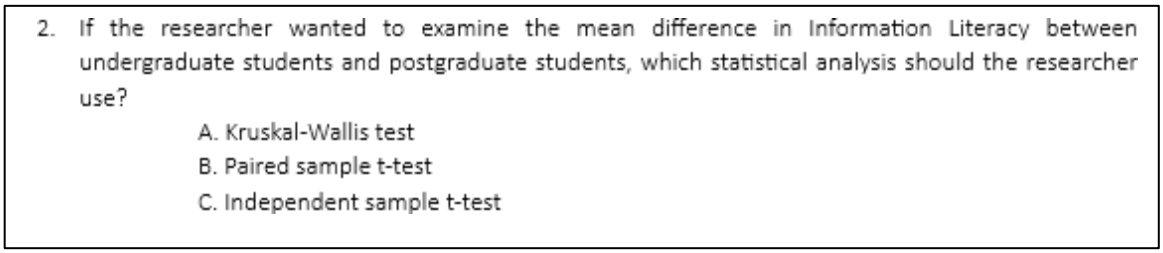

Figure 5. Item 2 in the statistical literacy test

Item 2 is about what is an appropriate statistical method to evaluate the mean Information Literacy variation between undergraduate and postgraduate students. Among the options are the Kruskal-Wallis test, paired sample t-test, and independent sample t-test. Two independent groups require the t-test for independent samples as it represents the best statistical choice to analyze their difference, so the answer is letter C. Independent Sample T-Test.

Figure 6 shows item 7 in the statistical literacy test of the study.

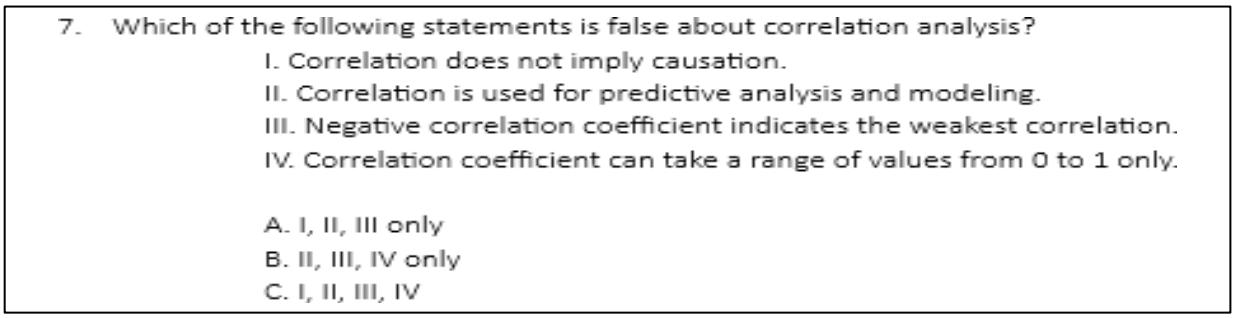

Figure 6. Item 7 in the statistical literacy test

The objective of Item 7 requires to identify wrong statements about correlation analysis. The statements cover key concepts such as the distinction between correlation and causation, the role of correlation in predictive modeling, the interpretation of negative correlation coefficients, and the range of correlation values. Of the provided wrong statements III is incorrect because negative correlations do not signify weakness and IV is incorrect due to correlation values spanning from -1 to 1. The right choice is option B because only sections II, III, and IV are accurate.

Figure 7 shows item 8 in the statistical literacy test of the study.

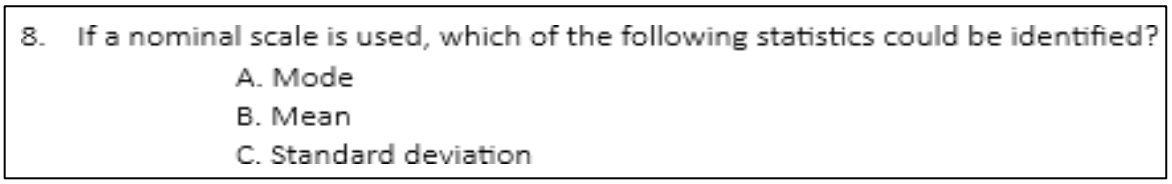

Figure 7. Item 8 in the statistical literacy test

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Item 8 dealt with selecting accurate statistical measures for nominal data distribution. The nominal scale possesses categories that lack inherent numerical values or order so its analysis cannot contain measures such as the mean and standard deviation. The mode proves to be an accurate measure of nominal data because it reveals the most common category. The correct statistical measure for this question is the letter A. Mode.

Moreover, Item 12 (61.90%, Z = 0.38999) was also assigned to Moderate High (relatively strong) but showed a somewhat weak performance in comparison to the High category.

Figure 8 shows item 12 in the statistical literacy test of the study.

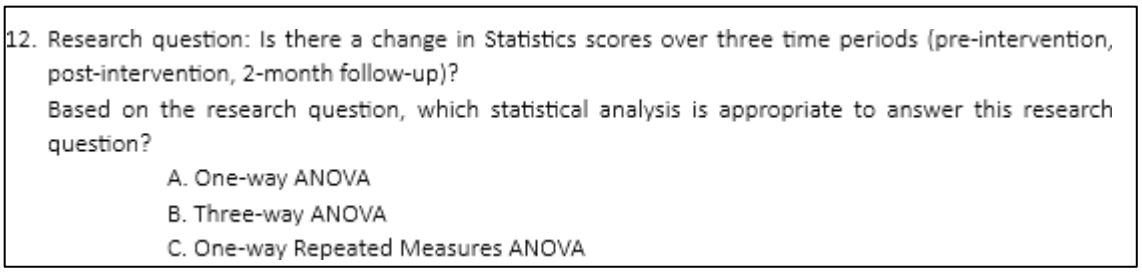

Figure 8. Item 12 in the statistical literacy test

Item 12 requires determining the best statistical approach for evaluating Statistics score variations across pre-intervention and post-intervention phases and the 2-month follow-up. The correct statistical analysis can be found in option C. One-way Repeated Measures ANOVA because it specifically handles changes in the same subjects throughout various time periods.

However, Item 11, with 33.33% (Z = -1. 67466), and Item 13 (52.38%, Z= -0.29823) was the most difficult for graduate students, located in the 'Very Low' category (how difficult it is to understand or use the tested concept).

Figure 9 shows item 11 in the statistical literacy test of the study.

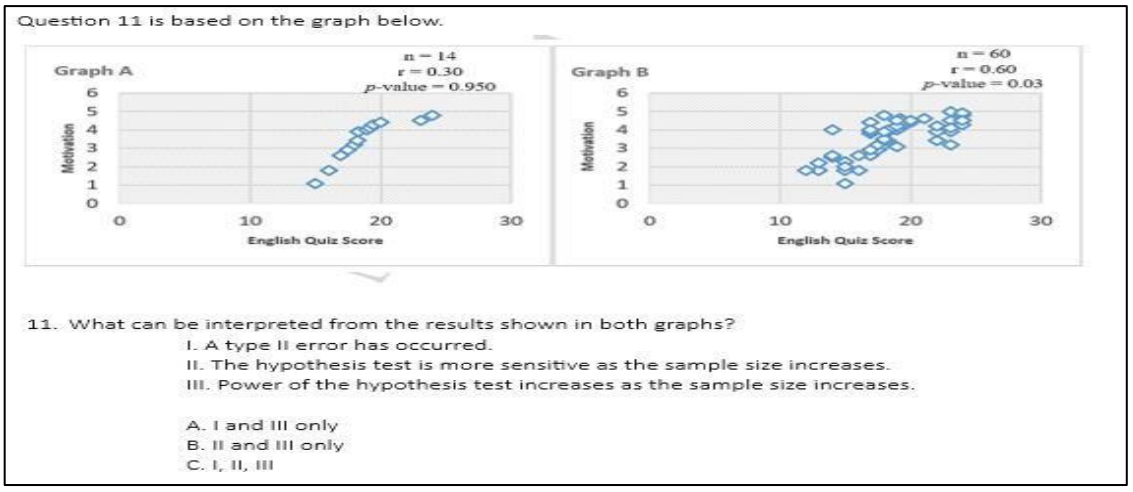

Figure 9. Item 11 in the statistical literacy test

Item 11 analyzes the correct interpretation of two scatterplots that display correlation results by showing sample sizes and statistical significance levels. The item asks to evaluate Type II error together with hypothesis test sensitivity and statistical power concepts. The proper answer is C. I, II, III because the insufficient sample size in Graph A could have produced Type II errors while different test sensitivities and statistical power related to sample sizes correct the results.

Figure 10 shows item 13 in the statistical literacy test of the study.

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Result:

A one-way ANOVA was conducted to determine the impact of students' level of study (undergraduate level, master level, and doctoral level) on research literacy test (RLT) score. There was a statistically significant difference at the $p<.05$ level in RLT scores for the three groups: $F(2, 330) = 4.3$, $p= .01$. The effect size, eta squared was .02.

13. Identify variables used in the study.
    A. One categorical independent variable, and one continuous dependent variable.
    B. One continuous independent variable, and three continuous dependent variables.
    C. One categorical dependent variable, and three continuous independent variables.

Figure 10. Item 13 in the statistical literacy test

Item 13 is about the independent and dependent variables that were utilized in a study employing one-way ANOVA. The right response is A. One categorical independent variable, and one continuous dependent variable, which describes a study measuring one continuous dependent variable through one categorical independent variable.

Items 5, 6, 9, 10, and 14, categorized as 'Low', had correct response rates of 45.24% to 47.62% and Z-scores of -0.81439 to -0.64233, which implies that graduate students possessed a sense of statistical concepts; however, some required additional attention in areas.

Figure 11 shows item 5 and item 6 in the statistical literacy test of the study.

5. Which of the following research questions is appropriate to use statistical analysis as shown in the Table above?
   A. Does gender predict the choice of compulsory course?
   B. Is there any association between gender and the choice of compulsory course to attend?
   C. Is there a significant difference in the mean of choice of compulsory courses for female and male students?
6. Which of the following results is true?
   A. The choice of compulsory course to attend cannot be statistically predicted by gender.
   B. There is no association between gender and the choice of compulsory course to attend.
   C. There is no significant difference in the mean of choice of compulsory courses for female and male students

Type of Compulsory Courses

		Compulsory Course			Total
		Dynamic Leadership	Philosophy of Science and Civilization	Global Development	
Gender	Female	18	10	12	40
	Male	16	14	10	40
Total		34	24	22	80

Chi-Square Test

	Value	df	Assym. Sig (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.485[a]	2	.483	.640	.389
Continuity Correction[b]	.215	2	.542		
Likelihood ratio	.485	2	.472		
Linear-by-Linear Association	.480	1	.487		
N of Valid	80				

Figure 11. Item 5 and Item 6 in the statistical literacy test

Figure 11 presents two items, Item 5 and Item 6, for Item 5 is about which research questions are appropriate to use based on the table presented. The correct answer is the letter B. Is there any association between gender and

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the choice of compulsory course to attend?. While Item 6 is about the correct interpretation of the statistical results on the table presented. The correct answer is also letter B. There is no association between gender and the choice of compulsory course to attend.

Figure 12 shows item 9 and item 10 in the statistical literacy test of the study.

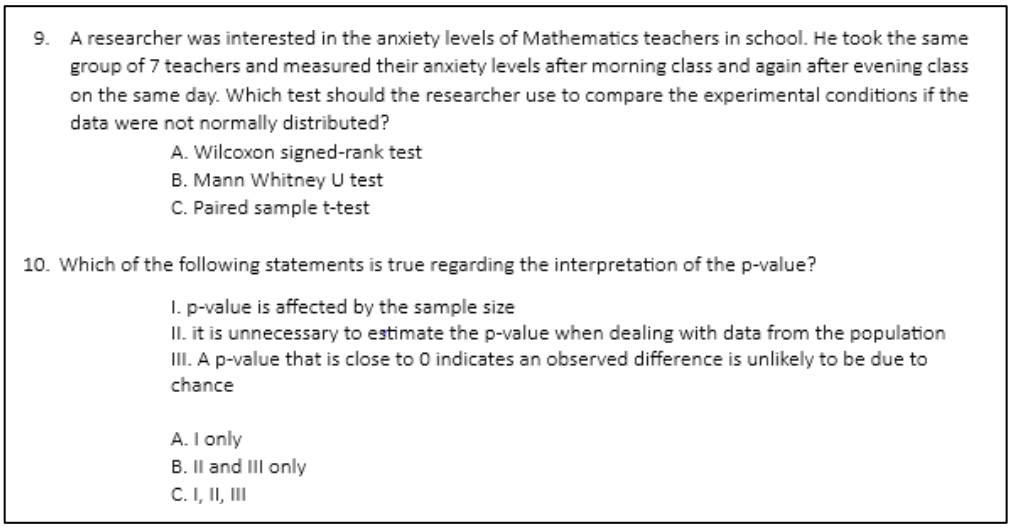

Figure 12. Item 9 and Item 10 in the statistical literacy test

The items presented in Figure 11 are questions to evaluate the fundamental statistical understanding of hypothesis tests along with p-value comprehension. In Question 9 a research team measures anxiety levels of 7 mathematics teachers twice across two distinct periods - after morning sessions and evening sessions. The correct response is letter A. Wilcoxon signed-rank test. The p-value interpretation is the main subject of Question 10. The statements in option C (I, II, III) correctly represent the content, so it is the answer.

Figure 13 shows item 14 in the statistical literacy test of the study.

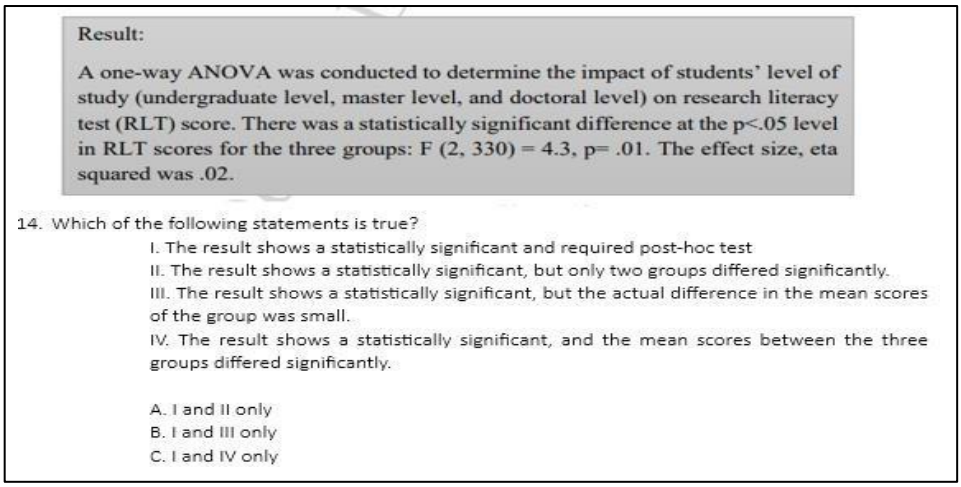

Figure 13. Item 14 in the statistical literacy test

Item 14 is presented in Figure 12. The question evaluates how a one-way ANOVA result should be interpreted. Research has investigated if test scores from research literacy test (RLT) show meaningful differences between students from undergraduate through doctoral programs. The correct answer is B. I and III only.

Item 1 (54.76%, z=-0.12617) was categorized as 'Moderate suggesting that graduate students demonstrated a basic understanding but encountered some difficulties.

Figure 14 shows item 1 in the statistical literacy test of the study.

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Competency	Study Level	Mean	SD	Sig.
Research	Undergraduate	4.59	0.47	0.35
	Post Graduate	4.68	0.46	
Information	Undergraduate	4.19	0.48	0.06
	Post Graduate	4.39	0.49	
Statistical	Undergraduate	4.32	0.32	0.24
	Post Graduate	4.36	0.42	
Critical Thinking	Undergraduate	3.96	0.43	0.33
	Post Graduate	4.11	0.44	
Reflection	Undergraduate	3.54	0.41	0.32
	Post Graduate	4.10	0.42	

1. Which research competency component has a significant difference between undergraduate students and postgraduate students?
   A. Information Literacy
   B. All except for Information Literacy
   C. None of the research competency components

Figure 14. Item 1 in the statistical literacy test

Item 1 in the figure is about examining the research competency components showing statistically significant patterns between undergraduate and postgraduate student populations. The correct answer is letter C. None of thew research competency components.

The results indicate that graduate students were competent in some aspects of statistical literacy, but also had significant weaknesses in certain concepts, particularly in the item that categories are Low and Very Low. This kind of variation in performance illustrates the necessity of targeted instructional intervention programs to address areas where students aren't performing as well to even out the notion of statistical concepts across all test items.

Herosian et al. (2022) performed an IRT analysis of student statistical literacy tests in assessing the difficulty and discrimination parameters of items. Their results showed that the quality of all the analyzed items was good and that the 2-parameter logistic model was suitable for assessment of statistical literacy instruments with polytomous answer type. The results of this study provide support for the idea that well-constructed assessments with varying item difficulties are built with a spectrum of student ability. These findings coincide with the presence of items with differing levels of difficulty in the Statistical Literacy Test, which lends support to the effectiveness of the test at discriminating between degrees of student proficiency.

Section 2. Profile of the Teacher Education Graduate Students

This section provides the profile of Teacher Education graduate students in Research Literacy and AI Literacy. Research Literacy is addressed through the dimensions of Research Awareness, Attitude toward research, Research Skills and Research Use; and AI Literacy regarding Affective Learning, Behavioral Learning, Cognitive Learning and Ethical Learning. It groups the data at different levels, resulting in a detailed frequency distribution of graduate students' competencies in every domain. Descriptive statistics summarize the overall trends, whereas the additional analysis helps understand what the strengths and weaknesses are in graduate students' research and AI literacy.

Research Literacy

Research Awareness

Table 14 presents the mean and standard deviation of each item in the research awareness part of the research literacy questionnaire.

Table 14. Mean and Standard Deviation for Each Item of Research Literacy Questionnaire in Terms of Research Awareness

Research Awareness	Mean	SD	Description
I know what information I need when I want to do research.	3.31	0.56	Moderately Aware

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I know what topics research consists of.	3.29	0.51	Moderately Aware
I understand whether a study is scientific research or not.	3.31	0.60	Moderately Aware
I know where scientific research is published.	3.17	0.73	Moderately Aware
Overall	3.26	0.49	Moderately Aware

*Note: 1-1.49=Not at all aware, 1.50-2.49=Slightly Aware, 2.50-3.49= Moderately Aware, 3.50-4= Fully Aware

The findings indicate that Teacher Education graduate students are moderately aware of topics in research across all items. *'I know what information I need when I want to do research'* has a mean of 3.31, falls under 'Moderately Aware', indicating that the respondents understand how to gather information when doing research. The relatively low SD (0.56) suggests that responses were consistent; most of them share the same level of research awareness. Similarly, there is awareness in the statement *'I know what topics research consists of.'* (M=3.29, SD= 0.51), also indicates that they are 'Moderately Aware' of the research topics and share the same level of knowledge in this area.

Moreover, their ability to distinguish between scientific information and non-scientific information reflects a certain level of discernment, with a mean of 3.31 and SD of 0.60, although variances in responses highlight that some students still struggle with research evaluation. The knowledge about publication of scientific works — the least common mean score from the questions mentioned above (M= 3.17, SD= 0.73)— indicates that students are aware that scientific sources exist around them, but their knowledge of journals, databases and research repositories is linear. The greater standard deviation in this area indicates variance in graduate students' experiences.

In general, the results indicate that graduate students have a fundamental awareness of research, although if they received more training about research methods, how to evaluate sources, and how to obtain academic literature, they would be better equipped to engage in scholarly research. This study is supported by the results of other studies of graduate students' research literacy. According to Diocos (2022), despite the observation that students enrolled in education programs possess a basic level of understanding of research concepts, many lack experience in identifying authoritative research sources, resulting in challenges when it comes to engaging with academic literature.

Table 15 describes the Level of Research Awareness of Teacher Education graduate students in four degrees of awareness, namely Fully Aware, Moderately Aware, Slightly Aware, and Not at All Aware. It shows the frequency (f) and percentage (%) of graduate students in each category and depth information about the way the graduate students know the research concepts, what research methodology they know, and how well they could apply the research concepts to problems.

Table 15. Level of Research Awareness of Teacher Education graduate students

Research Awareness	f	%
Fully Aware	15	35.71%
Moderately Aware	25	59.53%
Slightly Aware	2	4.76%
Not at all Aware	0	0%

Overall mean and description: 3.26, Moderately Aware

A large proportion of Teacher Education graduate students are keen and are well-engaged in at least a considerable amount of research awareness. In terms of the level of awareness of the so-called research concepts,

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25 graduate students (59.53%) specifically identified themselves as Moderately Aware of concepts, and 15 graduate students (35.71%) declared them to be Fully Aware of research concepts. That seems to indicate that most of them have a good base in terms of research awareness, although there is still some improvement potentially possible in further digging education about how research principles work.

However, as few as two graduate students (4.76 per cent) fell into the Slightly Aware group, characterizing those familiar with very little research. Interestingly, there were also no graduate students (0%) in the Not at All Aware category, meaning that none of the respondents had no exposure whatsoever to research. It is a reflection of a positive trend in terms of graduate students being aware of the importance of research to practice in an educational context.

According to Bueno (2023), this finding matches his study that graduate students in education programs have medium to high research awareness, but have lower awareness when not directed to research and classes that do not provide structure to research training. This provides some focus to their study, and it points out just how important institutional support in the form of research methodology courses, thesis writing courses, and mentorship is in helping students to get familiar with the research concept.

Attitude Towards Research

Table 16 presents the mean and standard deviation of each item in the attitude towards research part of the research literacy questionnaire.

Table 16. Mean and Standard Deviation for Each Item of Research Literacy Questionnaire in Terms of Attitude Towards Research

Attitude Towards Research	Mean	SD	Description
Scientific research is essential to my profession.	3.69	0.60	Highly Positive
Educators should benefit from research in their professional practice.	3.79	0.42	Highly Positive
Scientific research is useful for my professional development.	3.74	0.49	Highly Positive
Overall	3.74	0.44	Highly Positive

*Note: 1-1.49=Highly Negative, 1.50-2.49=Negative, 2.50-3.49=Positive, 3.50-4= Highly Positive

Research has a positive perception among the Teacher Education graduate student population according to research results. According to the respondents' mean score of 3.69 (SD = 0.60) they have a highly positive attitude that professional research represents an essential component of their field. Their understanding of evidence-based decision-making and continuous learning in the field of education has shaped their positive stance.

The majority of respondents supported the principle that research benefits the professional practice of educators as evidenced by the highest mean score of 3.79 (SD = 0.42). Research-based practices lead to better educational results according to the respondents because similar studies underline how pedagogy benefits from implemented research findings (Bueno, 2023).

Research serves as a valuable resource for educators to develop professionally since respondents rated this statement with 3.74 (SD = 0.49). The respondents show awareness about research because it enhances their knowledge base and teaches them better educational strategies while allowing them to react to educational progress. Research appreciation reaches a considerable peak when teachers show agreement about all statements, thus stimulating ongoing scholarly pursuits and evidence-based teaching methods (Munna & Kalam, 2021).

A study discovered that most graduate students suffer from research fear and distrust upon encountering statistical analysis and writing (Chance, Farwell & Hessmiller, 2022). They demonstrated through their work

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that students with limited exposure to research view it as being complex and encountering obstacles, with subsequent neutral or even negative bias.

The Level of Attitude Towards Research of Teacher Education graduate students is presented in Table 17 with four levels of responses: Highly Positive, Positive, Negative and Highly Negative. The frequency (f) and percentage (%) of the graduate students in each category is given in the table, which explains their perception and disposition towards research. It is important to know graduate students' attitudes because if they have a positive attitude towards research, they are engaged and motivated, and confident doing scholarly research (Abun et al., 2023).

Table 17. Level of Attitude Towards Research of Teacher Education graduate students

Attitude Towards Research	F	%
Highly Positive	31	73.81%
Positive	10	23.81%
Negative	1	2.38%
Highly Negative	0	0.00%

Overall mean and description: 3.74, Highly Positive

The majority of Teacher Education graduate students possess a positive attitude towards research. In particular, 31 graduate students out of 42 (73.81%) have a highly positive attitude that research is valuable and necessary for their academic and professional development, whereas 10 graduate students out of 42 (23.81%) agree with it as such. This implies that almost all students recognize the importance of research needed to provide evidence-based teaching that enables us to grow professionally. Only one graduate student (2.38%)have a negative attutude with the positive statements about research and no students (0.00%) have a highly negative attitude. This means that there are at least, if not any negative perceptions advised to the respondents as regards research. From institutional support, research training, and curriculum aimed at research engagement, it can be said that research is highly recognized by Teacher Education graduate students as they have overwhelmingly positive attitudes to it.

But a study has presented contrary results showing that some graduate students suffer from anxiety and skepticism about research, especially where they lack confidence in performing statistical analysis and research writing (Bulusan et. al., 2024). The study found that students with a little prior exposure to research perceive it as a complex and unpleasant work, which gives them a negative and neutral attitude towards research.

However, the results of this study indicate that the Teacher Education graduate students have a neutral or positive attitude towards research that can generate and sustain the willingness to engage in scholarly work as well as their readiness to apply research practices in future teaching.

Research Skills

Table 18 presents the mean and standard deviation of each item in the research skills part of the research literacy questionnaire.

Table 18. Mean and Standard Deviation for Each Item of Research Literacy Questionnaire in Terms of Research Skills

Research Skills	Mean	SD	Description
I can carry out a literature review on a topic.	3.14	0.61	Moderately Competent
I can discuss the research that has been done on a topic.	3.12	0.67	Moderately Competent

I can access research resources effectively.	3.17	0.79	Moderately Competent
I can turn my research into an academic article.	2.95	0.70	Moderately Competent
I can understand the results of statistical analysis.	3.12	0.77	Moderately Competent
I know how to interpret tables, graphs, charts, and similar figures in research.	3.36	0.69	Moderately Competent
Overall	3.14	0.57	Moderately Competent

*Note: 1-1.49=Not at all Competent, 1.50-2.49=Slightly Competent, 2.50-3.49= Moderately Competent, 3.50-4= Highly Competent

Results show that Teacher Education graduate students consider their research abilities to be moderately competent. Respondents demonstrated an average of 3.14 (SD = 0.61) according to the assessment of their capability to execute literature reviews which suggests they can accomplish reasonable reviews but should develop their skills further. The respondents demonstrated a moderate ability to speak about previous research studies through a mean score of 3.12 (SD = 0.67) in the statement "I can discuss the research that has been done on a topic." Nevertheless, they lacked assurance in their abilities to analyze and present the key findings of the studied research. Results show that respondents possess decent resource retrieval skills which matches the average score of 3.17 (SD = 0.79) regarding "I can access research resources effectively." Nonetheless, they need better training on efficient academic research tool utilization.

Respondents showed limited capabilities in converting research output into academic writing based on the score of 2.95 (SD = 0.70). Academic writing skills, research dissemination methods, and journal submission processes require more training for all researchers based on the results. The statement "I can understand the results of statistical analysis" received 3.12 (SD = 0.77) as an average score due to moderate understanding of statistical interpretations. Respondents exhibited maximum confidence in figuring out visual data representations through tables as well as graphs along with charts by averaging 3.36 (SD = 0.69) on this survey question.

Research skills of respondents are measured at a moderate level, but supplementary training in academic writing and statistical interpretation would improve both their presentation abilities and their research conduct effectiveness. Graduate students who specialize in educational fields need to master research skills according to multiple research studies. Walter & Stouck (2020) noted that literature review execution constitutes a critical research skill although graduate students often show deficiencies in source synthesis and critical analysis. The research data indicates that students assess their performance of literature reviews as average. The ability of graduate students to discuss research topics has been verified by Agatep & Villalobos (2020), but their capacity to evaluate findings and apply them effectively needs improvement, according to their research.

The Level of Research Skills of Teacher Education graduate students are presented in Table 19 with four level of responses: Highly Competent, Moderately Competent, Slightly Competent, and Not at all Competent. Frequency (f) and percentage (%) of graduate students per category show their perceived capability to perform research tasks, such as developing research problems, conducting literature reviews, applying research methods, analyzing data, and interpreting results.

Table 19. Level of Research Skills of Teacher Education Graduate Students

Research Skills	F	%
Highly Competent	10	23.81%
Moderately Competent	26	61.90%
Slightly Competent	6	14.29%
Not at all Competent	0	0.00%

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Overall mean and description: 3.14, Moderately Competent

The results indicate that most Teacher Education graduate students possess moderate to strong research skills. Ten (23.81%) of the graduate students rated themselves highly competent, indicating confidence in independent research and the proper application of research techniques, and 26 graduate students (61.90%) were rated as moderately competent, suggesting that they are well established in research but require strengthening in advanced research skills.

In the meantime, six graduate students (14.29%) labeled themselves slightly competent, which may imply that they can struggle with some aspects of research, for example, data analysis, academic writing, or interpreting results of statistical analysis. Strikingly, no graduate students (0.00%) described themselves as not at all competent, meaning all respondents possess a basic level of knowledge regarding research processes.

These findings show that despite a vast majority of graduate students having adequate research competence, they would need additional assistance in the form of workshops, mentorship programs, and actual research exposure to refine their research abilities further. Investment in dedicated training in quantitative and qualitative analysis, academic writing, and research ethics would most likely render them capable of planning and conducting research independently.

In addition, Comon and Corpuz (2024) established that graduate students in some teacher education programs are not able to apply research methodologies to practice, resulting in lower levels of perceived competency in research. Their research indicates that application of practice in research is poorly established, as opposed to the findings of this paper where the majority of the students rate themselves at least moderate competency.

Research Use

Table 20 presents the mean and standard deviation of each item in the research use part of the research literacy questionnaire.

Table 20. Mean and Standard Deviation for Each Item of Research Literacy Questionnaire in Terms of Research Use

Research Use	Mean	SD	Description
I use scientific research to organize my daily professional activities.	2.81	0.67	Sometimes
I read current research results for my professional development.	2.93	0.68	Sometimes
I benefit from scientific research while preparing the course contents.	3.19	0.63	Sometimes
I use scientific research to examine my professional practices from different perspectives.	2.95	0.73	Sometimes
I base everything I do in my practice on scientific research.	2.81	0.71	Sometimes
I base my statements on research to inform parents.	2.81	0.59	Sometimes
I benefit from research to improve my pedagogical knowledge.	3.26	0.54	Sometimes
Overall	2.97	0.51	Sometimes

*Note: 1-1.49= Never, 1.50-2.49= Rarely, 2.50-3.49= Sometimes, 3.50-4= Always

The results show that respondents occasionally access research during their work days since their mean rating was 2.81 (SD = 0.67) for using research to organize daily tasks. The survey reveals that professionals understand

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the importance of the latest research for development (M = 2.93, SD = 0.68) yet it does not indicate steady use of new research findings during their work.

Achieving the most favorable outcome (M = 3.26, SD = 0.54) occurs through pedagogical knowledge enhancement using research. The willingness to use research findings for teaching strategy enhancement stands out as the strongest preference among all research application aspects according to survey respondents. Research influences content preparation for courses among educators (M = 3.19, SD = 0.63) though educators do not depend on research as their main instructional resource template. Respondents infrequently leverage research to examine professional practices according to different perspectives (M = 2.95, SD = 0.73) and occasionally use research to educate the students' parents (M = 2.81, SD = 0.59). The respondents show minimal use of research in their professional work although they indicate that some of their activities rely on empirical evidence (M = 2.81, SD = 0.71).

Research material does not fully form a core part of the working practices demonstrated by respondents according to these findings. Educational practice requires additional encouragement alongside professional development initiatives to establish a consistent implementation of research. Teachers value research activities but show minimal involvement with implementing these practices within educational environments based on current study findings. Research practices receive high priority from educators yet these professionals actively participate in a limited number of research activities (Procter, 2015).

Table 21 shows the Level of Research Use of Teacher Education graduate students. The table is divided into four levels of research use: Always, Sometimes, Rarely, and Never, with respective frequencies (f) and percentages (%). This categorization is based on how often graduate students use research findings in their academic or professional work.

Table 21. Level of Research Use of Teacher Education graduate students

Research Use	F	%
Always	8	19.05%
Sometimes	26	61.90%
Rarely	8	19.05%
Never	0	0.00%

Overall mean and description: 2.97, Sometimes

The findings show that most Teacher Education graduate students (61.90%) apply research 'Sometimes', indicating that although research is integrated into their academic and professional work, it is not yet a routine for most graduate students. This could be because they have limited access to research materials, time or do not have enough confidence in applying research findings efficiently.

Respondents 'Always' (8, 19.05%) used research, that means some graduate students employed research in career development, teaching practice, or academic life. Such graduate students may have had improved research literacy, high motivation, or academically supported individual.

Alternatively, 19.05% of the graduate students also indicated 'Rarely' using research, which could be indicative of barriers like lack of familiarity with the conduct of research, inability to access relevant studies, or low perceived relevance of research findings to their area of study. Encouragingly, no graduate students (0.00%) indicated 'Never' using research, which indicates that all respondents hold research in some regard as a resource.

A study highlighted that even though teachers know the importance of research use, their actual practice of applying research results in classrooms is not evident (Pedler, Yeigh, & Hudson, 2020). Institutional support as

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well as training programs may play an important part in enhancing how often research gets used by students of teacher education.

AI Literacy

Affective Learning

Table 22 presents the mean and standard deviation of each item in the affective learning domain of the AI literacy questionnaire.

Table 22. Mean and Standard Deviation for Each Item of AI Literacy Questionnaire in Terms of Affective Learning

Affective Learning	Mean	SD	Description
Artificial intelligence is relevant to my everyday life (e.g., personal, work).	3.48	0.55	High
Learning AI is interesting.	3.62	0.58	Very High
Learning AI makes my everyday life more meaningful.	3.19	0.59	High
I am curious about discovering new AI technologies.	3.55	0.50	Very High
I am confident I will perform well on AI related tasks.	3.12	0.59	High
I am confident I will do well on AI related projects.	3.05	0.66	High
I believe I can master AI knowledge and skills.	3.12	0.71	High
I believe I can earn good grades in AI related assessments.	3.05	0.73	High
I can understand AI related resources/ tools.	3.19	0.63	High
I feel confident that I will do well in the AI related tasks.	3.07	0.71	High
Overall	3.25	0.45	High

*Note: 1-1.49=Very Low, 1.50-2.49=Low *2.50-3.49= High, 3.50-4= Very High*

Respondents highly believe that AI is relevant in their daily (M = 3.48, SD = 0.55) as well as in personal, as well as professional contexts. Further, AI learning is found to be very highly interesting (M = 3.62, SD = 0.58), which signifies that AI concepts are perceived as being in an interesting learning context. They also express interest in finding out more of the new AI technologies (M = 3.55, SD = 0.50) with a very high rating.

It seems that people tend to feel confident in completing AI related tasks M = 3.12 (S.D. = 0.59) and AI related projects M = 3.05 (S.D. = 0.66), which is slightly lower than their interest M = 3.40 and S.D. = 1.12 which falls on high level, suggesting that there was some space to grow on their self-efficacy to working with AI. They also believe that they are capable of mastering AI skills (M = 3.12, SD = 0.71) and a positive but leaning towards the cautious belief of performance in AI related assessments (M = 3.05, SD = 0.73).

Learning AI also means that respondents believe learning AI contributes to adding meaning in their everyday life (M = 3.19, SD = 0.59), further supporting that learning how to use AI is engaging but also meaningful for practical use. An increased familiarity of AI concepts was demonstrated, their ability to understand AI-related resources and tools were high (M = 3.19, SD = 0.63). These results suggest that respondents have a positive affective disposition toward the development of AI literacy from their interest and curiosity, but need to increase their confidence to apply what they know about AI in real life.

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The study respondents demonstrated a high level of affective learning as shown by an overall mean score of 3.25 and a standard deviation of 0.45. The respondents show generally positive feelings toward their study of artificial intelligence (AI) based on their survey responses. Students view AI as personally relevant, and they experience both fascination with the subject matter and assurance about their capabilities when performing AI-related tasks and using AI tools. A rating of 0.45 indicates solid motivational and interest levels, although it falls short of the maximum scale, thus creating a firm foundation that supports learning persistence in AI subjects.

These results are consistent with Viberg et al. (2024) that teachers' trust in AI is positively associated with its usage and, thereby, with benefits. Like so, AI familiarity builds confidence and engagement, keeping respondents believing that AI is relevant and useful. This shows the gap between AI interest and its application and the need for structured AI literacy programs to fill in the gap.

Table 23 describes the Level of AI Literacy of Teacher Education graduate students in terms of Affective Learning in four levels, namely Very High, High, Low, and Very Low. It shows the frequency (f) and percentage (%) of the respondents.

Table 23. Level of AI Literacy of Teacher Education Graduate Students in terms of Affective Learning

Levels	f	%
Very High	12	28.57%
High	29	69.05%
Low	1	2.38%
Very Low	0	0%

Overall mean and description: 3.25, High

About 28.57% of respondents display a 'Very High' level of literacy, which reflects their confidence and enthusiasm towards AI, and 69.05% of them are 'High' demonstrating active interest and motivation towards AI. A very minimal percent (2.38%) has a 'Low' level, suggesting a minimal confidence in AI learning. The overall level of affective learning among the teacher education graduate students is classified as High. This indicates that the respondents generally exhibit positive feelings, interest, and attitudes toward artificial intelligence. They find AI relevant, are curious about it, and express confidence in engaging with AI-related content. The high affective learning level suggests a strong emotional and motivational foundation, which is essential for fostering sustained interest and deeper involvement in AI learning experiences.

A study demonstrated that teachers overwhelmingly accepted the use of artificial intelligence in educational settings because it sparked their enthusiasm for adopting this technology(Uygun, 2024). The findings from this study confirm that most teaching professionals maintain high levels of affective learning about AI through their strong emotional involvement and motivation.

Behavioral Learning

Table 24 presents the mean and standard deviation of each item in the behavioral learning domain of the AI literacy questionnaire.

Table 24. Mean and Standard Deviation for Each Item of AI Literacy Questionnaire in Terms of Behavioral Learning.

Behavioral Learning	Mean	SD	Description
I will continue to use AI in the future.	3.55	0.50	Very High

I will keep myself updated with the latest AI technologies.	3.40	0.59	Very High
I plan to spend time exploring new features of AI applications in the future.	3.26	0.59	High
I actively participate in AI-related learning activities.	2.98	0.84	High
I am dedicated to AI-related learning materials.	3.05	0.73	High
I often try to explain the AI learning materials to my classmates or friends.	2.76	0.85	High
I try to work with my classmates to complete AI learning tasks and projects.	2.69	0.87	High
I often spend spare time discussing AI with my classmates.	2.55	0.92	High
Overall	3.03	0.59	High

*Note: 1-1.49=Very Low, 1.50-2.49=Low 2.50-3.49= High, 3.50-4= Very High

Respondents display a 'Very High' behavior in the statements 'I will continue to use AI in the future.' (M=3.55, SD=0.50) and 'I will keep myself updated with the latest AI technologies.' (M= 3.40, SD= 0.59), that means respondents are aware that AI is in the long term and are proactive when it comes to knowledge on advancements.

Notably, other aspects of behavioral learning, such as exploring AI features (M = 3.26, SD = 0.59), participating in AI-related activities (M = 2.98, SD = 0.84), and dedicating time to AI learning materials (M = 3.05, SD = 0.73), are rated "High". This implies that while respondents engage with AI learning, there is room for more active participation. Collaboration and knowledge-sharing behaviors, such as explaining AI concepts to classmates (M = 2.76, SD = 0.85), working with peers on AI tasks (M = 2.69, SD = 0.87), and discussing AI in spare time (M = 2.55, SD = 0.92), are also at a "High" level but show comparatively lower means. Thus, it seems that respondents are less frequent in behaviors related to AI discussions and teamwork.

Research has shown the importance of social interaction in learning processes, and these findings are consistent with them. A study shows that individual engagement with technology is positive but that the social elements will make the learning experience better and help in understanding more deeply (Haleem et. al., 2022; Cartens et. al., 2021).

Table 25 describes the Level of AI Literacy of Teacher Education graduate students in terms of Behavioral Learning in four levels, namely Very High, High, Low, and Very Low. It shows the frequency (f) and percentage (%) of the respondents.

Table 25. Level of AI Literacy of Teacher Education Graduate Students in Terms of Behavioral Learning

Levels	f	%
Very High	12	28.57%
High	25	59.52%
Low	5	11.90%
Very Low	0	0%

Overall mean and description: 3.03, High

Of the respondents, 59.52% are within the high category, meaning they have almost enthusiastically adopted AI applications by exploring the applications of AI, and collaborating on the AI discussion or projects. Moreover, 28,57 percent are in a very high level of behavioral learning, which means that they often carry out tasks related to AI. However, only 11.90% indicate low level of engagement in practicing AI concepts. The teacher education graduate students demonstrate a High degree of behavioral learning. The results show that most respondents in the study continue to seek artificial intelligence knowledge by using AI tools together with AI concepts in

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practice and pursuing skill development for AI. The high rating indicates students translate their interest in AI into concrete actions, which demonstrates their active engagement with AI both in their education and professional growth.

One relevant study that fits the finding about the use of AI was that the majority of faculty members had used AI based tools in six months on a personal or teaching or outside jobs. Specifically, one-third said they were frequently using AI-based tools in their teaching. Faculty members reported the main use for AI tools to be in the preparation and conception of teaching (Mah 2024).

These findings taken together show several educators are not only actively engaged in AI-related activities, e.g., surfing around AI apps, but are also participating and discussing with colleagues/topics on these AI-related topics that are in the same range of the behavioral learning high and very high as found in your data.

Cognitive Learning

Table 26 presents the mean and standard deviation of each item in the cognitive learning domain of the AI literacy questionnaire.

Table 26. Mean and Standard Deviation for Each Item of AI Literacy Questionnaire in Terms of Cognitive Learning.

Cognitive Learning	Mean	SD	Description
I know what AI is and recall the definitions of AI.	3.36	0.53	High
I know how to use AI applications (e.g., Siri, chatbot).	3.36	0.73	High
I can compare the differences between AI concepts (e.g., deep learning, machine learning).	3.19	0.77	High
I can apply AI applications to solve problems.	3.26	0.73	High
I can create AI-driven solutions (e.g., chatbots, robotics) to solve problems.	2.83	0.88	High
I can evaluate AI applications and concepts for different situations.	2.93	0.84	High
Overall	3.15	0.60	High

*Note: 1-1.49=Very Low, 1.50-2.49=Low 2.50-3.49= High, 3.50-4= Very High

The respondent's cognitive aspect with AI reveals a high level of learning. They show very high familiarity with AI and remember the definition of AI (M = 3.36, SD = 0.53) or the use of AI applications (M = 3.36, SD = 0.73). However, although their capacity to evaluate AI concepts (M = 3.19, SD = 0.77) and to apply AI applications on problems (M = 3.26, SD = 0.73) is also high, there is a slightly more variability on the responses. Although they appear to be less able to produce AI-driven solutions (M = 2.83, SD = 0.88) or evaluate AI applications under various circumstances (M = 2.93, SD = 0.84), indicating areas such as synthesis and evaluation are areas that may benefit from further development.

These findings agree with studies that found educators and students become more comfortable with AI tools but lack skills for developing and evaluating AI techs (Chan and Lee, 2023) and require AI literacy programs that go beyond basic knowledge and engaged in problem solving hands on activities, in line with the outcomes of this study (Pinski and Benlian, 2024).

The results underscore why experiential, project-based learning around AI is needed to enable students to create and assess how AI is applied. For the AI education, it should have structured frameworks with a focus on problem solving, and critical thinking to enhance the higher order cognitive skills.

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Table 27 describes the Level of AI Literacy of Teacher Education graduate students in terms of Cognitive Learning in four levels, namely Very High, High, Low, and Very Low. It shows the frequency (f) and percentage (%) of the respondents.

Table 27. Level of AI Literacy of Teacher Education Graduate Students in Terms of Cognitive Learning

Levels	F	%
Very High	10	23.81%
High	26	61.90%
Low	6	14.29%
Very Low	0	0%

Overall mean and description: 3.15, High

A majority (61.90%) of respondents' level of literacy is very high (they know a substantial amount of AI concepts and technologies). At the same time, 23.81 % have a very high level and can easily understand and apply AI methodologies. Nevertheless, 14.29 percent are low, meaning that they possess limited knowledge and familiarity with the AI-related topics. The level of cognitive learning achieved by teacher education graduate students is identified as High. Most students have mastered fundamental artificial intelligence knowledge together with its principles and practical applications according to this measurement. Students exhibit effective processing abilities and applications in addition to their knowledge of AI terminology based on their high cognitive learning level. The respondents demonstrate an advanced level of cognitive knowledge about AI which enables them to participate actively in academic and professional scenarios where AI decisions and problems need solving.

An exploratory mixed method study based on in-service and pre-service educators' attitudes towards AI, its appropriateness in education, and the need for AI competencies aligns with these results. The study showed that although the majority believes in the prospects of using AI as a convenient and beneficial tool, most educators said they were not so competent when using AI or using AI in their classes which reflects that most of the educators do not know much related to the AI topics (Sadykova & Kayumova, 2024). This showed educator willingness to undergo training to improve in their AI capabilities.

These studies point out that there are variances in educator levels of understanding of AI, and suggest that professional development kinds of programs assist to bridge that gap and ensure that educational establishments are educated on AI literacy to some degree (Riggs, 2025).

Ethical Learning

Table 28 presents the mean and standard deviation of each item in the ethical learning domain of the AI literacy questionnaire.

Table 28. Mean and Standard Deviation for Each Item of AI Literacy Questionnaire in Terms of Ethical Learning.

Ethical Learning	Mean	SD	Description
I understand how misuse of AI could result in substantial risk to humans.	3.64	0.49	Very High
I think that AI systems need to be subjected to rigorous testing to ensure they work as expected.	3.57	0.50	Very High
I think that users are responsible for considering AI design and decision processes.	3.55	0.55	Very High

I think that AI systems should benefit everyone, regardless of physical abilities and gender.	3.52	0.59	Very High
I think that users should be made aware of the purpose of the system, how it works and what limitations may be expected.	3.67	0.53	Very High
I think that people should be accountable for using AI systems.	3.69	0.52	Very High
I think that AI systems should meet ethical and legal standards.	3.69	0.52	Very High
I think that AI can be used to help disadvantaged people.	3.57	0.55	Very High
Overall	3.61	0.45	Very High

*Note: 1-1.49=Very Low, 1.50-2.49=Low 2.50-3.49= High, 3.50-4= Very High

Based on the findings, mean scores from 3.52 to 3.69 are attained for ethical learning of AI by the respondents. Statements ranking highest in rating are about accountability and keeping with ethical standards and respondents are very agreeable (M = 3.69, SD = 0.52) that people ought to use AI responsibly (M = 3.69, SD = 0.52) and that AI systems ought to operate as per ethical and lawful standards. Respondents also recognize the value of transparency in accounting for how users should be notified about AI systems' purpose, functionality, and limitations (M = 3.67; SD = 0.53). It is also highly recognized by them that concern about misuse of AI as well as risk imposed on humans (M = 3.64, SD = 1.0) and the need of rigorous testing of AI (M = 3.57, SD = 1.0). Respondents extremely agree that the AI should be for all people (M = 3.52, SD = 0.59), and can help the deprived community (M = 3.57, SD = 0.55).

Although this is contrary to the studies that show AI users lacking in ethical awareness. A study concluded that while AI literacy is growing, ethical awareness and critical thinking about the AI decision are not part of general education curricula (Kajiwara & Kawabata, 2024). They are clearly in conflict with the current findings in which respondents have a very good understanding of ethical responsibilities. Secondly, Fernholz et al. (2024) argued that while ethical AI principles are prominently discussed, they are hardly deeply gained, or effectively applied, indicating that although people do have high self-reported ethical awareness, this is not always translated into real life scenarios.

These results suggest strong ethical foundations of AI in respondents and this provides insights into an immediate demand for practical application of ethical AI principles, to make awareness lead to responsible use of AI. To foster these ethical considerations in future AI education programs, for instance, real world case studies, ethical dilemmas, and principles of decision making should be used.

Table 29 describes the Level of AI Literacy of Teacher Education graduate students in terms of Ethical Learning in four levels, namely Very High, High, Low, and Very Low. It shows the frequency (f) and percentage (%) of the respondents.

Table 29. Level of AI Literacy of Teacher Education Graduate Students in Terms of Ethical Learning

Levels	f	%
Very High	28	66.67%
High	14	33.33%
Low	0	0%
Very Low	0	0%

Overall mean and description: 3.61, Very High

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The majority of them have a Very High level of literacy in this regard (AI ethics, which includes understanding of biases, fairness, transparency, and accountability), meaning they had a deep understanding of AI ethics. The High literacy group consists of 33.33% who can use and incorporate ethical considerations occasionally. However, not all respondents were found to have a low or very low level of ethical awareness in dealing with AI. The teacher education graduate students demonstrate a strong ethical learning capability which earned them a Very High classification. Students show advanced ethical understanding of artificial intelligence because they demonstrate solid knowledge about the ethical issues with AI application. Strong ethical awareness demonstrated by the students signifies their commitment to ethical AI use while preparing them to incorporate ethical elements in their future professional activities.

Educators had a very deep understanding of the ethics of AI and were doing this in their everyday practice, according to a study. Additionally, it was also highlighted that ethical issues in educational settings with AI integration were evident (Kamali, Alpat, and Bozkurt, 2024). This study results concur with the observation that most educators have a very high level of literacy in AI ethics and they are aware of biases, fairness, transparency, and accountability. This is consistent with the data to show that ethical learning is a part of AI, since they consider ethical conditions in their professional work.

The results indicate that almost all of Teacher Education graduate students have high or very high levels of AI literacy across all dimensions, but there are some areas of room for improvement in cognitive and behavioral engagement. The awareness of the ethics is shown by the strong consideration of responsible AI use in education.

Section 3. The Profiles that Significantly Influence Statistical Literacy of The Teacher Education Graduate Students

Table 30 presents the multiple linear regression model, which was used to examine the relationship between Statistical Literacy (SL) as the dependent variable and AI Literacy (AIL) and Research Literacy (RL) as the independent variables.

Table 30. Multiple Linear Regression Analysis of Research Literacy and AI Literacy as a Predictor of Statistical Literacy.

	Coefficients	*Standard Error*	*t Stat*	*p-value*
Intercept	-2.63	1.52	-1.73	0.09
Research Literacy	0.34	0.37	0.91	0.37
AI Literacy	0.47	0.38	1.23	0.23

R^2= 0.073, F(1)=1.525, p=0.23

The SL can be predicted using the equation y = 0.34x + 0.47z – 2.63, where x is RL, z is AIL, and y is the predicted SL. The results demonstrate that the ability of the model to explain SL is weak (R^2 = 0.073), only 7.3% of the variation in SL is explained by AIL and RL. Besides, the F statistic (1.525) and its p value (0.23) lead us to conclude that the independent variables are not collectively explanatory for SL at a statistically significant level and the intercept is found to be -2.63 with p-value of 0.09 which further suggests that the model does not have such a good predictive validity. SL in this sample is not predicted by the independent variables (F = 1.525, p = 0.230). Examining the individual predictors, both RL (B = -0.335, p = 0.369) and AI Literacy (B = 0.469, p = 0.227) have a positive but insignificant relationship with SL.

The fact that other unmeasured factors might have a larger impact on Statistical Literacy (such as educational background, cognitive abilities, etc.) may explain these findings. There may have been several limitations to these unexpected results. The few respondents (N = 42) reduces statistical power, making it more likely that the analysis will fail to yield significant results. Furthermore, the low R^2 value indicates that an important

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explanatory variable may have been missed, resulting in omitted variable bias. In addition, measurement issues could be a factor as the constructs of AI, Research, and Statistical Literacy were not captured adequately.

Previous studies' findings support the weak predictive power of AIL and RL on statistical literacy. In a study focused on AI Literacy, and trust of AI by mathematics teachers, the use of AI was correlated positively with the trust of AI but with a decrease in critical thinking and problem solving skills (Wijaya et. al.,, 2024). This implies that although an increased AI Literacy may lead to more familiarization with AI tools, the knowledge acquired from AI Literacy does not seem to have a significant effect on statistical reasoning skills, consistent with the results from the current study. Moreover, another study of statistical literacy across different academic fields revealed that SL does not appear to develop naturally over time and is mostly determined with structured curriculum exposure, numeracy skills, attitudes toward statistics, and not general cognitive abilities (Berndt, 2021). However, it adds to the fact that AI Literacy and Research Literacy alone cannot explain the SL, which provides more reasons to inquire into additional domain specific factors, including statistical training, epistemic beliefs, and instructional methods.

The results do not offer strong support for a predictive relationship between AI Literacy, Research Literacy, and Statistical Literacy, and in this situation we identify important gaps to be further explored. Despite the small sample size and weak model fit, the findings should be interpreted with caution, however, they do provide valuable information to help in the further development of studies in this field.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

In an increasingly data-driven world, statistical literacy, research literacy, and AI literacy are essential competencies for graduate students. The ability to interpret data, conduct meaningful research, and engage with emerging technologies enables students to make informed decisions and contribute to their fields effectively. The study explored the graduate students' Statistical Literacy, Research Literacy, and AI Literacy competencies, finding strengths in basic statistical interpretation but weaknesses in inferential reasoning.

The statistical literacy of graduate students indicates varied levels of understanding across different statistical domains. The research findings demonstrate that graduate students show strong abilities with descriptive statistics, yet their difficulties in inferential reasoning show weakness, particularly with probability and sampling distribution understanding.

Teacher Education graduate students possess a moderate level of research literacy across all dimensions. Research literacy-level abilities of students remain adequate, yet they need stronger training in academic writing combined with data analysis, along with research dissemination methods.

The teacher education graduate students demonstrated an overall high level of AI literacy across all domains. The respondents are positively inclined toward AI, actively engaging with it, and possess substantial knowledge, yet would benefit from structured programs to strengthen confidence, collaboration, and advanced problem-solving with AI.

Statistical literacy fails to show any connection with AI or research literacy based on the study data, indicating that curriculum design and domain-specific training matter more.

Recommendations

Faculty Members and Educators

Faculty should consider integrating scaffolded instruction that goes beyond descriptive statistics, focusing intentionally on inferential concepts such as probability, hypothesis testing, and sampling distributions. Alongside this, educators should provide opportunities for students to apply AI tools within the research process, helping bridge the gap between interest in AI and practical use.

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Educational Institutions and Graduate Schools

Graduate programs should offer targeted capacity-building workshops or short courses on academic writing, research dissemination, and practical applications of AI in research. These offerings should be embedded within or supplement existing research methods courses, ensuring students not only understand content but also gain confidence in communicating and applying their findings.

Curriculum Developers and Academic Administrators

Curriculum revisions should ensure that statistical, research, and AI literacy are developed as distinct yet complementary strands, with practical, discipline-specific applications. Given that statistical literacy did not correlate with AI or research literacy in the findings, integration should not assume natural overlap but instead strategically design connections across domains to foster transfer of learning and practical engagement.

Future Researchers

Treatment of a larger sample size to increase statistical reliability for future research (e.g. >100 respondents) should be looked into. Moreover, incorporation of other potential predictors including numeracy skills, self-efficacy in statistics or teaching methods may enhance the understanding of Statistical Literacy. In case of multicollinearity or small sample, alternative statistical approaches like Partial Least Squares Regression (PLS) or Structural Equation Modeling (SEM) could have been used. Finally, a refinement of the measurement instruments for AI Literacy, Research Literacy, and Statistical Literacy could be made, which would help better measure these relationships. Future research should consider a larger, more diverse sample of teacher-education graduate students to enhance generalizability. Adding qualitative methods like interviews or focus groups could deepen understanding of their challenges and strategies in statistical, research, and AI literacy. Studies may also examine targeted interventions for improving inferential reasoning and explore long-term impacts through longitudinal research.

Approval Sheet

This Thesis entitled prepared and submitted by **MELANIE ABAN-SERQUIÑA** has been approved and accepted in partial fulfillment of the requirements for the degree

Master Of Science In Teaching

Major In Mathematics

Dr. Melanie G. Gurat

Adviser

APPROVED by the Panel of Examiners in the **Oral Defense** held on **March 31, 2025** at the School of Graduate Studies Defense Room (2nd floor, Rev. Fr. John Van Bauwel Building).

Dr. Analyn A. Guevara

Member

Dr. Rowena A. Rivera

Member

Dr. Dominga C. Valtoribio

Chairman

Dr. Mayvelyn S. Covita

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Dean, School of Graduate Studies

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Melanie Aban-Serquiña

Dedication

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APPENDICES

Appendix A

Matrix of Related Literature and Studies

Authors and Date	Research Locale	Domains/Focus of the Study	Methodology Used	Salient Findings	Recommendations/Limitations
Heri Retnawat, Kana Hidayati, Ezi Apino, Ibnu Rafi & Munaya Nikma Rosyada (2024)	Indonesia	1. How is the SL profile of undergraduate students in mathematics education programs in terms of gender, higher education institution's status, laptop ownership, and research preference? 2. What factors and conditions significantly predict the SL of undergraduate students in mathematics education programs?	Research Design: Survey research Research Instruments: An online survey was designed to collect data on predictor variables and statistical literacy achievement and the 20-item multiple-choice SL test on core areas of elementary statistics.	Students of mathematics education have demonstrated generally unsatisfactory SL scores, the highest in interpretation and the lowest in critical evaluation. Interpretation scores were significantly higher for male students and for students attending public institutions. Similarly, ownership of a laptop significantly predicted higher SL scores, except for those about the aspects of communication. Preference for research was found not to be significant enough to influence SL scores. Regression analysis explains that gender, status of the institution, and ownership of a laptop predict a 5.9% variance in SL, with laptop ownership being the most important predictor.	The revision in the curriculum for statistics education should be more inclusive and student-centered, addressing diversity in background and resources. The policy emphasizes equal distribution of resources such as laptops to enhance SL. Support programs should also be extended to students from private institutions and those with limited tech access.
Marc Pinski & Alexander Benlian (2024)	Germany	The study focuses on the emerging field of AI literacy, specifically addressing how individuals can develop the knowledge and skills necessary for the effective, ethical, and purposeful use of artificial intelligence technologies. It seeks to understand and structure the existing research on AI literacy, highlighting its relevance across various user groups.	The researchers conducted a systematic scoping literature review, synthesizing 68 relevant papers to assess the fragmented landscape of AI literacy research. This review involved critically examining the literature's specificity to different user groups and its differentiation from other forms of technology literacy. The findings were organized into a conceptual framework that outlines the learning methods	The review revealed that AI literacy research is somewhat disjointed, with insufficient integration of efforts across different studies. The findings highlighted the need for a more cohesive understanding of AI literacy, specifying how it varies among different user groups. The study established a comprehensive conceptual framework that categorizes AI literacy into distinct components and identifies the learning methods that lead to its acquisition. It also emphasized the impact of AI literacy on users' ability to navigate an AI-driven landscape effectively.	The study proposes a research agenda that aligns with the developed conceptual framework, identifying promising avenues for further exploration in AI literacy. It encourages researchers to focus on the specific needs of diverse user groups and to explore innovative educational methods that enhance AI literacy. By doing so, the study aims to prepare AI users for a future where AI technologies play an increasingly pivotal role in work and society, fostering responsible and informed use of these technologies.

			leading to AI literacy, the components that constitute it, and the outcomes associated with it.		
Andrew M. Cox & Suvodeep Mazumdar (2024)	Not Specified	The paper aims to define Artificial Intelligence for librarians by looking at the general definitions of AI; considering the umbrella of technologies making up AI; defining the types of use cases by area of library operation; and then reflecting on implications for the profession, including from an equality, diversity, and inclusion perspective.	Research Design: Exploratory literature review Research Instrument: Scopus, LISA, and Google Scholar were undertaken, but the emergent nature of the literature prevented following a systematic SLR methodology.	AI in librarianship is enriching and challenging at the same time. Boosting productivity, and performing complex tasks, it also bears the danger of workforce divisions, inequalities, and job losses due to embedded cultural and gender biases. The focus of a librarian should be on high-quality data management and supplementation of AI technologies. AI will eventually worsen the existing gender and racial imbalances in the sector, especially with the predominance of white males in technical roles.	This could be addressed by the libraries through investing in training programs for AI literacy and technical skills that will enable librarians to work effectively with these emerging AI technologies. Promote diversity in technical roles as a means to help address potential gender and racial disparities in AI development and application. Moreover, libraries should carefully consider the ethical standards of third-party AI solutions and how well they serve the needs of all users. In this respect, there is a place where libraries can exploit AI for their benefit while encouraging the values of equality and inclusiveness in the profession.
Allan Dela Torre, Edson Macapagong, Jaycee Pieri Magbanua, Hazel Lim & Jearly Gift Ortiz (2024)	Negros Occidental	This study seeks to specifically answer the following questions: 1. What is the level of literacy skills of Grade 9 learners before and after AI intervention? 2. Is there a significant difference in the level of literacy skills of grade 9 learners before and after intervention?	Research Design: Descriptive Research Research Instruments: AI Text-to-Speech and SPSS software	The test was a 20-item test that gauged the increase in literacy among Grade 9 learners as facilitated by AI assistance. Its scores were segregated into three ranges: Low, which covers 1-7.33; Average, which is within the range of 7.34-13.67; and High, within the range of 13.68-20. Pre-test scores had a mean of 6.6714, classified as Low, while post-test scores had a mean of 12.7143, classified as Average. With the paired t-test, the mean difference was 6.04286 with a correlation of 0.324, indicating that there is significant improvement in literacy.	AI has the potential to be effective in education when students apply its tools to achieve improved ways of studying. Artificially intelligent aids for students with special needs ensure readable and audible options that facilitate the comprehension process. Teachers must incorporate the daily teaching of AI tool-based lessons as a means of making teaching more engaging and effective. Indeed, AI's potential lies in capturing and holding the attention of students to boost learning. Because of this, it is recommended that administrators incorporate AI into their School Development Plans.
UNESCO (2024)	Global Context	The purpose of the study will be to establish how AI is used in institutions of learning throughout the	Research Design: Mixed-method research design, combining qualitative analysis of expert opinions, policy	The study finds that AI is increasingly being deployed to facilitate personalized learning, automate some administrative tasks, and provide real-time support to students. While there are radical differences in the	The integration of AI can bring a sea change to education, but this will be possible only when the question of the digital divide is taken up with seriousness by the governments, who

		world and the impact it has on teaching, learning, and administrative processes. Additionally, the study will try to establish disparities in the use of AI throughout countries, ethical concerns raised by its usage, and risks that AI poses to the labor market and students' privacy.	documents, and case studies with quantitative data on AI implementation in schools, colleges, and universities. Research Instruments: Primary materials include reports and publications from UNESCO, interviews with education experts, policy reviews, and case studies from educational institutions utilizing AI.	level of adoption across countries, the situation remains such that developed countries utilize their robust infrastructure and resources to the fullest while developing nations have minimal access to basic technology. These concerns include the digital divide being enhanced by AI, ethical issues regarding the privacy of students' data, and AI rendering jobs obsolete by automation. At the same time, AI is bound to upgrade research possibilities and is likely to help with large-scale data analyses.	must increase connectivity and develop infrastructure for the smooth integration of AI. Educators and students will need training on using AI tools and understanding related ethics. Policymakers must develop comprehensive regulations, addressing privacy, data security, and job displacement. AI can be used to enhance but not substitute the human factor in education and to encourage social and collaborative learning.
Thomas Chiu, Zubair Ahmad, Murod Ismailov & Ismaila Sanusi (2024)	Hongkong	The two major aims of this paper are to (i) define AI literacy and competency for a non-technical audience, i.e., K–12 education, and (ii) suggest an expanded framework of AI education. How teachers design the teaching and learning activities of AI directly influences how and what students will learn. It is teachers' perspectives that can make sense of any innovative education.	Research Design: Co-design research design Research Instruments: Workshops, meetings, and digital platforms for immediate feedback	This framework was built from this work: technology, impact, ethics, collaboration, and self-reflection. Technology includes the basics of AI and its applications; impact includes the influence of AI on work and society; ethics include the area of fairness, trust, and privacy; collaboration underlines interactions with AI; and self-reflection encourages continuous assessment.	Practical sessions and involvement with the community may strengthen insight into the concept of AI; other aspects are ethical issues and cultural sensitivity, which must be instilled during teacher training. Future research should test the applicability of this framework across a variety of contexts as one means of supporting educators and policymakers in the effective implementation of the framework.
Yimin Ning, Cheng Zhang, Binyan Xu, Ying Zhou, and Tommy Tanu Wijaya (2024)	China	This research is aimed at achieving the following primary objectives: To develop and validate an AI-TPACK measurement tool designed for teachers, featuring ideal	Research Design: Survey-based research Research Instruments: SPSS 27 was used for Exploratory Factor Analysis (EFA) to identify the structure of the AI-TPACK scale.	Both EFA and CFA were used to investigate the adequacy of the AI-TPACK model in integrating AI into teaching. From the EFA analysis, seven variables were retained after excluding some items for validity, as they explained 75% of the variance. In the CFA analysis, strong reliability was shown: CR > 0.7, Cronbach's α = 0.957, and convergent validity as AVE > 0.5. By SEM analysis, CK and PK had only a small effect, while	Future research studies should aim at improving the AI-TPACK model; revisit the aspect of content knowledge; and try out other structural equations. There is a need to collect more quantitative data to have a better understanding of the behavioral parameters related to the AI-TPACK integration among pre-

		metrics for assessing their knowledge levels across the various components of AI-TPACK; To explore the relationships among the constituent knowledge elements of AI-TPACK and confirm whether these connections are consistent with theoretical assumptions.	Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) were used to validate the relationships between AI-TPACK components.	the technology-related elements, such as AI-TK, AI-TCK, and AI-TPK, developed a moderate one. Thus, AI-TPK presents the highest predictive value for the overall AI-TPACK.	service and in-service teachers.
Kendra Cherry (2023)	Not Specified	To explore how cognitive development occurs through social interactions and how the Zone of Proximal Development (ZPD) facilitates learning with guidance.	Research Design: Theoretical and observational Research Instruments: Observational studies, theoretical analysis	Social interaction is thus a heavy influencer of cognitive development; learning will occur best when tasks fall within the learner's ZPD and, as such, require guidance from a more knowledgeable other. Scaffolding enables the learner to move through his ZPD.	Educators have to be oriented and trained in identifying each child's progressive ZPD and adjusting accordingly. Give time and available resources to apply scaffolding effectively among the educators. Address issues related to the handling of a large number of students and cognitive flexibility.
Matthias Carl Laupichler, Alexandra Aster & Tobias Raupach (2023)	Germany	1. Which items are relevant for and representative of AI literacy? 2. How can the items be rephrased to most accurately represent the construct of AI literacy?	Research Design: Delphi study- a qualitative research method used to gather expert opinions and achieve consensus on specific topics. Research Instruments: Descriptive statistics, including the mean, median, and standard deviation. Data analysis was conducted using SPSS Statistics.	The experts rated the items in three rounds and included 38 items in this final scale, excluding nine for a lack of relevance. Items rated 9 or above were retained, while those rated 5 or below were rejected. Certain items, after review, were reconsidered for inclusion. The refinement of this wording by expert feedback increased the content validity of the scale; therefore, the final AI Literacy scale was a valid measure of the key AI competencies.	The direction of future research should be the strict verification of the construct of the item set in AI literacy, testing its psychometric properties across populations. Of equal importance is ensuring reliability and objectivity. It is recommended that this item set be iteratively tested by researchers with a view to refinement in contributing to a robust tool for the assessment of AI literacy and advancing AI education.
Davy Tsz Kit Ng, Wenjie Wu, Jac Ka Lok Leung, Thomas Kin Fung Chiu & Samuel Kai	Hongkong	The core of this paper, therefore, lies in developing and validating an instrument to assess the	Research Design: Mixed Method Research Instruments: AI Literacy Questionnaire	The pilot study enhanced the AI literacy program and AILQ for predictive validity and paired t-tests. All ABCE learning constructs improved significantly, except 'career interest' with $p = 0.064$ and	Technical skills shall be integrated into a curriculum that emphasizes emotional intelligence, meta-cognitive strategies, and ethical considerations. The schools should therefore include

Wah Chu (2023)		affective, behavioral, cognitive, and ethical learning of students in the process of developing AI literacy in school. This study will contribute to the literature gap by designing a comprehensive AI Literacy Questionnaire, AILQ, which measures the AI literacy of students beyond cognitive and ethical domains but rather includes an affective and behavioral dimension that allows deeper insights into the concept of AI literacy among young learners.	(AILQ), Lessons incorporated AI learning tools like Teachable Machine, Quickdraw, and image stylizers. Pedagogical strategies included collaborative project-based learning and the use of AI-driven hardware and software.	'collaboration' with p = 0.057. Items were refined for 'confidence', 'self-efficacy', and 'AI ethics'. In the main study with 363 students, the refined AILQ has shown high-reliability Cronbach's alpha > 0.90 and good fit indices. CFA confirmed the ABCE framework while the second-order model having an Affective, Behavioral, Cognitive, and Ethical dimension proved more robust than the third-order model in measuring AI literacy.	activities that enhance higher-order thinking, collaboration, and the ethical implications of AI. Further research is required to establish long-term implications for career choices from such a well-rounded AI literacy program. Going forward, the ABCE model may help educators build an increasingly superior version of AI literacy models for their students and the challenges of the AI-embedded world.
Reshu Sharma & Dr. C. S. Shukla (2023)	Not Specified	This research aims to investigate the impact and implementation challenges of the constructivist approach in education, particularly in promoting active learning and critical thinking skills among students in the 21st century. It also seeks to address the gap in understanding how to effectively train teachers to implement this approach in classrooms.	Research Design: The study employs a qualitative research design, drawing on literature reviews, case studies, and comparative analyses of Piaget's and Vygotsky's theories about the constructivist approach. Research Instrument: The study relies on secondary data collection from peer-reviewed journals and publications.	It effectively helps to increase the engagement, motivation, and deeper understanding of the students. Still, the constructivist approach has different disadvantages concerning implementation, proper training of teachers is not provided, and it faces resistance to change from the traditional mold of education. Both Piaget's cognitive development theory and Vygotsky's sociocultural theory have helped in the shaping of this approach; both of these theorists focused on a different but complementary aspect of learning.	I would further go on to recommend designing comprehensive training for teachers on practical activities in the use of constructivist approaches. Further, schools must be encouraged to adopt collaborative learning environments that reflect both Piaget's and Vygotsky's theories to ensure that social interaction is given equal emphasis with individual exploration. Finally, institutions should support ongoing professional development and supportive policies that will cushion the transition process from conventional teaching methods toward constructivist-based methods.
Mark Anthony Llego (2023)	Philippines	This study aims to investigate how AI technology can be utilized in an	Research Design: Qualitative research	AI can, therefore, assist Philippine educators in the following ways: automating some administrative tasks, personalizing learning, and	The full benefits of AI in Philippine education will thus be realized when policymakers and education professionals focus on the

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		attempt to contribute to the Philippines' education system by focusing on collaboration rather than competing with human educators. The problem addressed by this research involves the various challenges faced by the educators of the Philippines, which range from inadequate infrastructure and resource constraints to an increasing number of students. It tries to show the way to understand how AI will support teachers and administrators, improve learning experiences, and prepare students for entering the future workforce.	Research Instrument: It is a multi-disciplinary approach to interviews with experts in education, AI experts, implementation case studies on AI in educational settings, and reviews of existing literature on AI applications in educational settings. These varied materials give insight into the potentials and limitations AI will have within the Philippine context.	facilitating communication in schools. Adaptive technologies, virtual assistants, and interactive educational games can be ways to realize personalized learning through AI tools. At the same time, there is a need to consider the challenges that such integration might create: the need for digital literacy and integrating these AI tools into already existing curricula.	development and integration of AI tools responding to local needs. This means the training of teachers in AI technologies, access to AI-powered educational resources, and direct collaboration between AI developers and educators in developing solutions for specific challenges faced within the Philippine Education System. Apart from this, students should be motivated towards digital literacy to help them meet the workforce requirements of the future.
Anita Dani & Elaine Al Quraan (2023)	United Arab Emirates	The study focuses on the attitudes of research students toward statistical methods and how these attitudes influence their choice between qualitative and quantitative research approaches. It examines the underlying factors that affect students' preferences in research methodologies, particularly	The research involved a survey conducted with 81 research students from three different universities. The survey included both quantitative and qualitative components, with an open-ended question allowing for thematic analysis of student responses. Quantitative data were analyzed using cluster analysis and independent sample t-tests to compare attitudes	The study found that postgraduate students in social science disciplines generally exhibit a reluctance to adopt quantitative research approaches. The attitudes toward statistics differed significantly between master's and doctoral students. Many students who perceive statistics as primarily focused on numerical methods tend to avoid it in favor of qualitative research. This reluctance suggests a need for enhanced engagement with statistical methods in research training to promote a more balanced approach to research methodologies among students.	Based on the findings, the study recommends revisions to the curriculum for research methods courses to emphasize the importance and applicability of quantitative methods alongside qualitative approaches. This could include integrating hands-on statistical training, fostering a more positive attitude towards statistics, and providing real-world examples that demonstrate the relevance of quantitative analysis. Additionally, workshops and mentoring programs could be established to boost students' confidence in their statistical skills, encouraging them to

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		within the context of postgraduate education in social sciences.	between master's and doctoral students. Additional analyses, such as cross-tabular analysis, chi-square tests, and ANOVA, were employed to explore differences in attitudes and preferences among the participants.		embrace quantitative research methodologies.
Katharina Schüller (2022)	Germany	This study deals with how professional statisticians' roles are emerging with the rapid increase in the democratization of data. It looks into various challenges faced by statisticians in shifting the role of citizens from mere data consumers to active collaborators and producers through open data movements. The study also points to an increase in the need for data and AI literacy for citizens and decision-makers in engaging with public statistics.	Research Design: Qualitative Research Research Instruments: HFD Data Literacy Framework	University adoption of the HFD Data Literacy Framework and converting it into a form suitable for adult learning through the "Stadt | Land | DatenFluss" (SLDF) app proves that the HFD Data Literacy Framework is flexible. The innovative app, which has been the focus of this concept, applies game-intense concepts to discuss multiple topics such as economy, mobility, and health. This proves that data literacy tools can be applied in any context and with any target learners, educators, or students with ease. Further, the focus that the app has on fun learning contributes to the aspect of accessibility when it comes to developing data literacy.	For continuous data and AI competency, it is believed that these competencies should be integrated into school curricula, universities, colleges, or vocational training institutions. It is very clear that there is a tremendous social demand for data literacy among the general populace; and, for this reason, there will be a need for a close working relationship between the public statistical institutions, educational centers, and policymakers in the formulation of composite data literacy programs. Future work needs to dedicate efforts to precisely specifying AI literacy and its enactment into existing data literacy paradigms, to provide for a comprehensive model of digital competencies learning principles.
Renelle Caraig & Maria Anan Quimbo (2022)	Los Baños, Philippines	This study focuses on assessing the reading comprehension levels of Senior High School students in core science subjects—specifically, Life Science, Earth Science, and Disaster Risk Management. It aims to identify	The research employs a descriptive-survey method, involving a sample of 115 Senior High School students from academic and technical vocational strands at a private school in Calamba City, Philippines. The study utilizes a reading comprehension	The findings reveal that only 7% of the respondents are classified as Mastery Level readers, indicating a concerning deficiency in reading comprehension skills among the students. In contrast, 49% of the students fall under the near mastery level, while 44% are categorized as low mastery level readers. This suggests that a significant majority of students struggle with comprehension in their core science subjects, highlighting the need for	The study recommends a holistic approach to teaching science, advocating for the incorporation of creative methods that enhance various aspects of learning and boost students' self-esteem. It suggests that instructors should create interactive learning environments and consider integrating subjects to foster better comprehension and engagement. Additionally, ongoing collaboration between science instructors

		various factors that affect students' reading comprehension skills, which are essential for their overall academic success and functioning within the community.	test with three levels of difficulty: upper beginner, intermediate, and upper intermediate. Specific stories used in the assessment include "GM Food" for upper beginner, and "The Most Amazing Structures on Earth" for intermediate level. Students' performance is categorized based on their correct answers, with thresholds set for mastery, near mastery, and low mastery levels.	improved instructional strategies.	and teachers from other disciplines could promote a more comprehensive understanding of the material, ultimately improving students' reading comprehension skills in core science subjects.
Chien Chou & Yuan-Hsuan Lee (2022)	Taiwan	The study focuses on the critical importance of research integrity (RI) in graduate education, particularly in Taiwan, where there is a notable lack of a standardized curriculum and assessment framework. It aims to develop a literacy-based RI assessment framework that encompasses essential components of responsible research conduct, ensuring graduate students are well-equipped with the necessary knowledge and skills.	The study utilized a comprehensive review of existing research integrity (RI) education and training programs to identify five core areas of focus: basic concepts in RI, RI considerations in the research procedure, research ethics and research subject protection, publication and authorship, and conflict of interest. These core areas were rigorously validated by RI experts to ensure content validity. Subsequently, test items were developed for each area, spanning three literacy levels: remembering and understanding, applying and analyzing, and evaluating and creating. This	The results demonstrated that the RI assessment items possessed adequate discrimination and were at a low difficulty level, making them effective for assessing a range of trainees' RI literacy. The assessment was able to provide valuable information to identify trainees who needed additional instruction or alternative training. Additionally, the low guessing parameters indicated that the online RI assessment effectively controlled test exposure and prevented cheating.	The study recommends that higher education authorities adopt this RI assessment framework to systematically evaluate graduate students' research integrity literacy. Implementing a standard curriculum based on this framework can prepare students for meaningful discussions about responsible research conduct, thereby fostering a culture of research integrity within academic institutions. This framework can serve as a foundational tool for building awareness and understanding of RI, ultimately enhancing the quality and ethical standards of research conducted by graduate students.

			structured framework was then implemented in an 18-unit RI course, which was attended by 7,087 graduate-level trainees. After completing the course, the trainees participated in a computer-based RI assessment, which consisted of items randomly selected from 26 RI testing booklets. This assessment was meticulously designed in accordance with mastery-oriented assessment principles to effectively gauge the trainees' understanding and application of research integrity concepts.		
Erwin Benedictos (2022)	Laguna State Polytechnic University Siniloan Campus - Laguna	1. What is the demographic profile of the respondents in terms of? a. Sex b. Gadget used 2. What is the Level of student's attitude toward statistics before and after using the Statistical Software platform in terms of? a. Affect b. Cognitive c. Value d. Difficulty e. Interest	Research Design: Descriptive Research Design using the one–group pretest and posttest design. Research Instruments: Questionnaire SATS 36 (Survey Attitudes Toward Statistics, frequency counts and percentages, mean and rank, mean and standard, Wilcoxon rank test and paired T-test, Mann-Whitney test and independent T-test and Kruskal-Wallis	The survey revealed that 80% of all the respondents were females, while 63.3% were using a mobile phone as the most used device. The lowest proportions were those students who owned both laptops and mobile phones at 20%, while 16.7% were using laptops alone. Besides, it was observed that there had been significant differences in the attitude and performance of students after using the statistical software. The observed differences were in values, interests, and efforts, while no difference was indicated by groups according to gender and kind of device.	Results thus show that the inclusion of statistical software in the regular curricula of courses in statistics are worth it, given its positive impacts on attitude and performance. Devices do not influence outcomes, and as such, facilitators are encouraged to focus on accessible tools. Extra tutorials and workshops on how to use software, and equal opportunities for both genders, are encouraged. Further follow-ups are recommended to test the long-term implications of software use at school levels on the academic success and logical analysis skills of the students.

		f. Effort 3. What is the level of students' performance in Statistics? 4. Is there a significant difference between student's attitudes and performance in Statistics before and after using Statistical Software Applications? 5. Is there a significant difference between students' attitudes and performance in Statistics in terms of sex and gadgets used before and after using Statistical Software Applications?			
Joseph B. Quinto (2022)	Benguet State University, Philippines	The study focuses on the impact of CHED Memorandum Order Number 15, Series of 2019, on graduate students in the Philippines, particularly regarding the requirements for publishing research in refereed journals. It examines the challenges faced by students in meeting these publication standards, especially in the context of developing countries like the Philippines, and emphasizes	The methodology involves a qualitative review of existing literature and policies related to academic publishing in the Philippines. It likely includes a content analysis of CHED guidelines and feedback from graduate students, faculty members, and academic administrators regarding their experiences and perceptions of the publication process. Surveys or interviews may be conducted to gather firsthand accounts of the barriers to publication and the effectiveness	The findings indicate that while the CHED memorandum has set higher publication standards for graduate students, many face significant barriers such as a lack of expertise, mentorship, and resources. The growth of publication pollution is noted, as developing-country researchers, including those in the Philippines, struggle with the transition to international publishing standards. Moreover, the study highlights the importance of mentorship in guiding students through the research and publication process, thereby enhancing their academic and professional development.	The study recommends the implementation of robust mentorship programs that pair experienced researchers with graduate students. These programs should focus on providing guidance from research ideation to publication. Additionally, institutions should offer workshops and training sessions on academic writing and publication processes. It is suggested that universities collaborate with established researchers and academics to develop resources that can assist students in navigating the complexities of publishing in high-quality journals. Finally, raising awareness of the importance of publication for career advancement and academic credibility among both students and faculty is essential for fostering a

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		the role of mentorship in overcoming these challenges.	of mentorship programs.		culture of research and publication.
Rosemary Luckin, Mutlu Cukurova, Carmel Kent & Benedict du Boulay (2022)	Arizona State University-USA	1. Where the AI is making decisions, e.g., in choosing the next task for the learner in an online educational tool a. Do the decisions seem sensible? b. On what basis were these decisions initially programmed into the system? In other words, were these just educated guesses by the programmer derived from an analysis of the decisions of highly effective human teachers, or by some other method? c. Are there any biases embedded in the decisions whether they are based initially on human experts? d. Can the system explain why it made these decisions if challenged either by the learner or the human teacher? e. Was the data on which the system trained properly representative of the population affected by the decisions?	Research Design: Applied research, qualitative and iterative, focusing on interactive and adaptive processes to facilitate AI readiness within organizations. Research Instruments: The research utilized both qualitative and quantitative methods, emphasizing statistical tools like mean, median, and standard deviation for data analysis. Qualitative analysis software was also employed to identify key themes. Materials included detailed documentation of the AI Readiness Framework and training modules, providing structured guidelines and educational support for AI integration.	It shows that the importance of AI in educational and training contexts is significantly increasing; however, these contexts are not well-positioned to make knowledgeable decisions about AI products and services. The AI Readiness Framework, but more specifically its 7-step ETHICAL approach, provides a structured approach for guiding organizations on how to understand and integrate AI into their operations. The early results appear to indicate that the framework has helped educational institutes, and more importantly those functioning in the higher education space, to understand how AI can help solve a certain set of problems. The fact that faculty members actively participated in the follow-up workshops shows interest in furthering such initiatives based on AI, therefore implying that the framework was helpful in effectively facilitating knowledge and use of AI.	It is suggested that the AI Readiness Framework be further engaged in educational organizations to conceptualize the benefits of AI and how it might serve the genesis of specific challenges within their institutions. Further research is needed to assess the long-term effectiveness of the framework in different educational contexts. Further, institutes should focus on continuous improvement of iterative training sessions in which the applications of AI will align with organizational goals and strengths of human intelligence. This would ensure that educators and administrators make fully informed decisions about the integration of AI and optimize their use of AI tools and services.

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		2. Where the AI is offering advice or information for a human to make a decision, e.g., in a dashboard for admissions tutors assessing students: a. Does the advice seem well-balanced? b. On what basis was the advice initially programmed into the system? In other words, were these just educated guesses by the programmer derived from an analysis of the advice from highly effective admissions tutors, or by some other method? c. Are there any biases embedded in the advice whether they are based initially on human experts? d. Can the system explain its thinking behind the advice if challenged by the admission tutor receiving the advice? e. Was the data on which the system trained properly representative of the population affected by the advice? 3. Where AI is looking for and finding patterns in data, e.g., a			

		pattern of behavior suggesting that an incoming student may be at risk: a. Is the data from which the patterns were derived properly representative of the kinds of applicants who might be affected by the insights derived from these patterns? b. Does the pattern-finding method introduce its sources of bias into those patterns? c. Can the patterns be explained in humanly understandable ways that make sense for the context of concern, or do the patterns seem to lack any semantics?			
Jessica McMaster (2022)	United Kingdom	This study has provided a review of recent research into statistical literacy commissioned by the Office for Statistics Regulation. It outlines the problems of the lack of any single definition and measures, discusses related skills of general literacy and numeracy, reviews attempts to improve statistical communication to non-experts,	Research Design: Theoretical Review Research Instruments: Related literature and journals	There was no single definition of statistical literacy agreed upon in this review, although basic skills, statistical knowledge, and thinking skills are common components. Demographic variables that include age, gender, and education affect differences in assessment methods. Effective recommendations for statistical communication to non-experts were underlined; also, a lack of coordination among the different UK and international initiatives aimed at improving statistical literacy was noted.	Future work should, therefore, be invested in developing a more standardized and contextualized definition of statistical literacy. Secondly, integration with several global initiatives given a view to sharing best practices could result in robust and truly effective approaches to improving statistical literacy and communication.

		and summarizes measures taken in the UK and elsewhere to improve statistical literacy and communication.			
Reynaldo Repedro & Cristina Diego (2021)	Negros Occidental	This study will look into the difficulties Grade 12 students have in learning statistics-a cognitive and non-cognitive disposition tied to attitude, perception, interest, and motivation.	Research Design: Quantitative descriptive-correlational research design Research Instruments: a survey of Attitudes Toward Statistics (SATS-36©), Multiple Linear Regression Analysis, and Researcher Test	The attitudes towards statistics were mixed, ranging from students valuing statistics and finding it interesting, although challenging, beyond their perceived capabilities. Students preferred applied statistics rather than abstract conceptualization. At a general level, students' statistical literacy appeared low, particularly in correlation and regression analysis, for which various reasons can be identified, including lack of qualified personnel, resources, and time. Especially noteworthy is that the students appreciating statistics had a considerably higher level of literacy, while the other facets of attitude, such as effect, interest, and difficulty, were less strongly related to literacy. This underlines the importance of teaching methods and curriculum development for the enhancement of statistical literacy.	The instruction should focus on the practicality of the concepts instead of just the mere theory of the idea. The teachers should incorporate more practical examples that the students can work on and present instructional materials showing their daily lives. The design of the curriculum should also accommodate more class time for the infusion of the subject of statistics and probability to enable the students to learn challenging calculations and formulae. Teacher training and curriculum development will also have to concentrate on developing an appreciation of the value of statistics since this is one of the prime motivational factors in student involvement and achievement in the subject.
Thomas Chiu (2021)	China	As per the research questions and objectives of this study, this study used a holistic approach of all four curriculum approaches to fulfill its objectives. Analyses by teachers are important in gras[ping with the nature of the new emerging AI technology in curriculum development. Therefore, this study incorporated the content, product, process, and praxis treatment within a framework with	Research Design: Qualitative Research Research Instruments: Interviews, teaching materials (including plans, slides, and worksheets), and review of minutes from 12 curriculum meetings.	The study identified six elements that one needs to address to design an AI curriculum that can be implemented in K12 settings and grouped into two clusters. First of all, the as content and product of the curriculum, we stressed the acquirement of AI knowledge, the understanding of AI processes, and the debate of the Social and ethical implications of Artificial Intelligence. Second, the curriculum as process and praxis encouraged the awareness of suitable, flexible, and efficient teaching practices that engage students and comply with various schools' settings.	Thus, I suggest that more attention should be paid to future developments of AI learning materials at students' different age cognition levels, the continued establishment of teacher training programs, the provision of AI-based tools in an open-source manner, and the cultivation of a partnership between teachers and AI practitioners to keep the course offerings relevant. In this way, K-12 students will be equipped with the aspect of AI literacy that will make them responsible citizens in the future.

		which to investigate teachers' perceptions and their teaching practices, as well as the design pointers for K-12 AI learning they may prescribe.			
Gengen Padillo, Ramil Manguilimotan, Reylan Capuno & Raymond Espina (2021)	Cebu, Philippines	This study examines the quality of instruction and professional development activities for teachers at a prominent university in Cebu, Philippines. It specifically investigates teachers' teaching competencies and their perceptions regarding the effectiveness and benefits of professional development initiatives, as well as any related issues and concerns.	The researchers conducted a systematic scoping literature review, synthesizing 68 relevant papers to assess the fragmented landscape of AI literacy research. This review involved critically examining the literature's specificity to different user groups and its differentiation from other forms of technology literacy. The findings were organized into a conceptual framework that outlines the learning methods leading to AI literacy, the components that constitute it, and the outcomes associated with it.	The review revealed that AI literacy research is somewhat disjointed, with insufficient integration of efforts across different studies. The findings highlighted the need for a more cohesive understanding of AI literacy, specifying how it varies among different user groups. The study established a comprehensive conceptual framework that categorizes AI literacy into distinct components and identifies the learning methods that lead to its acquisition. It also emphasized the impact of AI literacy on users' ability to navigate an AI-driven landscape effectively.	The study proposes a research agenda that aligns with the developed conceptual framework, identifying promising avenues for further exploration in AI literacy. It encourages researchers to focus on the specific needs of diverse user groups and to explore innovative educational methods that enhance AI literacy. By doing so, the study aims to prepare AI users for a future where AI technologies play an increasingly pivotal role in work and society, fostering responsible and informed use of these technologies.
Jukka Hoffrén (2021)	Global	The study focuses on the essential need for varying levels of statistical literacy in society, emphasizing the importance of understanding statistical information in relation to social phenomena. It critiques the limitations of the term "statistical	The methodology involves a comprehensive review and analysis of existing literature on statistical literacy competencies. It likely includes an evaluation of educational frameworks and curricula to assess how well they prepare individuals for statistical	The findings indicate that current educational systems often fall short in providing the comprehensive statistical literacy competencies needed by individuals. The paper highlights the importance of equipping citizens with skills to seek, evaluate, and apply statistical information in various contexts. It suggests that the commonly used term "statistical literacy" does not fully encompass the range of skills required for meaningful engagement with statistics. Furthermore, the study outlines four additional competencies essential for	The study recommends that educational institutions expand their curricula to include a broader range of competencies related to statistical literacy. This includes teaching critical thinking skills for evaluating statistical data, practical applications of statistics in daily life, and the ethical use of statistical information. It suggests developing programs that enhance the art of reading and interpreting statistics, thereby fostering a more informed citizenry capable of engaging with

		literacy" and aims to identify the competencies and skills necessary for individuals to effectively engage with statistics and apply them in real-world contexts.	understanding. The study may also incorporate qualitative assessments, such as surveys or interviews with educators, students, and statistical professionals, to gather insights on the competencies that are currently taught and those that are necessary for effective citizenship.	understanding and using statistics effectively in society.	social issues through a statistical lens. Additionally, collaboration between national statistical institutes and educational institutions is advised to ensure that the competencies reflect the needs of society and prepare individuals for informed decision-making.
Milushka M. Elbulok-Charcape (2021)	Brooklyn College of the City University of New York (CUNY)	The goal of this research is to design an ecologically valid, holistic assessment of research literacy for undergraduate students. The present research will fill in the lacuna in the literature regarding knowledge and skills concerning research methods and statistics, and the application of knowledge in realistic situations. This assessment would also provide valuable feedback for instructors of statistics and research methods about the areas where students are lacking proficiency. The aim is to enable educators to modify their teaching methodologies, develop new courses, and refine learning objectives with a	Research Design: mixed-methods design Research Instruments: The assessment utilized vignettes covering three topics: criminal justice, health, and education. The Critical Research Literacy Assessment (CRLA), video interviews, four research assistants.	Descriptive analyses revealed a sample predominantly female (81.7%) with an average GPA of 3.29. The CRLA's reliability was confirmed through internal consistency and inter-rater reliability measures. Validity was supported by significant correlations with other research literacy measures and weak correlations with self-reported research literacy. Content and criterion validity were demonstrated, though some hypotheses about demographic differences were only partially supported.	Further refinement is now needed for the CRLA through expanded expert input and confirmatory factor analysis to ensure that the concept of research literacy is fully captured. Demographic influences should then be explored in the future with more diverse participants. Coursework should also be revised to include real examples of research to which theory is explicitly connected to practice. Objective measures, such as academic records, should replace self-reported grades. Beyond that, further CRLA testing in other disciplines would be beneficial to assess the generalizability of the tool, and alternative test formats may provide even greater detail about research skills. These steps will go toward ensuring the assessment is used more effectively to foster critical research literacy.

		view toward the students' research literacy.			
Siu-Cheung Kong, William Man-Yin Cheung, Guo Zhang (2021)	Hongkong University	The study aims to develop and evaluate an AI literacy program that enhances university students' understanding of AI concepts, their AI literacy, empowerment, and ethical awareness.	Research Design: Mixed-Method Research Instruments: Surveys, self-reflective essays, bilingual text-mining system, focus group interviews	The findings indicated that participants showed significant improvement in AI conceptual understanding, literacy, empowerment, and ethical awareness. Dropout rates have gone down throughout it, with some challenges due to the non-credit-bearing nature and online teaching mode.	In this context, future AI literacy programs should continue to emphasize conceptual understanding and ethical considerations, as well as integrate project work to keep students more engaged and creative. Solutions for dropout rates and the challenges of adapting to online learning need to be found.
Duri Long & Brian Magerko (2020)	USA	This paper aims to define AI literacy, describing key competencies and design considerations necessary for non-technical learners. It identifies the need to understand the role that AI plays in everyday technologies, along with the potential misconceptions of those technologies. The research develops a conceptual framework for AI literacy from an interdisciplinary review that could inform future educational activities and stimulate further discussion.	Research Design: Scoping study design to explore and map key concepts and literature related to AI literacy. Research Instrument: Literature databases (e.g., Google Scholar, ACM Digital Library), AI4K12, public syllabi from accredited universities, grey literature (non-peer-reviewed, AI Education Papers and Surveys and Polls.	This study provided a scaffolded definition of AI literacy and identified key competencies and design considerations through an interdisciplinary review. It showed that while AI education is on the increase, there is a lack of empirical research regarding the ways non-technical audiences perceive AI and are being taught about it. Interest in AI literacy among non-programmers is on the rise, and new initiatives are being developed for both formal and informal learning contexts.	Future research should address the validation and refinement of the competencies of AI literacy by empirical investigations with non-technical learners, checking their preconceptions, learning outcomes, and effective teaching methods. AI literacy will have to be integrated into the school curriculum, corporate training, and community programs if learners are to be prepared for a world in which AI is becoming increasingly integral. Successful educational initiatives in this respect are likely to require continuing collaboration among educators, AI developers, and policy-makers if they are to be adaptive and responsive.
Kathryn E. Joyce & Nancy Cartwright (2020)	Europe	The article focuses on addressing the disconnect between research in evidence-based education policy and its practical	The study employs a conceptual analysis of existing literature on evidence-based education research, particularly	The article highlights that current research methodologies, primarily RCTs, fall short in providing actionable insights for local educational practices. It argues that while RCTs can establish causality, they do not adequately account for local variables that influence the	The authors recommend shifting the focus of educational research from causal ascription to improving local effectiveness predictions. This involves utilizing mixed methods that integrate qualitative and quantitative

		application in local contexts. It critiques the reliance on randomized controlled trials (RCTs) for making causal claims and emphasizes the need for research that helps predict local effectiveness of educational interventions rather than merely asserting their efficacy in general.	examining the limitations of RCTs for local effectiveness predictions. It discusses various methodological approaches that can provide richer, context-specific information, such as implementation science, improvement science, and practice-based evidence. The authors propose a framework for collecting and analyzing information that directly contributes to local effectiveness predictions.	effectiveness of educational interventions. The authors advocate for research approaches that consider contextual factors and the specific needs of local educational environments, ultimately enhancing the predictive power of research findings.	approaches to gather comprehensive data about local contexts. They encourage researchers to prioritize collecting information relevant to implementation conditions, stakeholder perspectives, and community needs, thus fostering more applicable and effective educational interventions.
Jessica Obrial & Minie Rose Lapinid (2020)	Philippines	This research will explore how students conduct a statistical investigation, level of understanding, and problems encountered. Guided by the introduction of statistics into the Philippine K-12 curriculum, this study examines how real-world statistical practices can inform statistical literacy and influence teaching methods. This work is undertaken toward the high demand in educational/applied statistics on the improvement of reasoning, critical thinking, and decision-making skills in students through the use of the	Research Design: Action Research Research Instruments: GAISE framework, Qualitative data from interviews, observation field notes, and student reflections.	The general observation was that most students were confined to questions relating to academic issues, reflecting their immediate concerns and interests. Another concern was the data gathering, in which students relied too much on classmates as respondents, which brought about delayed and incomplete data on account of non-cooperation. Data analysis proved to be another problem point wherein students committed a variety of errors in presenting data and were problematic in using measures of statistics fittingly. Anyways, despite those setbacks, the students did get some good insight, especially into the understanding of how basic statistical concepts such as measures of central tendency are applied.	The study concludes by recommending increased teacher support at all stages of the investigative process and the use of more specific examples that can provide students with a clearer distinction between qualitative and quantitative research questions. Another suggestion is to perform prior knowledge tests and subsequent interventions concerning the usage of appropriate statistical concepts before students engage in investigations. However challenging, the process of going through a statistical investigation was indeed a worthwhile experience in building up the problem-solving skills, data management, and teamwork of the students.

		GAISE framework.			
Ina Sander (2020)	Germany	The paper aims to explore what current online resources foster critical big data literacy; it also looks at how these resources shape users' perceptions and behavior and therefore provide indications of how individuals interact with and make sense of big data in the digital setting.	Research Design: Qualitative Research Research Instruments: User testing involves questionnaires, screen recordings, and interviews to assess the tools' impact on users' privacy concerns and behavior.	The study found over thirty-seven basic big data literacy tools in 15 types of innovative formats, including graphic novels. Qualitative analysis revealed that the tools affected the participants' concerns about privacy and their online activity. The participants liked the interactive aspect and graphics of the tools; however, they felt that information on big data was not available. The above-mentioned results correspond to the outcome of other studies on generational and cultural differences concerning digital skills.	Future data literacy tools should, therefore, be both interactive and accessible, incorporating real-life examples of data harm and practical advice. Tools must be designed for different target groups, considering their digital skills, interests, and learning preferences. In addition, it requires educators, policymakers, and data experts to systematically collaborate so that literacy efforts address the dynamic landscape and challenges presented by big data in our society.
Muhammad Sharif Uddin (2019)	USA	This paper critically assesses Paulo Freire's concept of critical pedagogy and its potential to enhance critical thought for students in agitating social change. To this end, it questions how high-stakes testing and traditional teacher-centered approaches, which Freire identifies as a "Banking Concept of Education," stifle student intellectual growth and then search for alternative learner-centered directions that may liberate students from passivity.	Research Design: critical literature review design Research Instruments: Scholarly journal articles, books, and reports on critical pedagogy, particularly the works of Paulo Freire. Case studies from various educational settings that have applied critical pedagogy strategies.	Critical pedagogy by Freire inspires learning through dialogue and the approach of problem-posing rather than by mere memorization. Focusing on questioning and analysis, the students are led to be active in the process and encouraged to enhance their critical thinking. Interlinking lessons with real life and interactive activities in debate and simulations enables deeper involvement and creative application of knowledge. Furthermore, this concept aspires toward social change, wherein students are allowed to question social inequalities and promote social justice and equity in education.	The approaches in education must consistently dwell on strategies that relate to the learners, dialogue, and real-life connections that enhance problem-solving for active and critical learning. Professional preparation should be adequately informed of the need to apply Freire's methods efficiently in the classroom. Assessment must be shifted from high-stakes testing to critical thinking and problem-solving. Additionally, there must be a creation of an inclusive class offering diverse students transformative learning opportunities.
Rhey L. Dizon, Jamera S. Calbi, Jipie S. Cuyos & Dr. Marilyn Miranda (2019)	Philippines	This research paper would like to know the perspectives of teachers, parents, and students on the implementation	Research Design: Phenomenological Research Research Instruments: Survey	The K to 12 Program in the Philippines, intended to enhance education by extending basic schooling to 12 years, has encountered several challenges, including insufficient teacher preparation, excessive student workloads, and inadequate	Key recommendations that need to be instituted to better the K to 12 Program include: strengthening teacher preparation through extension of time of training and practice in school that will make teachers more

		of K to-12 programs in the country. This research used a systematic procedure to analyze the data. This sought to answer the following question: 1. What are the challenges of the K to 12 program upon its implementation ? 2. What are the teaching approaches used in K to 12 programs to enhance the lesson? 3. What are the views of teachers, students, and parents on the implementation of this new curriculum? 4. Based on readings, what are the proposed action plans that would address the gaps seen in this new curriculum? 5. What are the recommendations that can be created to address the problems under the implementation of the K to 12 program?	questionnaire, interview, observations, thematic analysis, chi-square test, and t-test for independent sample	school resources. Effective teaching strategies like Whole Brain Teaching have improved student motivation and performance, but a balanced approach is needed. Perspectives on the program vary, with teachers calling for more training, students generally optimistic, and parents divided on the financial impact. Addressing these issues requires prioritizing teacher development, improving school facilities, and fostering student research activities, with collaborative efforts from all stakeholders to ensure the program's success.	familiar with the new curriculum and develop appropriate teaching skills. Secondly, upgrading of school infrastructure with better facilities, laboratories, and teaching aids where improvement of teaching-learning conditions takes place. Finally, giving the students more exposure to research would allow them to apply their learning in appropriate environments and thus further develop their understanding. Put into place, the measures will have resolved some of the issues, and the K to 12 Program would have significantly improved the effectiveness.
Ibnatul Jalilah Yusof, Adibah Abdul Latif, Nor Fadila Amin, Aisamuddin	Malaysia	The study advocates for the development of a test measuring the research literacy of postgraduate	Research Design: instrument development research Research Instrument: the	This study developed a Research Literacy Test (RLT) that was utilized in the measurement of research literacy among postgraduate students in three domains: information literacy, knowledge of research	Future studies should develop other formats of the test such as open-ended questions to further measure higher-order thinking abilities such as problem-solving and reasoning. In

Mat Hassan, Mahyuddin Arsat, Aede Hatib Musta'amal & Jamal, Noor Azean Atan (2018)		students in terms of identifying, accessing, interpreting, and evaluating empirical literature. This is motivated by the fact that various challenges regarding reading research articles could result in numerous postgraduate students not completing their thesis or research study in due time.	study uses the Research Literacy Test (RLT) developed based on a literature review and expert validation. Fleiss Kappa analysis and Rasch Analysis were employed to assess the validity and reliability of the test items.	methodology, and statistical literacy. The test was composed of 40 multiple-choice items that were highly valid and reliable, as determined by Kappa values and Rasch Analysis. Thus, the test proved appropriate for evaluating research literacy within the specified domains.	addition, enabling the addition of other factors that affect research literacy such as the motivation of the student and reading skills in the RLT would make it more whole-rounded. The RLT can be adapted to any given learning environment with the intent of making research literacy programs more effective and assisting postgraduate students in becoming better researchers.
Sandra Mina Herrera (N.D.)	Not Specified	To explain the learning process for a community of practice, in which learners, moving from periphery to center, gain expertise; and learning occurs in social and contextual settings rather than in isolation.	Research Design: Theoretical review Research Instruments: Previous studies and literature on situated learning by Zheng, Bell et al., 2013, Catalano 2015. Authors reviewed empirical studies and theoretical works in developing their propositions about situated learning.".	The theory of situated learning has, however, made it clear that learning has to do with participation within a community of practice. In the process, LPP helps in the metamorphosis of learners from novices to experts through immersion and interaction. It stresses the point that there is no learning without considering its context and, secondly, that knowledge cannot exist on its own but rather as an outcome of the activity and culture it serves.	Further research on SLT is recommended to be conducted in different learning settings, such as online or blended learning. Different teaching areas should be tested to see the level at which their principles can be adopted. Educators should strive to construct learning contexts relevant to what happens.

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Appendix B

Plagiarism Clearance

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PLAGIARISM CLEARANCE

Research Proponent:
Melanie Aban-Serquiña

Adviser-Promoter:
Dr. Melanie G. Gurat

Program:
Master of Science in Teaching
Major in Mathematics

Research Title:
Predictors of Statistical Literacy among Teacher-Education Graduate Students

This is to certify that the above research manuscript passed the plagiarism evaluation and is ready for grammar and organization and APA format and style compliance evaluations.

DR. MELANIE G. GURAT — *Evaluator*
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Appendix C

Informed Consent

Title of Study: Predictors of Statistical Literacy among Teacher-Education Graduate Students

The purpose of this study is to evaluate statistical literacy among graduate students and to examine how various profiles, specifically research literacy and AI literacy, influence this literacy. The primary objectives are to assess the level of statistical literacy among the students, evaluate their profiles in terms of research and AI literacy, and determine which of these profiles significantly impacts their statistical literacy.

The results of this study may inform targeted education program development and support strategies for graduate students with an emphasis on teacher education. Thus, improvements in curriculum design, teaching methods, and resources toward making statistical and AI literacy stronger for future educators might result. Your participation will positively impact your graduate education experience and its utility in your teaching practice by making the whole thing more effective.

If you choose to participate, you will be asked to complete a questionnaire consisting of three sections: one covering your demographic profile (including course, gender, and age) and research literacy, another focusing on AI literacy, and the final section assessing statistical literacy.

Your participation in this study will involve completing a questionnaire that will take approximately 30 to 60 minutes. The study will not require any follow-up sessions or long-term commitments. The study aims to include approximately 40-100 graduate students enrolled in the Teacher Education and Humanities (TEA) programs under MAT, MAED, and MST at Saint Mary's University.

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This study has been submitted for ethical review to the Saint Mary's University Research Ethics Board (SMUREB). The board's contact information is as follows: 2nd Floor, Rev. John Van Bauwel Hall, SMU Main Campus, Ponce Street, Don Mariano Marcos, Bayombong, 3700 Nueva Vizcaya, Philippines (email: reb@smu.edu.ph; cellphone: 09177053041). The ethical review process is in place to ensure that the research adheres to the highest standards of integrity and ethical conduct, particularly regarding participant rights and welfare.

In conducting this study, I declare that there are no conflicts of interest that may affect the integrity of the results. There are no personal gains or financial incentives associated with this research that could compromise its objectivity or validity. I also have no direct personal or professional relationships with the study population or the study site that could influence the outcomes of the research. This commitment ensures that the study's findings are based solely on the data collected and not influenced by outside interests.

To protect the privacy of respondents and ensure the confidentiality of the data collected, measures will be implemented to safeguard the information throughout the research process. Participants' responses will be maintained confidentially, with their identities separated from their answers to prevent any linkage. Data collected will be securely stored and only accessible to the research team. Digital files will be encrypted, and all personal information will be managed according to ethical guidelines and institutional policies. After a retention period of three years, all data will be securely disposed of, ensuring that no identifiable information remains. Participants will be informed about these procedures to reinforce trust and confidentiality.

Your answers will be separated from your personal information, and no responses will be directly linked to you. To further protect your privacy, unique identification codes will be used instead of personal identifiers in the dataset, and pseudonyms will be used in any reports or publications related to this study.

Informed consent will be obtained directly from participants before data collection. This will involve presenting the consent forms to the graduate students, explaining the study's purpose, potential risks, and benefits, and confirming the voluntary nature of their participation. Students will have the opportunity to ask questions and express any concerns before signing the consent forms, ensuring that their participation is fully informed and voluntary. The study will be conducted in a supportive environment to promote open dialogue and comfort for all participants. This ethical approach is designed to protect participant autonomy while fostering an environment of trust and respect throughout the research process.

While the study is designed to minimize discomfort, you may experience mild emotional or psychological discomfort when answering questions related to your statistical, research, and AI literacy skills. This discomfort may arise from reflecting on personal knowledge or academic performance. Should you feel uncomfortable at any point, you may skip questions or withdraw from the study without penalty.

There are minimal risks involved in this study. Potential risks include feelings of self-consciousness or stress while evaluating your literacy in specific areas. No physical or significant emotional risks are expected.

To minimize any discomfort, you will be fully informed about the purpose of the study and what it entails before participating. You may stop answering the questionnaire at any time or choose not to answer specific questions if they cause discomfort. Your participation is voluntary, and your responses will not affect your academic standing or grades.

Consent:

I have read and understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____Date _____

Researchers Signature: _____

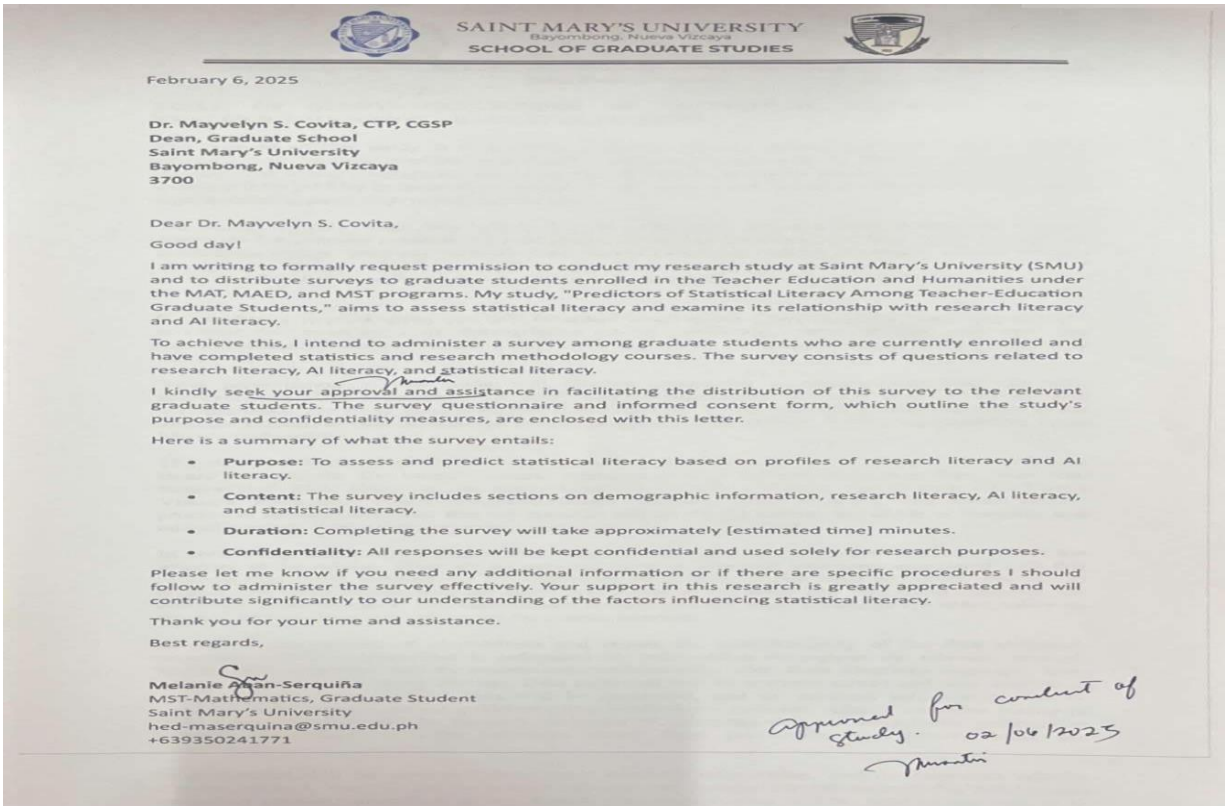
If you have any questions or concerns about this study, please contact:

- **Melanie Aban-Serquiña**
- **Phone:** +639350241771 **Email:** hed-maserquina@smu.edu.ph

Appendix D

Communication A

Letter to gather data



SAINT MARY'S UNIVERSITY
Bayombong, Nueva Vizcaya
SCHOOL OF GRADUATE STUDIES

February 6, 2025

Dr. Mayvelyn S. Covita, CTP, CGSP
Dean, Graduate School
Saint Mary's University
Bayombong, Nueva Vizcaya
3700

Dear Dr. Mayvelyn S. Covita,

Good day!

I am writing to formally request permission to conduct my research study at Saint Mary's University (SMU) and to distribute surveys to graduate students enrolled in the Teacher Education and Humanities under the MAT, MAED, and MST programs. My study, "Predictors of Statistical Literacy Among Teacher-Education Graduate Students," aims to assess statistical literacy and examine its relationship with research literacy and AI literacy.

To achieve this, I intend to administer a survey among graduate students who are currently enrolled and have completed statistics and research methodology courses. The survey consists of questions related to research literacy, AI literacy, and statistical literacy.

I kindly seek your approval and assistance in facilitating the distribution of this survey to the relevant graduate students. The survey questionnaire and informed consent form, which outline the study's purpose and confidentiality measures, are enclosed with this letter.

Here is a summary of what the survey entails:

- **Purpose:** To assess and predict statistical literacy based on profiles of research literacy and AI literacy.
- **Content:** The survey includes sections on demographic information, research literacy, AI literacy, and statistical literacy.
- **Duration:** Completing the survey will take approximately [estimated time] minutes.
- **Confidentiality:** All responses will be kept confidential and used solely for research purposes.

Please let me know if you need any additional information or if there are specific procedures I should follow to administer the survey effectively. Your support in this research is greatly appreciated and will contribute significantly to our understanding of the factors influencing statistical literacy.

Thank you for your time and assistance.

Best regards,

Melanie Aban-Serquiña
MST-Mathematics, Graduate Student
Saint Mary's University
hed-maserquina@smu.edu.ph
+639350241771

Approved for conduct of study. 02/06/2025

Appendix E

Communication B

Permission to Adopt and Use the Instrument

Request for a copy Inbox ×

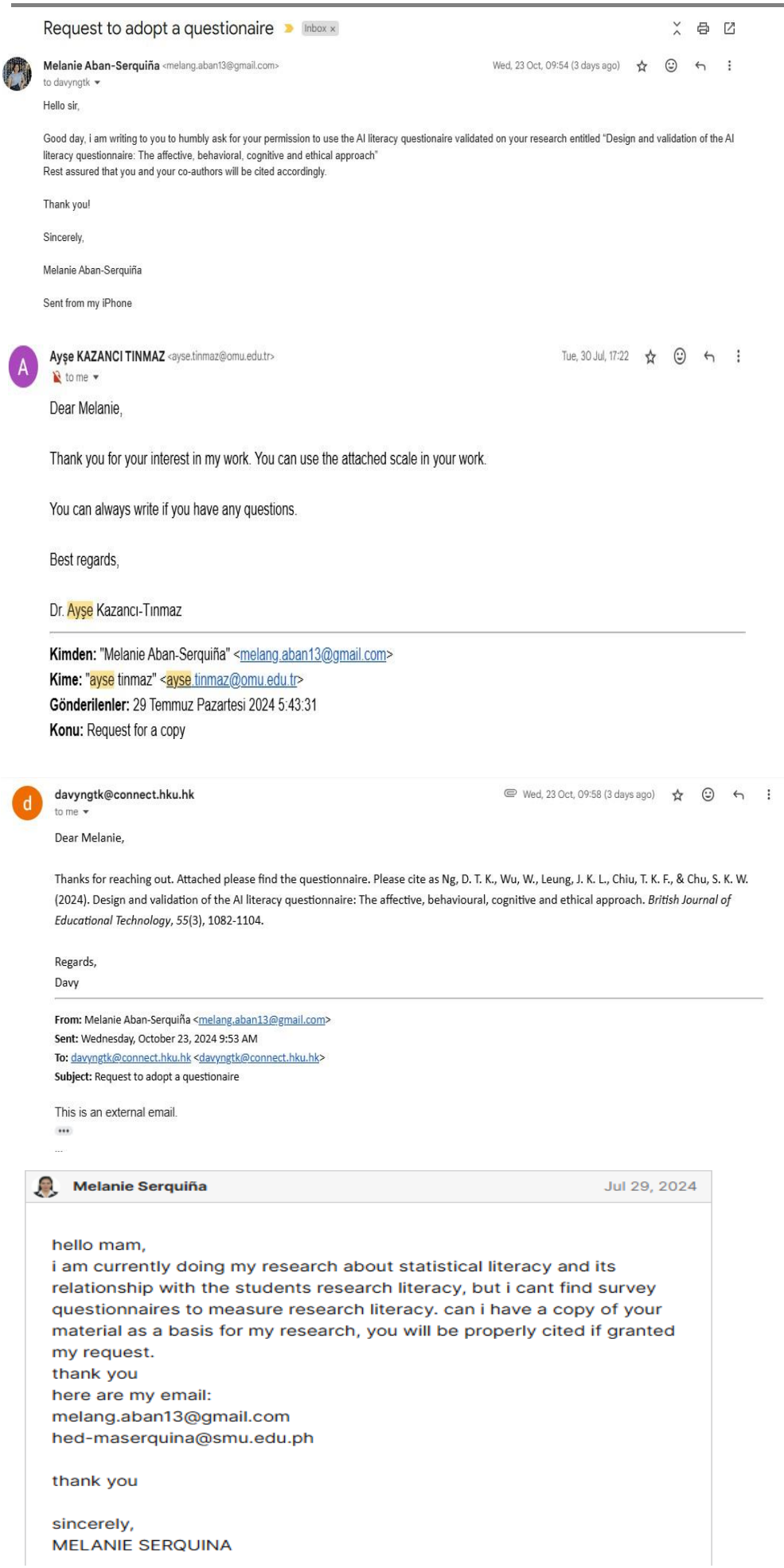
Melanie Aban-Serquiña <melang.aban13@gmail.com> Mon, 29 Jul, 10:43
to ayse.tinmaz

Good day sir:
I am Melanie Serquina, currently enrolled in my Masters degree at Saint Mary's University here in the Philippines.
I am writing you a request letter to have a copy of your developed research literacy scale for teachers, it will be my basis for crafting also a research literacy intended for my study
I hope to hear from you soon.

Thank you very much!

Sincerely,

MELANIE SERQUINA



Request to adopt a questionaire Inbox ×

Melanie Aban-Serquiña <melang.aban13@gmail.com> Wed, 23 Oct, 09:54 (3 days ago)
to davyngtk

Hello sir,

Good day, i am writing to you to humbly ask for your permission to use the AI literacy questionaire validated on your research entitled "Design and validation of the AI literacy questionnaire: The affective, behavioral, cognitive and ethical approach"
Rest assured that you and your co-authors will be cited accordingly.

Thank you!

Sincerely,

Melanie Aban-Serquiña

Sent from my iPhone

Ayşe KAZANCI TINMAZ <ayse.tinmaz@omu.edu.tr> Tue, 30 Jul, 17:22
to me

Dear Melanie,

Thank you for your interest in my work. You can use the attached scale in your work.

You can always write if you have any questions.

Best regards,

Dr. Ayşe Kazancı-Tınmaz

Kimden: "Melanie Aban-Serquiña" <melang.aban13@gmail.com>
Kime: "ayse tinmaz" <ayse.tinmaz@omu.edu.tr>
Gönderilenler: 29 Temmuz Pazartesi 2024 5:43:31
Konu: Request for a copy

davyngtk@connect.hku.hk Wed, 23 Oct, 09:58 (3 days ago)
to me

Dear Melanie,

Thanks for reaching out. Attached please find the questionnaire. Please cite as Ng, D. T. K., Wu, W., Leung, J. K. L., Chiu, T. K. F., & Chu, S. K. W. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach. *British Journal of Educational Technology*, *55*(3), 1082-1104.

Regards,
Davy

From: Melanie Aban-Serquiña <melang.aban13@gmail.com>
Sent: Wednesday, October 23, 2024 9:53 AM
To: davyngtk@connect.hku.hk <davyngtk@connect.hku.hk>
Subject: Request to adopt a questionaire

This is an external email.

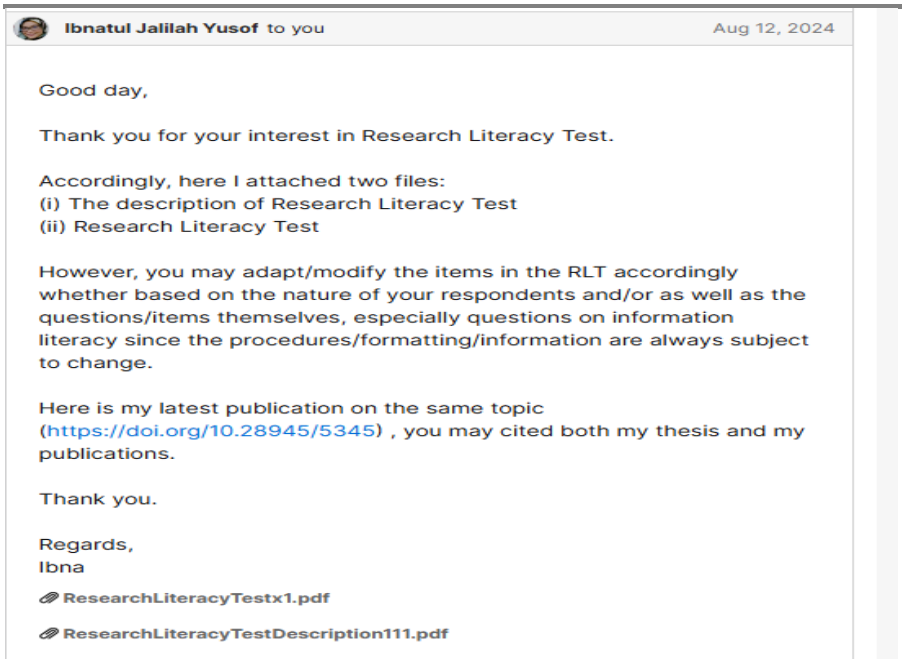
...

Melanie Serquiña Jul 29, 2024

hello mam,
i am currently doing my research about statistical literacy and its relationship with the students research literacy, but i cant find survey questionnaires to measure research literacy. can i have a copy of your material as a basis for my research, you will be properly cited if granted my request.
thank you
here are my email:
melang.aban13@gmail.com
hed-maserquina@smu.edu.ph

thank you

sincerely,
MELANIE SERQUINA



Ibnatul Jalilah Yusof to you Aug 12, 2024

Good day,

Thank you for your interest in Research Literacy Test.

Accordingly, here I attached two files:
(i) The description of Research Literacy Test
(ii) Research Literacy Test

However, you may adapt/modify the items in the RLT accordingly whether based on the nature of your respondents and/or as well as the questions/items themselves, especially questions on information literacy since the procedures/formatting/information are always subject to change.

Here is my latest publication on the same topic (https://doi.org/10.28945/5345) , you may cited both my thesis and my publications.

Thank you.

Regards,
Ibna

ResearchLiteracyTestx1.pdf

ResearchLiteracyTestDescription111.pdf

Appendix F

Research Questionnaire

Statistical, Research, And Ai Literacy Test

Predictors Of Statistical Literacy Among Teacher-Education Graduate Students

(Survey and Questionnaire)

Thank you for participating in this survey. Your responses will help assess the levels of research literacy, AI literacy, and statistical literacy among graduate students, and explore how these factors contribute to statistical literacy. Your participation is voluntary, and all answers will be kept confidential.

Name (optional): _____ Age: _____

Gender: _____ Department: __TEH __Sci-Math

This survey integrates elements from three established studies to assess respondents' competencies comprehensively. The first section evaluates research literacy using a questionnaire adapted from Tinmaz and Sezgin's Research Literacy Scale for Teachers, which measures research awareness, attitudes, skills, and application. The second part is based on the work of Ng et. al which assesses AI literacy across four dimensions: affective, behavioral, cognitive, and ethical learning. The final section, derived from Yusof et. al research, measures statistical literacy, focusing on core concepts such as central tendency, variability, hypothesis testing, and data analysis.

I. Research Literacy

This section of the questionnaire aims to assess your knowledge, skills, attitudes, and use of research in your profession. You will be presented with statements related to research literacy, divided into four key areas: Research Awareness, Attitude Toward Research, Research Skills, and Research Use. For each statement, please indicate the extent to which you agree or disagree using the following scale:

1 – Strongly Disagree, 2 – Disagree, 3 – Agree and 4 – Strongly Agree

Please read each statement carefully and choose the response that best reflects your perspective toward research. Put a check (√) on the scale that best describes each statement.

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Statements	1	2	3	4
Research Awareness				
1. I know what information I need when I want to do research.				
2. I know what topics research consists of.				
3. I understand whether a study is scientific research or not.				
4. I know where scientific research is published.				
Attitude toward Research				
1. Scientific research is essential to my profession.				
2. Educators should benefit from research in their professional practice.				
3. Scientific research is useful for my professional development.				
Research Skills				
1. I can carry out a literature review on a topic.				
2. I can discuss the research that has been done on a topic.				
3. I can access research resources effectively.				
4. I can turn my research into a academic article.				
5. I can understand the results of statistical analysis.				
6. I know how to interpret tables, graphs, charts, and similar figures in research.				
Research Use				
1. I use scientific research to organize my daily professional activities.				
2. I read current research results for my professional development.				
3. I benefit from scientific research while preparing the course contents.				
4. I use scientific research to examine my professional practices from different perspectives.				
5. I base everything I do in my practice on scientific research.				
6. I base my statements on research to inform parents.				
7. I benefit from research to improve my pedagogical knowledge.				

Kazancı Tınmaz, A., & Sezgin, F. (2023). Development of the Research Literacy Scale for Teachers. Sage Open, 13(4). https://doi.org/10.1177/21582440231199033

II. AI Literacy

This survey assesses your knowledge, attitudes, and behaviors related to Artificial Intelligence (AI) across four categories: Affective Learning, Behavioral Learning, Cognitive Learning, and Ethical Learning. Each category includes a series of statements. Please read each statement carefully and indicate your level of agreement using the following scale: 1 – Strongly Disagree, 2 – Disagree, 3 – Agree, and 4 – Strongly Agree.

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There are no right or wrong answers; please answer based on your experiences and opinions. Put a check (√) on the scale that best describes each statement. Your responses will help us understand your perspectives on AI. Complete each section by rating how much you agree/disagree with each statement.

Statement	1	2	3	4
Affective learning				
Artificial intelligence is relevant to my everyday life (e.g., personal, work).				
Learning AI is interesting.				
Learning AI makes my everyday life more meaningful.				
I am curious about discovering new AI technologies.				
I am confident I will perform well on AI related tasks.				
I am confident I will do well on AI related projects.				
I believe I can master AI knowledge and skills.				
I believe I can earn good grades in AI related assessments.				
I can understand AI related resources/ tools.				
I feel confident that I will do well in the AI related tasks.				
Behavioral learning				
I will continue to use AI in the future.				
I will keep myself updated with the latest AI technologies.				
I plan to spend time exploring new features of AI applications in the future.				
I actively participate in AI-related learning activities.				
I am dedicated to AI-related learning materials.				
I often try to explain the AI learning materials to my classmates or friends.				
I try to work with my classmates to complete AI learning tasks and projects.				
I often spend spare time discussing AI with my classmates.				
Cognitive learning				
I know what AI is and recall the definitions of AI.				
I know how to use AI applications (e.g., Siri, chatbot).				
I can compare the differences between AI concepts (e.g., deep learning, machine learning).				
I can apply AI applications to solve problems.				

I can create AI-driven solutions (e.g., chatbots, robotics) to solve problems.				
I can evaluate AI applications and concepts for different situations.				
Ethical learning				
I understand how misuse of AI could result in substantial risk to humans.				
I think that AI systems need to be subjected to rigorous testing to ensure they work as expected.				
I think that users are responsible for considering AI design and decision processes.				
I think that AI systems should benefit everyone, regardless of physical abilities and gender.				
I think that users should be made aware of the purpose of the system, how it works and what limitations may be expected.				
I think that people should be accountable for using AI systems.				
I think that AI systems should meet ethical and legal standards.				
I think that AI can be used to help disadvantaged people.				

Ng, D. T. K., Wu, W., Leung, J. K. L., Chiu, T. K. F., & Chu, S. K. W. (2023). Design and validation of the AI literacy questionnaire: The affective, behavioral, cognitive and ethical approach. British Journal of Educational Technology, 1–23. https://doi.org/10.1111/bjet.13411

III. Statistical Literacy

This section consists of 15 multiple-choice questions, please encircle the correct answer.

For question 1 & 2

Competency	Study Level	Mean	SD	Sig.
Research	Undergraduate	4.59	0.47	0.35
	Post Graduate	4.68	0.46	
Information	Undergraduate	4.19	0.48	0.06
	Post Graduate	4.39	0.49	
Statistical	Undergraduate	4.32	0.32	0.24
	Post Graduate	4.36	0.42	
Critical Thinking	Undergraduate	3.96	0.43	0.33
	Post Graduate	4.11	0.44	
Reflection	Undergraduate	3.54	0.41	0.32
	Post Graduate	4.10	0.42	

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1. Which research competency component has a significant difference between undergraduate students and postgraduate students?

A. Information Literacy

B. All except for Information Literacy

C. None of the research competency components

2. If the researcher wanted to examine the mean difference in Information Literacy between undergraduate students and postgraduate students, which statistical analysis should the researcher use?

A. Kruskal-Wallis test

B. Paired sample t-test

C. Independent sample t-test

3. Which of the following statements is correct about standard deviation (SD)?

I. SD can be a negative number

II. SD should be higher in each statistical analysis

III. Used to quantify the amount of variation of a set of data values

IV. A low SD means that the values in a data set are close to the mean of the data set

A. I and III only

B. II and III only

C. III and IV only

Type of Compulsory Courses

		Compulsory Course			Total
		Dynamic Leadership	Philosophy of Science and Civilization	Global Development	
Gender	Female	18	10	12	40
	Male	16	14	10	40
Total		34	24	22	80

Chi-Square Test

	Value	df	Assym. Sig (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.485[a]	2	.483	.640	.389
Continuity Correction[b]	.215	2	.542		
Likelihood ratio	.485	2	.472		
Linear-by-Linear Association	.480	1	.487		
N of Valid	80				

For questions 3,4 and 5

4. What types of variables were used in this study?

A. Ratio

B. Continuous

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C. Categorical

5. Which of the following research questions is appropriate to use statistical analysis as shown in Table above?

A. Does gender predict the choice of compulsory course?

B. Is there any association between gender and the choice of compulsory course to attend?

C. Is there a significant difference in the mean of choice of compulsory courses for female and male students?

6. Which of the following results is true?

A. The choice of compulsory course to attend cannot be statistically predicted by gender.

B. There is no association between gender and the choice of compulsory course to attend.

C. There is no significant difference in the mean of choice of compulsory courses for female and male students

7. Which of the following statements is false about correlation analysis?

I. Correlation does not imply causation.

II. Correlation is used for predictive analysis and modeling.

III. Negative correlation coefficient indicates the weakest correlation.

IV. Correlation coefficient can take a range of values from 0 to 1 only.

A. I, II, III only

B. II, III, IV only

C. I, II, III, IV

8. If a nominal scale is used, which of the following statistics could be identified?

A. Mode

B. Mean

C. Standard deviation

9. A researcher was interested in the anxiety levels of Mathematics teachers in school. He took the same group of 7 teachers and measured their anxiety levels after morning class and again after evening class on the same day. Which test should the researcher use to compare the experimental conditions if the data were not normally distributed?

A. Wilcoxon signed-rank test

B. Mann Whitney U test

C. Paired sample t-test

10. Which of the following statements is true regarding the interpretation of the p-value?

I. p-value is affected by the sample size

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II. it is unnecessary to estimate the p-value when dealing with data from the population

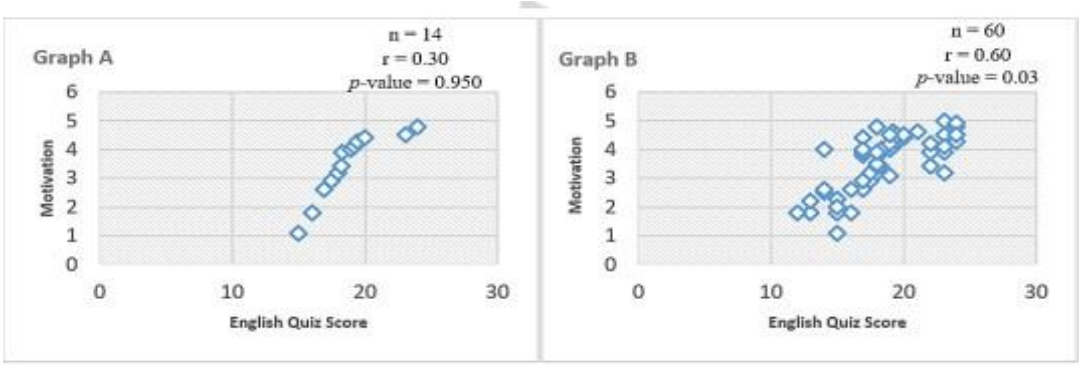
III. A p-value that is close to 0 indicates an observed difference is unlikely to be due to chance

A. I only

B. II and III only

C. I, II, III

Question 11 is based on the graph below.



11. What can be interpreted from the results shown in both graphs?

I. A type II error has occurred.

II. The hypothesis test is more sensitive as the sample size increases.

III. Power of the hypothesis test increases as the sample size increases.

A. I and III only

B. II and III only

C. I, II, III

12. Research question: Is there a change in Statistics scores over three time periods (pre-intervention, post-intervention, 2-month follow-up)?

Based on the research question, which statistical analysis is appropriate to answer this research question?

A. One-way ANOVA

B. Three-way ANOVA

C. One-way Repeated Measures ANOVA

Result:

A one-way ANOVA was conducted to determine the impact of students' level of study (undergraduate level, master level, and doctoral level) on research literacy test (RLT) score. There was a statistically significant difference at the $p<.05$ level in RLT scores for the three groups: $F(2, 330) = 4.3$, $p= .01$. The effect size, eta squared was .02.

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For Questions 13 & 14

13. Identify variables used in the study.

A. One categorical independent variable, and one continuous dependent variable.

B. One continuous independent variable, and three continuous dependent variables.

C. One categorical dependent variable, and three continuous independent variables.

14. Which of the following statements is true?

I. The result shows a statistically significant and required post-hoc test

II. The result shows a statistically significant, but only two groups differed significantly.

III. The result shows a statistically significant, but the actual difference in the mean scores of the group was small.

IV. The result shows a statistically significant, and the mean scores between the three groups differed significantly.

A. I and II only

B. I and III only

C. I and IV only

15. After conducting the post-hoc test, result are presented below.

(I). Study Level	(J). Study Level	Sig
1 Undergraduate	2 Masters	.203
	3 Doctoral	.008
2 Masters	1 Undergraduate	.203
	3 Doctoral	.107
3 Doctoral	1 Undergraduate	.008
	2 Masters	.107

Which of the following statements is true?

I. Mean score for undergraduate students was significantly different from doctoral students

II. Mean score for undergraduate students was significantly different from master and doctoral students.

III. Mean score of master students did not differ significantly from either undergraduate students and doctoral students

A. I only

B. I and II only

C. I and III only

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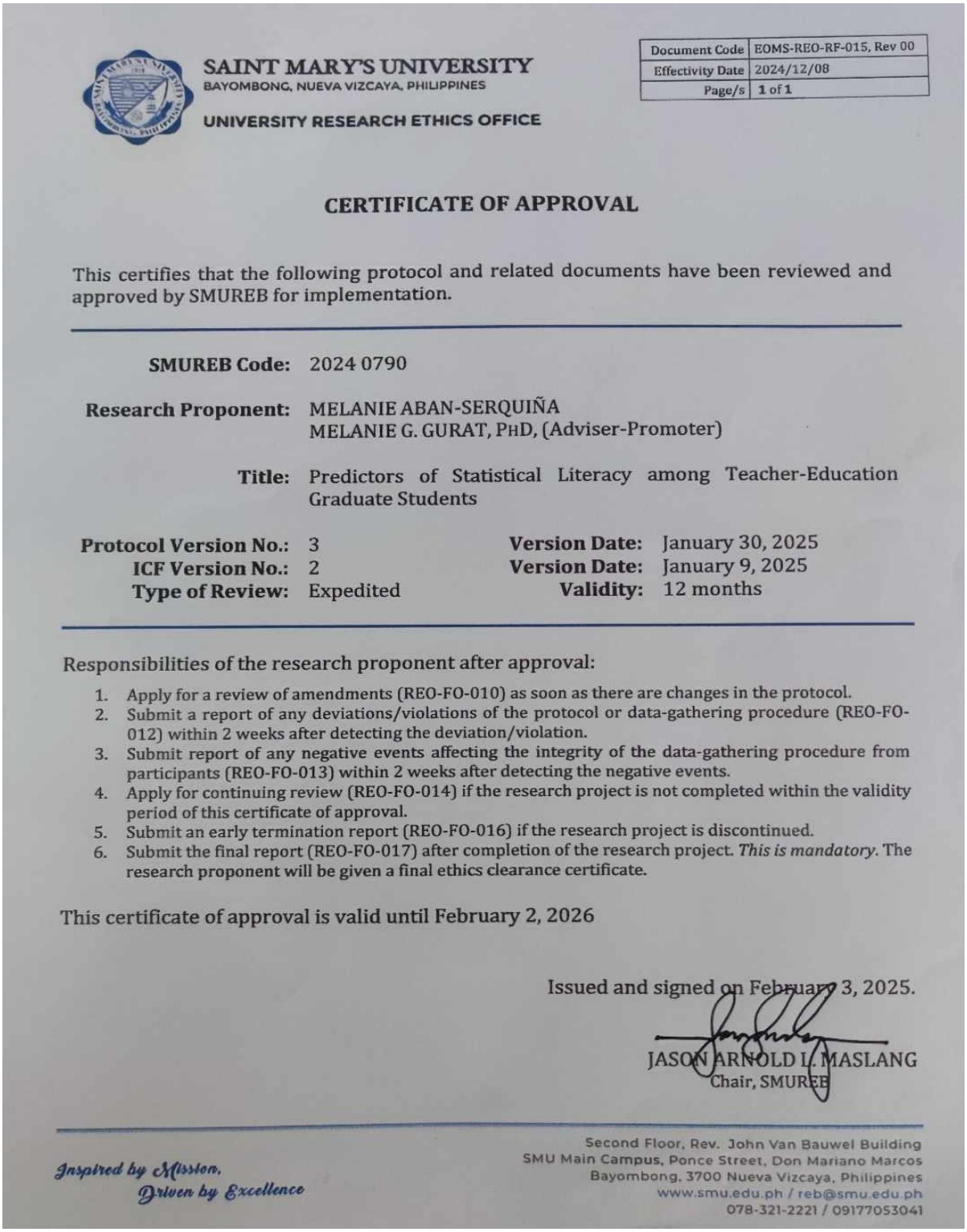
Yusof I. J., Abdul Latif A., Amin N. F., Hassan A. M., Arsat M., Musta'amal A. H. (2018, Special Edition). Measuring research literacy: Development of research literacy test. The Turkish Online Journal of Design, Art and Communication, 8, 1649–1655. https://doi.org/10.7456/1080SSE/221

Thank you very much for agreeing to participate in this survey.

Appendix G

Certificate Of Approval (UREO)



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BAYOMBONG, NUEVA VIZCAYA, PHILIPPINES
UNIVERSITY RESEARCH ETHICS OFFICE

Document Code	EOMS-REO-RF-015, Rev 00
Effectivity Date	2024/12/08
Page/s	1 of 1

CERTIFICATE OF APPROVAL

This certifies that the following protocol and related documents have been reviewed and approved by SMUREB for implementation.

SMUREB Code: 2024 0790

Research Proponent: MELANIE ABAN-SERQUIÑA
MELANIE G. GURAT, PHD, (Adviser-Promoter)

Title: Predictors of Statistical Literacy among Teacher-Education Graduate Students

Protocol Version No.: 3 **Version Date:** January 30, 2025
ICF Version No.: 2 **Version Date:** January 9, 2025
Type of Review: Expedited **Validity:** 12 months

Responsibilities of the research proponent after approval:

1. Apply for a review of amendments (REO-FO-010) as soon as there are changes in the protocol.
2. Submit a report of any deviations/violations of the protocol or data-gathering procedure (REO-FO-012) within 2 weeks after detecting the deviation/violation.
3. Submit report of any negative events affecting the integrity of the data-gathering procedure from participants (REO-FO-013) within 2 weeks after detecting the negative events.
4. Apply for continuing review (REO-FO-014) if the research project is not completed within the validity period of this certificate of approval.
5. Submit an early termination report (REO-FO-016) if the research project is discontinued.
6. Submit the final report (REO-FO-017) after completion of the research project. *This is mandatory.* The research proponent will be given a final ethics clearance certificate.

This certificate of approval is valid until February 2, 2026

Issued and signed on February 3, 2025.

JASON ARNOLD L. MASLANG
Chair, SMUREB

Inspired by Mission, Driven by Excellence

Second Floor, Rev. John Van Bauwel Building
SMU Main Campus, Ponce Street, Don Mariano Marcos
Bayombong, 3700 Nueva Vizcaya, Philippines
www.smu.edu.ph / reb@smu.edu.ph
078-321-2221 / 09177053041

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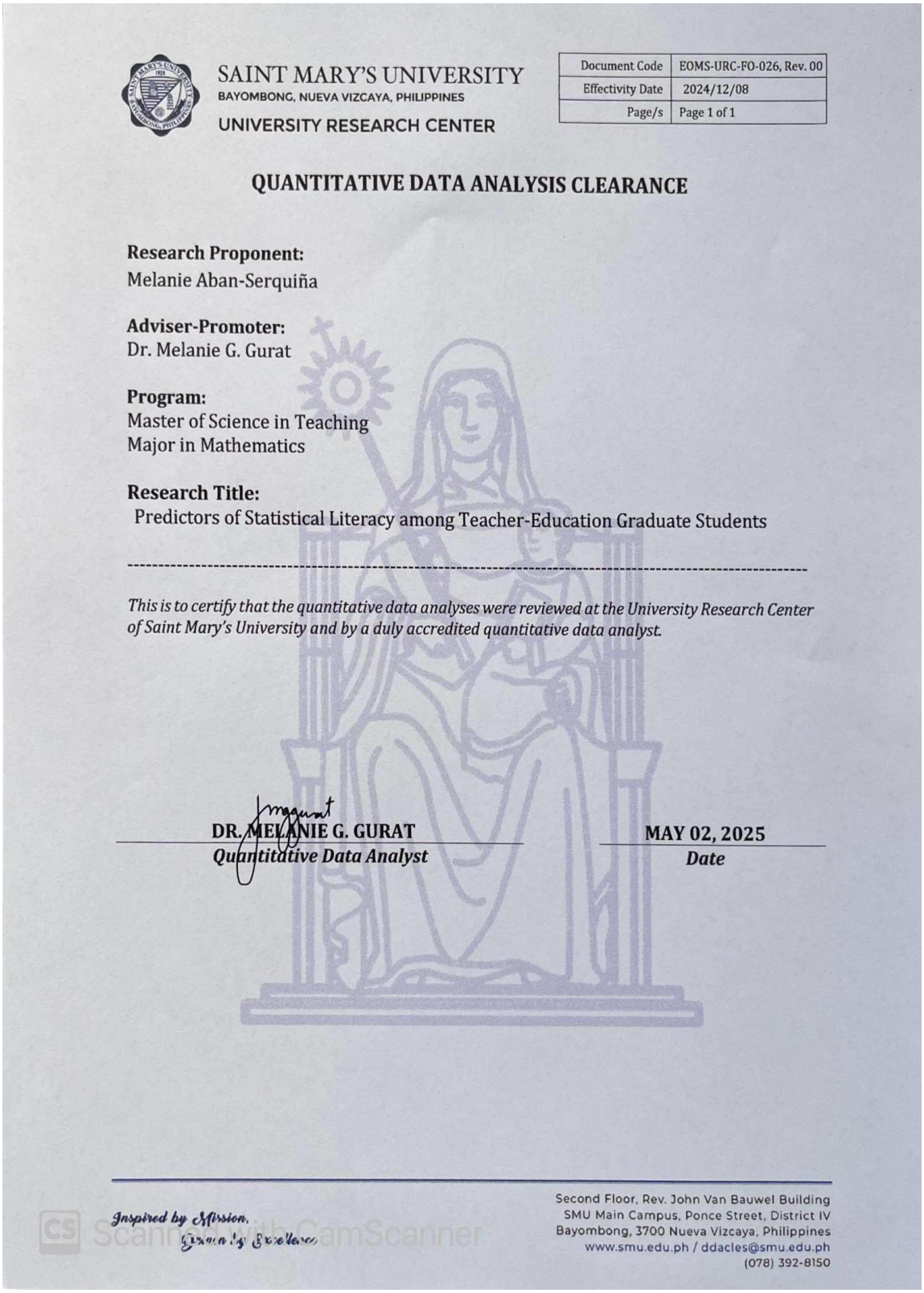
Appendix H

Quantitative Data Analysis Clearance



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UNIVERSITY RESEARCH CENTER

Document Code	EOMS-URC-FO-026, Rev. 00
Effectivity Date	2024/12/08
Page/s	Page 1 of 1

QUANTITATIVE DATA ANALYSIS CLEARANCE

Research Proponent:
Melanie Aban-Serquiña

Adviser-Promoter:
Dr. Melanie G. Gurat

Program:
Master of Science in Teaching
Major in Mathematics

Research Title:
Predictors of Statistical Literacy among Teacher-Education Graduate Students

---

This is to certify that the quantitative data analyses were reviewed at the University Research Center of Saint Mary's University and by a duly accredited quantitative data analyst.

DR. MELANIE G. GURAT
Quantitative Data Analyst

MAY 02, 2025
Date

Inspired by Mission, Driven by Excellence

Second Floor, Rev. John Van Bauwel Building
SMU Main Campus, Ponce Street, District IV
Bayombong, 3700 Nueva Vizcaya, Philippines
www.smu.edu.ph / ddacles@smu.edu.ph
(078) 392-8150

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Appendix I Language Editing Clearance

SAINT MARY'S UNIVERSITY
BAYOMBONG, NUEVA VIZCAYA, PHILIPPINES
UNIVERSITY RESEARCH CENTER

Document Code	EOMS-URC-FO-028, Rev. 00
Effectivity Date	2024/12/08
Page/s	Page 1 of 1

Language Editing Clearance

Research Proponent:
Melanie Aban-Serquiña

Adviser-Promoter:
Dr. Melanie G. Gurat

Program:
Master of Science in Teaching
Major in Mathematics

Research Title:
Predictors of Statistical Literacy among Teacher-Education Graduate Students

Date of Final Defense:
March 31, 2025

This is to certify that I have thoroughly edited the final draft of the Research of the student/s listed above in terms of grammar and organization.

DR. FE YOLANDA G. DEL ROSARIO — *Editor*
MAY 05, 2025 — *Date*

This is to certify that I have thoroughly edited the final draft of the Research of the student/s listed above for compliance with the APA Format and Style.

DR. FE YOLANDA G. DEL ROSARIO — *Editor*
MAY 05, 2025 — *Date*

Inspired by Mission,
Driven by Excellence

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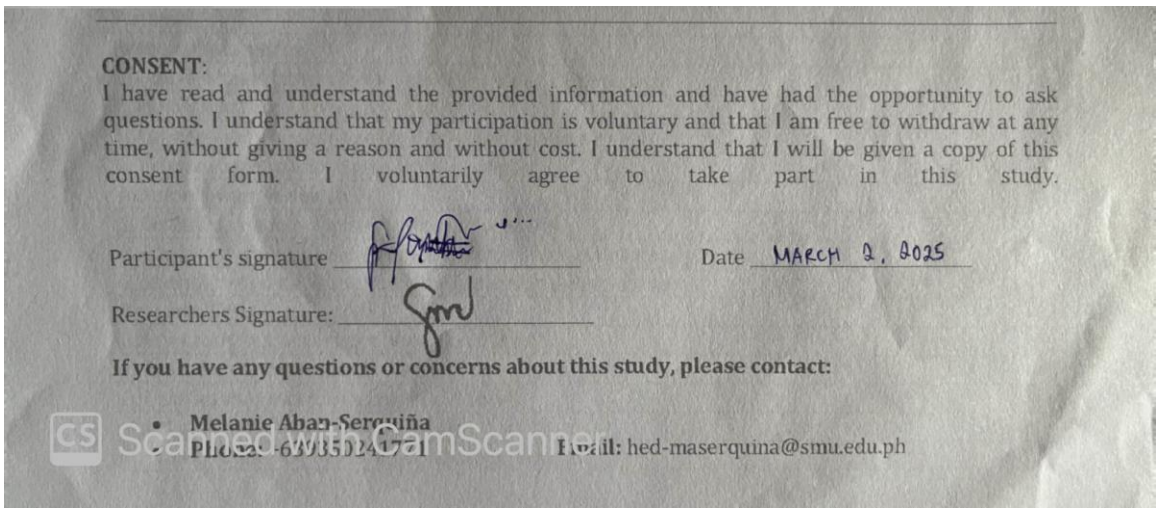
Appendix J

Consent Form Sample



CONSENT:
I have read and understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date MARCH 2, 2025

Researchers Signature: _____

If you have any questions or concerns about this study, please contact:

- **Melanie Abao-Serquiña**
  Phone: +639350247[illegible] **Email:** hed-maserquina@smu.edu.ph

Appendix K

University Research Ethics Board Clearance