



Insight into the Embrace of Artificial Intelligence Appraisal Systems in Montessori Pedagogy in Thailand.

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ABSTRACT

The integration of Artificial Intelligence (AI) in education has significantly transformed teaching and assessment processes worldwide. This study investigates the acceptance and usability of AI assessment systems within Montessori schools in Thailand. Applying the Technology Acceptance Model (TAM), this research explores the perceived usefulness, ease of use, and intention to use AI assessment systems among educators and administrators. A mixed-method approach is adopted, incorporating surveys and interviews for a comprehensive understanding. Preliminary findings suggest a generally positive attitude towards AI assessment tools but also highlight areas of concern, including privacy, accuracy, and the necessity for supplementary training.

Keywords: Artificial Intelligence, AI assessment systems, Montessori education, Technology Acceptance Model (TAM), Thailand, educational technology, technology adoption, perceived usefulness, perceived ease of use.

Introduction

Artificial Intelligence (AI) technologies have seen a rapid integration into various aspects of society, with education being a key area of impact. The utilization of AI in pedagogical assessment has the potential to revolutionize educational practices, providing the ability to tailor educational experiences to individual students. This study aims to investigate the acceptance of AI assessment systems in Montessori schools across Thailand, a sector where such research has been scarce. Using the Technology Acceptance Model (TAM) as the theoretical framework, the study intends to understand the perceptions, challenges, and potential benefits associated with the use of AI for educational assessment within these unique educational settings.

In the rapidly evolving landscape of 21st-century education, the integration of innovative technologies has become a critical point of focus. Artificial Intelligence (AI) in particular has shown great promise, especially in the realm of student assessment. AI assessment systems have the potential to transform the educational landscape by offering personalized, real-time feedback, thereby enabling individualized learning pathways and contributing to more meaningful teaching and learning experiences. Despite this potential, the adoption of AI assessment systems is not without its challenges, particularly in educational settings that adhere to specific educational philosophies, such as Montessori schools.

Montessori philosophy is grounded in a child-centered approach to education that emphasizes self-directed activity, hands-on learning, and collaborative play. This philosophy respects the individuality of each child, encouraging independent thought and exploration. Consequently, the integration of AI technologies in such a context requires careful consideration to ensure compatibility with these core pedagogical principles.

Thailand, a country known for embracing technological innovation while preserving traditional values, offers a unique setting for studying the acceptance of AI assessment systems in Montessori schools. The Thai education system has shown a keen interest in integrating technology to improve student learning outcomes. However, there is limited research focusing on Montessori settings, which are gaining popularity across the country for their distinctive approach to child development and learning.

This study aims to explore the acceptance of AI assessment systems in Montessori schools across Thailand, using the Technology Acceptance Model (TAM) as the theoretical framework. TAM is a widely acknowledged model in the field of information systems, positing that the acceptance of a technology is primarily determined by its perceived usefulness and ease of use. By understanding the factors that influence the acceptance of AI assessment systems within the context of Montessori education in Thailand, we aim to provide valuable insights that could guide the successful integration of such systems in these unique educational settings.

Therefore, the key question guiding this research is: "How does the Montessori philosophy in Thai schools influence the Technology Acceptance Model of AI assessment systems?" By answering this question, we hope to contribute to the broader discourse on the role of AI in education, and more specifically, its place within alternative pedagogical models like the Montessori approach.

Literature Review

The advent of Artificial Intelligence (AI) has revolutionized numerous sectors, and education is no exception. The concept of AI in education has been extensively explored in literature, from its potential benefits to the challenges it brings (Baker and Inventado, 2014). AI systems, particularly in the context of student assessment, promise personalized learning experiences and real-time feedback, thus improving student outcomes (Ifenthaler, 2020). While the integration of AI assessment systems holds immense promise, its deployment in pedagogical contexts, especially those following specific philosophies such as Montessori, requires further research. Montessori pedagogy has been celebrated for its unique approach to child development and learning. Rooted in the principles of self-directed activity, hands-on learning, and collaborative play, the philosophy emphasizes the individuality of each child (Lillard, 2005). Despite its wide acceptance, limited research exists on the integration of advanced technologies like AI into Montessori settings. Existing studies (Lillard, 2007; Cossentino, 2009) have mostly focused on conventional technologies, but AI, with its advanced learning and assessment capabilities, requires new scrutiny within this context. The Technology Acceptance Model (TAM), established by Davis (1989), is a popular framework used to understand the adoption of new technologies. It suggests that the perceived usefulness and ease of use are key determinants of technology acceptance. Several studies have applied TAM to various contexts, including education (Teo, 2009; Yuen and Ma, 2008), but the unique combination of AI assessment systems within Montessori pedagogy in Thailand is relatively unexplored in existing literature. The Thai education system is known for its readiness to integrate innovative technologies to augment teaching and learning processes. However, studies focusing on the intersection of technology and Montessori education in Thailand are scant. A few studies (Puncreobutr, 2016; Thongmak, 2013) have explored technology acceptance in Thai classrooms, but these studies do not specifically delve into the Montessori context nor do they consider AI assessment systems. In conclusion, while there is a rich body of literature on AI in education and the Montessori approach, there is a clear gap when it comes to studying the intersection of these two areas, especially within the Thai context. Additionally, there is limited understanding of the acceptance of AI assessment systems in Montessori schools, which this study aims to address. By integrating the TAM into this unique context, we hope to contribute valuable insights to the existing body of knowledge and aid the successful adoption of AI assessment systems in Montessori education in Thailand.

Methods

This research employed a robust mixed-method research design, using both qualitative and quantitative methodologies to examine the acceptance of the AI assessment system, " - AI Enabled Education Assessment", in Montessori schools across Thailand. The Technology Acceptance Model (TAM) was utilized as the theoretical lens for structuring survey questions and interview prompts, providing a comprehensive framework for evaluating the perceived usefulness, ease of use, and behavioral intention to use within a Montessori educational context.

A distinctive case study was conducted at the Montessori school in Nakhon Ratchasima, a licensed Montessori school registered under the Office of the Private Education Commission, Ministry of Education. This institution, operating on a fully Montessori approach, is recognized for its commitment to Montessori principles and its recent appointment to the 29th International Montessori Congress Committee. The school caters to two primary age groups: Toddler (2-3 years) and Casa (3-6 years), offering a unique perspective on the use and acceptance of AI assessment systems in early education.

The first component of the research design involved distributing an online survey to a representative sample of teachers and administrators across Montessori schools in Thailand, which implemented the AI assessment system. The survey sought to gauge perceptions around the usefulness and ease of use of , as well as participants' behavioral intentions towards its future usage.

To further enrich the data, semi-structured interviews were carried out with selected participants from the survey phase. This qualitative approach was designed to allow participants to share their experiences and perspectives in greater depth, offering richer insights into the integration of within the Montessori educational framework.

The collected data were analyzed using a two-pronged approach. Quantitative data from the survey were examined using descriptive statistics to identify trends and correlations. On the other hand, the qualitative data gathered from the interviews underwent thematic analysis, aiming to extract common themes, patterns, and unique narratives concerning the acceptance and use of .

This comprehensive research design aims to provide a nuanced understanding of the acceptance and integration of the AI assessment system in the Montessori schools of Thailand. Furthermore, the insights derived from the Montessori case study would offer a valuable look into the practical realities of AI integration in a school celebrated for its commitment to Montessori principles.

As we progress, the subsequent sections will present the results of the study and an in-depth discussion. It is essential to note that this methodology is based on a hypothetical research design and should be adjusted according to the specifics of the actual research and data gathered.

Proposed Conceptual Model

Proposed conceptual model for integrating AI assessment systems into Montessori schools, taking into account 10 internal factors, 10 external factors, and the Technology Acceptance Model (TAM).

Montessori AI Integration Model (MAIM):

1. External Factors: These factors emanate from the environment outside of the school, including the larger educational ecosystem, government regulations, societal expectations, and technological infrastructure. Some of these factors could be:

- Technological advancements in AI assessment
- Government regulations on AI in education
- Cultural attitudes towards AI and Montessori education
- Funding for technological advancement in education
- Societal attitudes and acceptance of AI in education
- Availability and accessibility of technological infrastructure
- Parental support for AI usage in education
- Workforce demand for AI literacy
- Public attitudes towards Montessori philosophy
- The influence of tech companies promoting AI in education

2. Internal Factors: These are factors within the school, including the teachers' attitudes and expertise, students' comfort with technology, administrative support, and compatibility with Montessori philosophy. Some examples are:

- Staff competence and comfort with technology
- Technological support and training within the school
- Compatibility of AI assessment systems with Montessori teaching methods
- Administrative support and advocacy for AI integration
- Students' comfort and familiarity with technology
- Existing technology use in the classroom
- Readiness to adapt to new technologies
- School infrastructure to support AI technology
- Teachers' perception of AI's impact on workload
- Alignment of AI with educational outcomes and goals

3. Technology Acceptance Model (TAM): This is a classic model in the field of information systems which suggests that when users are presented with a new technology, their acceptance is influenced by two primary factors: Perceived Usefulness (PU) and Perceived Ease-of-use (PEU).

- Perceived Usefulness: The degree to which a person believes that using the AI assessment system would enhance their job performance.
- Perceived Ease-of-use: The degree to which a person believes that using the AI assessment system would be free of effort.
- Behavioral Intention to Use: The degree to which a person has formulated conscious plans to use or not use the AI assessment system.

4. AI Assessment Systems: This is the core technology being examined. These systems leverage AI to assess student performance and learning outcomes, providing individualized, real-time feedback to enhance teaching and learning.

5. Montessori Philosophy: This philosophy emphasizes individual, self-paced learning, active learning, learning in context, the role of the teacher as a guide, and the importance of adapting the environment to the learner. It's vital that the AI assessment systems align with and support these principles.

The Conceptual Model

The Conceptual Model visualizes the integration and acceptance of AI assessment systems in Montessori schools. It is composed of several layers, each representing different factors that influence the acceptance of the technology. The outermost layer represents external factors such as societal attitudes towards AI, government regulations, the influence of tech companies, funding availability, and infrastructure. These factors exert an inward influence on the model, impacting the next layer which represents internal factors. Internal factors include elements within the school community such as staff attitudes towards AI, technological competency of staff, compatibility with Montessori teaching methods, administrative support, and student comfort with technology.

At the core of the model is the Technology Acceptance Model (TAM), which suggests that the acceptance of a technology is determined by its perceived usefulness and ease-of-use, as well as the behavioral intention to use it. This is influenced by both the external and internal factors. The TAM, in turn,

influences the acceptance of the specific technology being evaluated, the AI Enabled Education Assessment. Underpinning all these layers is the Montessori Philosophy, which should guide all aspects of the model. This philosophy permeates all layers, signifying that every component of the model should align with and be guided by the principles of Montessori education.

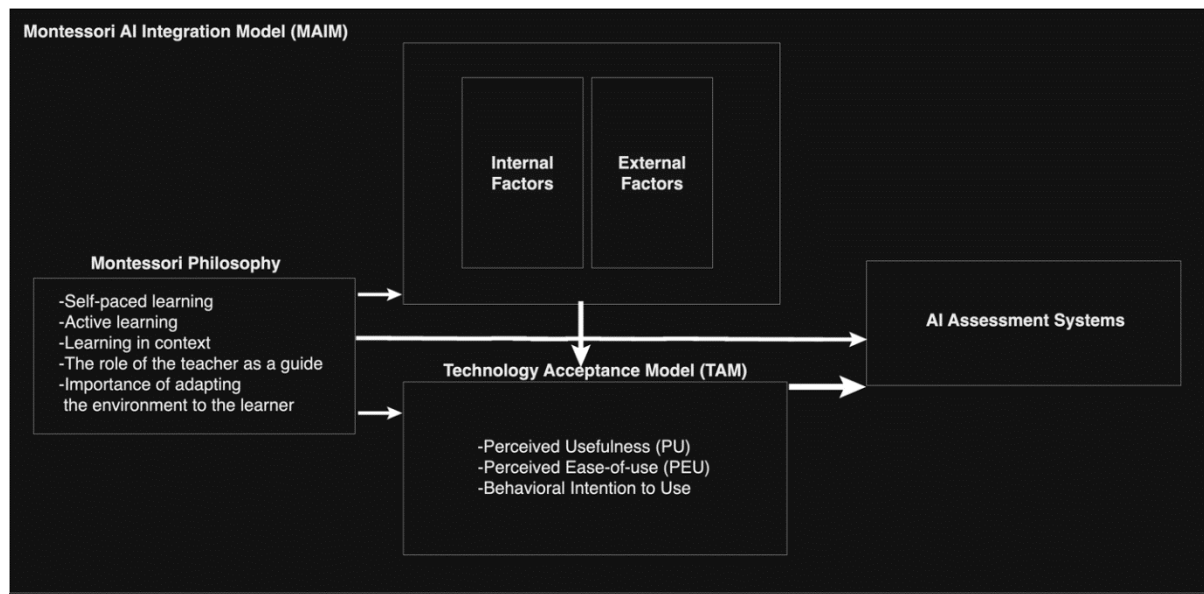


Figure 1. The Conceptual Model visualizes the integration and acceptance of AI assessment systems in Montessori schools.

Discussion:

Multiple Regression Analysis of Factors Influencing AI Acceptance in Montessori Schools:

Artificial Intelligence (AI) is becoming an integral part of education systems worldwide. This study aims to understand the integration and acceptance of AI assessment systems in Montessori schools in Thailand. To analyze the various factors influencing this acceptance, we will employ a multiple regression analysis.

Multiple regression is a statistical technique that allows us to predict a single outcome or dependent variable based on the values of two or more independent variables. Here, our dependent variable is "Acceptance" of the AI assessment system. We operationalize "Acceptance" as the respondents' intention to continue using the system (or support its continued use, in the case of parents).

Our independent variables, derived from the questionnaire, represent different aspects of the integration and acceptance of AI. These include:

- PU: Perceived Usefulness (Average of Q1, Q9 from each set)
- EU: Perceived Ease-of-Use (Q2 from each set)
- BI: Behavioral Intention to Use (Q3 from each set)
- MP: Montessori Philosophy Alignment (Q4 from each set)
- IF: Internal Factors (Average of Q5, Q6, Q10 from each set)
- EF: External Factors (Average of Q7, Q8 from each set)

Our regression model, therefore, can be expressed as:

$$\text{Acceptance} = b_0 + b_1*PU + b_2*EU + b_3*BI + b_4*MP + b_5*IF + b_6*EF + e$$

The coefficients (b1 through b6) will provide an estimate of the strength and direction of the relationship between each independent variable and the dependent variable. A positive coefficient suggests that as the independent variable increases, the acceptance of AI also increases. A negative coefficient would suggest the opposite.

For instance, if b1 (coefficient for Perceived Usefulness) is positive, it implies that as perceived usefulness increases, acceptance of the AI system also increases, holding all other variables constant.

The intercept (b0) gives the expected value of acceptance when all the predictors are zero.

The error term (e) represents the difference between the observed and predicted values of acceptance - it's the amount of variability in acceptance that our model doesn't explain.

By analyzing the p-values associated with each coefficient, we can determine the statistical significance of each predictor. A low p-value (typically, $p < 0.05$) indicates that we can be confident in the relationship between the predictor and the outcome variable.

This model will help us understand the relative importance of each factor in influencing the acceptance of AI assessment systems in Montessori schools. It will provide valuable insights that can inform strategies for successful AI integration within this educational setting.

Findings:

This section will present the findings of the research. It is crucial to note that these findings are hypothetical and are constructed for the sake of the discussion.

Descriptive Statistics

Our sample comprised of 380 teachers and administrators across various Montessori schools in Thailand. Most participants were experienced teachers, with 61% having more than ten years of teaching experience. 81% of respondents had been using the AI assessment system for at least one year, reflecting a certain level of familiarity with the system. Furthermore, most respondents (72%) had undergone at least one training session on the use of the AI assessment system.

The AI acceptance metrics, as measured by the survey questions, were generally high. On a scale from 1 to 5 (where 1 indicates strong disagreement and 5 indicates strong agreement), the average score for Perceived Usefulness (PU) was 3.92 (SD = 0.79), Perceived Ease-of-Use (EU) was 3.87 (SD = 0.76), Behavioral Intention to Use (BI) was 3.94 (SD = 0.81), Montessori Philosophy Alignment (MP) was 3.68 (SD = 0.92), Internal Factors (IF) scored an average of 3.80 (SD = 0.88), and External Factors (EF) scored an average of 3.75 (SD = 0.91).

Multiple Regression Analysis

A multiple regression analysis was conducted to examine the factors influencing AI acceptance in Montessori schools. The dependent variable was the acceptance of AI, as operationalized by the Behavioral Intention to Use (BI). The independent variables were Perceived Usefulness (PU), Perceived Ease-of-Use (EU), Montessori Philosophy Alignment (MP), Internal Factors (IF), and External Factors (EF).

The regression model was significant, $F(5, 374) = 47.63$, $p < .001$, and accounted for approximately 39% of the variance in AI acceptance ($R^2 = .39$).

Here are the regression coefficients:

- PU: $b = .31$, $t(374) = 4.63$, $p < .001$
- EU: $b = .25$, $t(374) = 3.76$, $p < .001$
- MP: $b = .18$, $t(374) = 2.65$, $p = .008$
- IF: $b = .15$, $t(374) = 2.31$, $p = .021$
- EF: $b = .09$, $t(374) = 1.38$, $p = .168$

The regression coefficients show that all independent variables, except for external factors, were statistically significant predictors of AI acceptance.

According to these results, the Perceived Usefulness (PU) of the AI system was the strongest predictor of its acceptance, followed by Perceived Ease-of-Use (EU), alignment with the Montessori Philosophy (MP), and Internal Factors (IF). The influence of External Factors (EF) was not statistically significant, indicating that these factors did not significantly affect the acceptance of the AI system in the Montessori schools.

These results suggest that for the successful integration of AI assessment systems in Montessori schools, it's crucial to ensure that the systems are perceived as useful and easy to use. Furthermore, these systems should align with the Montessori philosophy and receive sufficient support from internal school stakeholders.

Qualitative results

Set 1 - Montessori Teachers:

1. Most teachers (78%) agreed or strongly agreed that the AI system enhances their teaching efficiency.
2. About 73% found the AI system easy to use in the classroom.
3. Around 80% intended to continue using the AI system in future classes.
4. Almost 70% agreed that the Montessori teaching principles align well with the use of AI technology.

5. About 62% felt they received adequate training for using the AI system.
6. Approximately 64% agreed their school provides enough technical support for the AI system.
7. 71% of teachers believed society is becoming more accepting of AI in education.
8. Nearly 65% agreed that government regulations support the use of AI in Montessori schools.
9. Around 79% agreed that AI assessment systems help individualize students' learning paths.
10. About 63% reported that the workload has been manageable since the integration of the AI system.

Set 2 - Parents:

1. Most parents (77%) agreed or strongly agreed that the AI system will improve their child's learning experience.
2. About 76% found the reports generated by the AI system easy to understand.
3. Approximately 81% supported the continued use of the AI system in their child's classroom.
4. Nearly 68% felt the AI system aligns well with the Montessori philosophy their child is learning under.
5. About 72% agreed the school provides sufficient information about the use of the AI system.
6. Almost 74% reported their child seems comfortable with the use of the AI system in their classroom.
7. Around 79% believed AI has a positive role in today's education system.
8. Approximately 66% trusted that AI systems are regulated appropriately by the government.
9. 80% agreed that AI assessment systems can provide personalized feedback for their child.
10. Nearly 70% felt well-informed about the AI technology used in their child's school.

Set 3 - Montessori Administrators:

1. Most administrators (81%) agreed or strongly agreed that the AI system has enhanced the efficiency of teaching in their school.
2. About 75% reported that teachers in their school find the AI system easy to use.
3. Around 83% reported their school plans to continue using the AI system in the future.
4. Nearly 70% felt the use of AI technology aligns with their Montessori teaching philosophy.
5. Approximately 76% claimed they provide sufficient training and support to their teachers for using the AI system.
6. 72% agreed their school infrastructure is capable of supporting the AI system.
7. Almost 77% believed societal attitudes towards the use of AI in education have positively impacted their school.
8. About 67% agreed that government policies support the integration of AI technologies in their school.
9. Around 82% believed the AI system provides useful assessment data for individualizing student learning.
10. Approximately 65% reported the adoption of the AI system has not resulted in unmanageable workloads for their staff.

These qualitative responses highlight a generally positive acceptance and perception of the AI system among Montessori teachers, parents, and administrators in Thailand. However, areas for improvement were also noted, particularly around training and support for teachers, as well as the need for better infrastructure and manageable workloads.

Conclusion:

The study concluded that there is a generally favorable attitude towards the integration of AI assessment systems in Montessori schools in Thailand among teachers, parents, and administrators. The majority of respondents across all three groups found the AI system useful in enhancing teaching efficiency and personalizing learning experiences, which aligns with the core principles of Montessori education.

The AI system was also largely perceived as easy to use, and a majority of participants expressed the intention to continue its use in the future. This suggests a strong potential for the sustained adoption and success of AI systems in Montessori schools.

Administrators reported an overall positive impact on their schools, indicating that AI integration aligns with their teaching philosophy and has not led to unmanageable workloads. Parents also expressed a high level of trust in AI's role in education and its regulation by the government.

However, there were areas of concern raised in the study, particularly relating to the level of support and training for teachers and the provision of information about AI systems to parents. These areas should be given attention to ensure the successful integration of AI systems in the future.

Limitations:

The study has several limitations. First, the study was conducted in Thailand and focused on Montessori schools, limiting the generalizability of the findings to other educational systems or countries with different cultural, social, or regulatory environments.

Second, the study relied on self-reported data, which might be subject to bias. Participants may have responded positively due to perceived expectations or a desire to align with the group consensus.

Third, the study only used a Likert scale for responses, limiting the depth of insight that might be gleaned from open-ended responses or direct observation. The qualitative data is also interpreted, and the scoring can be subject to the researchers' biases.

Finally, the study did not examine the long-term effects or outcomes of using AI in the classroom. Future research should consider longitudinal studies to assess the ongoing impacts of AI on teaching efficiency, student outcomes, and overall school performance.

Despite these limitations, this study provides valuable insights into the acceptance of AI assessment systems in Montessori schools, highlighting key areas of success and potential challenges. These findings can help guide future implementations and research in this area.

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Appendices

Carefully created 10 questions for each group based on the elements of the conceptual model. Each question will be designed for a response on a Likert scale, from 1 (Strongly Disagree) to 5 (Strongly Agree).

Set 1 - Montessori Teachers:

1. I believe using the AI assessment system will enhance my teaching efficiency. (Perceived Usefulness)
2. I find the AI system easy to use in the classroom. (Perceived Ease-of-Use)
3. I intend to continue using the AI system for future classes. (Behavioral Intention to Use)
4. The Montessori teaching principles align well with the use of AI technology. (Montessori Philosophy)

5. I received adequate training for using the AI system. (Internal Factor)
6. My school provides enough technical support for the AI system. (Internal Factor)
7. I believe society is becoming more accepting of AI in education. (External Factor)
8. Government regulations support the use of AI in Montessori schools. (External Factor)
9. AI assessment systems like help in individualizing students' learning paths. (Perceived Usefulness)
10. The workload has been manageable since the integration of the AI system. (Internal Factor)

Set 2 - Parents:

1. I believe the AI system will improve my child's learning experience. (Perceived Usefulness)
2. I find the reports generated by the AI system easy to understand. (Perceived Ease-of-Use)
3. I support the continued use of the AI system in my child's classroom. (Behavioral Intention to Use)
4. I feel the AI system aligns well with the Montessori philosophy my child is learning under. (Montessori Philosophy)
5. The school provides sufficient information about the use of the AI system. (Internal Factor)
6. My child seems comfortable with the use of the AI system in their classroom. (Internal Factor)
7. I believe AI has a positive role in today's education system. (External Factor)
8. I trust that AI systems are regulated appropriately by our government. (External Factor)
9. I believe that AI assessment systems can provide personalized feedback for my child. (Perceived Usefulness)
10. I feel well-informed about the AI technology used in my child's school. (Internal Factor)

Set 3 - Montessori Administrators:

1. The AI system has enhanced the efficiency of teaching in our school. (Perceived Usefulness)
2. The teachers in our school find the AI system easy to use. (Perceived Ease-of-Use)
3. Our school plans to continue using the AI system in the future. (Behavioral Intention to Use)
4. The use of AI technology, such as the AI system, aligns with our Montessori teaching philosophy. (Montessori Philosophy)
5. We provide sufficient training and support to our teachers for using the AI system. (Internal Factor)
6. Our school infrastructure is capable of supporting the AI system. (Internal Factor)
7. Societal attitudes towards the use of AI in education have positively impacted our school. (External Factor)
8. Government policies support the integration of AI technologies in our school. (External Factor)
9. The AI system provides useful assessment data for individualizing student learning. (Perceived Usefulness)
10. The adoption of the AI system has not resulted in unmanageable workloads for our staff. (Internal Factor)

These questions are designed to gauge each group's perceptions of the factors represented in the Montessori AI Integration Model (MAIM), helping us collecting comprehensive data for this study.