A Sentiment Analysis Approach on the Acceptance of Radio Frequency Identification Technology-Based Solutions among Schools in Nueva Ecija, Philippines

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Abstract. Integrating new technologies in schools improves different processes and increases trust and confidence from various stakeholders. Advancements in education are a 21st-century goal that every learning institution should consider. This study aims to conduct sentiment analysis on the acceptance of Radio Frequency Identification technology-based solutions among the private and public learning institutions in Nueva Ecija, Philippines, that have implemented the technology. School administrators and teachers participated in the study. Sentiments were analyzed using open-ended questions relating to their acceptance of the technology. Based on the analysis, more favourable terms occurred in their responses than negative words, as presented using a word cloud. The researcher thinks that school administrators and teachers of today are more open to technological progress and integrating technologies into education to improve the quality of processes, improve the delivery of instruction, create a safer and more secure learning environment, and encourage the use of new technologies to raise the quality of teaching and learning.

Keywords: Radio Frequency Identification; Sentiment Analysis; Technology Acceptance; Technology Implementation; Technology Integration.

INTRODUCTION

The quality of education and the delivery of instruction in different parts of the world have significantly evolved through the years because of technological advancements. Technological advancements involve significant improvement and innovation in other areas and industries where new scientific knowledge is used [1]. In the field of computing, technological advances have been extensively observed. People are looking for new ways to do things, especially in software development and automation, machine learning, artificial intelligence, the internet of things, and big data. Hence, new products were made.

The field of information and communications technology (ICT) has contributed significantly to this evolution and has had an impact on how quality education has been delivered to every learner. At the onset of the global pandemic called the coronavirus 2019 (COVID-19), learning institutions immediately devised solutions to continuously provide quality instruction to every learner while ensuring the utmost safety of everyone. Different ways of learning were used to ensure that education continued [2].

ICT has played a crucial role in this development. Integrating new technologies at schools has paved the way for new information technology solutions and products to be developed and improved. One of which is the implementation of radio frequency identification (RFID) technologies.

Radio Frequency Identification Technology (RFID). RFID technology is also known as "electronic label technology". It is a non-contact automated identification technology that recognizes the target object and extracts relevant data and critical characteristics using radio frequency signals [3]. RFID is an example of an automatic identification and data collection (AIDC) technology. AIDC automatically captures the stored data using dedicated devices. Authors [4] wrote about the use of

AIDC technology and how it could be used to improve school operations.

During COVID-19, keeping your distance and not getting too close to other people is essential. This will help stop the virus from spreading. Putting this kind of technology into schools not only keeps students safe but also helps reach the goal of making schools into "smart campuses."

Higher learning institutions are gearing up to become "smart campuses" in the Philippines. The Commission on Higher Education (CHED) has provided means and support for these institutions to achieve this significant milestone in higher education. CHED defines smart campuses as "spaces where higher education institutions use next-generation digital technologies woven seamlessly with a well-architected infrastructure," which may lead to more significant improvements in the quality of teaching and learning, research and extension, and operational efficiency" [5].

Implementing new technologies in schools is a timely response to the call for improving the quality of education. This action is also a response to the United Nations Sustainable Development Goal No. 4 (SDG 4) [6], which says that learning institutions must "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" to improve the quality of one's life, the state of one's community, and help build a better world for the next generation.

Technology Integration in Education. Technology integration in schools is developing, utilizing, and implementing innovations that can improve school operations and management, curriculum, delivery of instruction, the overall student learning experience, and relationships with stakeholders. Technology integration also means using things like computers, laptops, cell phones, cameras, online platforms, and other tools in the classroom [7].

In recent years, several technologies have been successfully integrated into the teaching and learning process, as well as school administration and operation. Using learning management systems, videoconferencing technologies, online workspaces, and electronic learning materials has improved students' academic performance during the teaching and learning process. Several automated systems have been used to run and manage schools. These are the admissions and enrollment system, the grading system, the payment and accounting system, the library system, and the guidance management system.

In addition, RFID technology has been employed to ensure the safety of every student in school. It has been implemented to use RFID in student identification cards to monitor and track their entry and exit from school. Additional capabilities, such as sending text messages to their parents or guardians, are incorporated into these technologies. This technology-enhanced school safety and security bolstered stakeholder confidence and enhanced children's academic performance and overall learning experiences.

While technology integration provides many benefits, several challenges and difficulties may also be encountered. Some of the factors and barriers influencing technology integration have been expressed by [8]. Authors [8] suggested ways to reduce the obstacles and challenges of integrating technology, such as improving digital technology pedagogies, putting in place directives to build "net" skills, changing school curricula, and increasing the number of training and workshops to help people learn how to use technology better.

Implementing RFID in Schools. Over the years, different learning institutions in the province of Nueva Ecija, Philippines, have adopted other technologies. One of which is the implementation of RFID. While this technology has been developed to benefit schools, several learning institutions have immediately stopped its performance for several reasons.

The discontinuity factors can be put into four broad groups: problems and challenges in institutional, economic, social, and technological areas. Even though there may have been problems, it is essential to know how the RFID implementation affected the different learning institutions in the province. This will give readers a better idea of how various stakeholders feel about the technology and help them understand it better. By understanding how technology integration affects schools, readers can better understand how it should be used to ensure it lasts.

One effective measure to identify the impact of implementing technologies in schools is to determine the sentiments of different stakeholders. Through ideas, future technological projects can be further improved based on how stakeholders accept and adopt them.

Sentiment Analysis. Generating subjective data from original material to gain insights and a deeper understanding of individuals' perspectives is called "sentiment analysis" [9]. The term "opinion mining" or "emotional AI." is frequently utilized to refer to this approach. Employing sen-timent analysis, one can ascertain the underlying disposition of a piece of text, which may be positive, negative, or neutral [10].
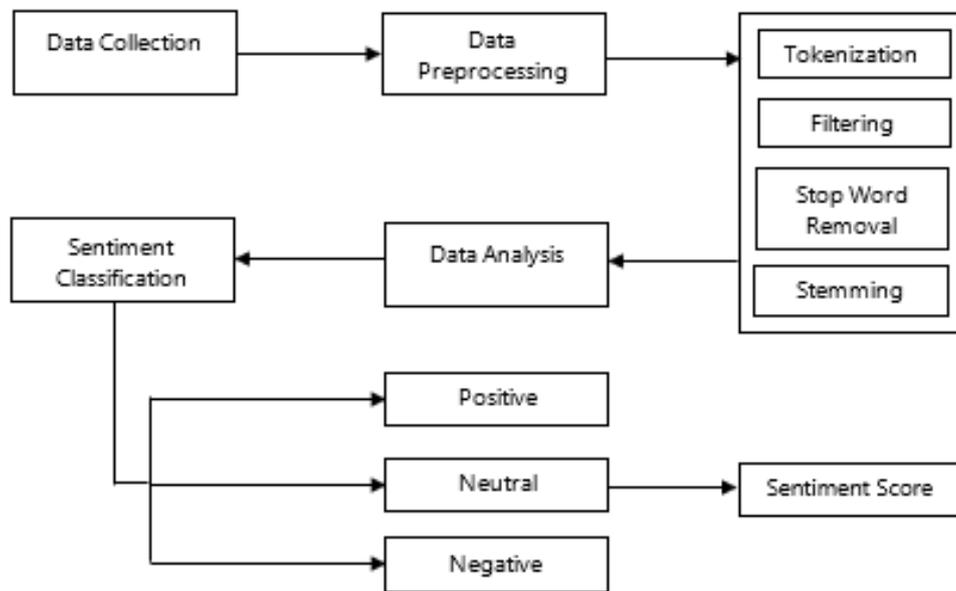
Figure 1 depicts the process flow of sentiment analysis based on work conducted by [11].

Figure 1 – Process Flow of Sentiment Analysis

It is possible to make use of a variety of approaches that involve sentiment classification. Hybrid, lexicon-based, and machine learning (ML) methods are some ways to do this.

The analysis in a machine learning approach is centred on creating classifiers from training examples of textual data. This data is used to train the machine. Supervised and unsupervised learning are included in the conventional approach to machine learning [12]. On the other hand, lexicon-based sentiment analysis is a type of data analysis in which opinion words and phrases are used in the analysis without any prior knowledge being required. The thoughts and feelings are gathered and organized. Within the framework of the lexicon-based methodology, the term "opinion lexicon" refers to the collection of positive and negative words and opinion phrases. In a method based on lexicons, both unlabeled data and dictionaries are used [13]. The final type of method is known as a "hybrid approach," a combination of lexicon and machine learning methods. Authors [14] showed that performance and classification are improved when the two strategies are used together.

Sentiment analysis is needed to understand how different groups of people feel about a new technology, like RFID, that has just been introduced.

Utilizing this methodology, one can gain insightful knowledge that can be applied to enhance technology, processes, and activities. In addition, sentiment analysis offers a platform for deriving valuable meaning about how various stakeholders feel about the technology. This makes it possible to solve problems and bring about long-term technological projects.

This research investigates the impact of implementing RFID technology in private and public schools within the province of Nueva Ecija in the Philippines. The sentiment analysis illustrates how various stakeholders feel about the technology and whether those feelings are positive, negative, or neutral. In addition, the frequency of the common words is visualized so that a general picture of how the participants feel about the technology can be obtained.

In general, this study aimed to analyze the impact of RFID among schools in Nueva Ecija, Philippines. Specifically, it aimed to:

1) Visualize the common words that appeared in the responses of the participants; and to

2) Determine the sentiments of school administrators and teachers on implementing RFID technology.

METHODS

Research Design. In this particular study, a qualitative research approach was employed. The researcher was able to use the texts to provide insights and draw significant conclusions based on the responses given by the participants. This design collects data in a qualitative, non-quantitative way by asking open-ended questions to learn more about the subject [14].

Participants of the Study. The participants of this study were composed of 94 school administrators and 121 teachers from private and public learning institutions in Nueva Ecija, Philippines, that had implemented RFID technologies. To better understand the term, "school administrator" means personnel with administrative designations such as the school head, academic coordinators, academic heads, department heads, and subject coordinators. Teachers are classroom teachers, which means they spend the majority of their time at school teaching.

Data Analysis. In analyzing the collected responses from the open-ended questions answered by the participants of this study, sentiment analysis was used. It uses natural language processing, text analysis, computational linguistics, and biometrics to find, extract, measure, and study affective states and personal information [10].

The first goal of this study was to create a visual representation of the common words that appeared. After cleaning the data, the familiar terms and keywords were extracted. This was then visualized using a word cloud. Following the processes presented in Figure 1, the researcher identified if the responses yielded positive, neutral, or adverse results using the Azure Machine Learning tool. Azure Machine Learning is a powerful tool that can be used to analyze textual data and identify the sentiments of participants. Figures 2–3 present the sample interface where the feelings were identified, including the sentiment scores.

Figure 2 – Sample interface of how responses were analysed

Figure 3 – Word Cloud of the most common terms occurred

RESULTS AND DISCUSSION

Visualization of the Most Common Words from the Participants' Responses. Figure 3 presents the visualization of the most common words from the participants' responses. It is necessary to determine the terms that frequently occurred from the reactions to grasp an initial understanding of whether the acceptance and sentiments of the participants in the implementation of RFID technology are positive, negative, or neutral.

Based on the visualization of the most common words from the responses of the participants, the following positive insights were drawn:

1. The school administrators and the teachers accept the implementation of RFID technology because it provides an easier means to monitor, track, and improve the quality of recording the attendance of students going in and out of the school.

2. The RFID technology contributes to strengthening the level of security in schools, resulting in a better learning experience for the students, increasing trust from parents and guardians, and promoting a safer learning environment.

3. RFID technology makes it easier to communicate with stakeholders, keep track of student information, and promote digitalization in schools.

However, based on the words that frequently occurred, the following negative insights were extracted:

1. The lack of proper training for personnel may lead to long-term problems with implementing the technology.

2. There is a need to prepare and make the students and other stakeholders aware of the implementation of RFID technology.

3. The cost of implementing the technology and the need to sustain it are needed to maximize the potential benefits of the technology in the long run.

For every technology being implemented, positive and negative aspects are observed. While favourable terms affirm the proponents of the technologies being implemented, it is valuable to consider the negative factors so that they can be quickly addressed and solved immediately, causing the technology to be implemented and sustained further.

Technologies can be a double-edged sword that can bring people together or tear them apart. For instance, social media platforms can be a source of collaboration among people from different walks of life but can also cause individuals to be divided and separated. While new technologies may provide up-to-date information, it is necessary to filter and analyze it to determine whether it is legitimate and relevant. Indeed, new technologies have their pros and cons.

Both positive and negative impacts have been observed in applying RFID in a school setting. It is then the responsibility of school administrators to carefully craft policies that would contribute to achieving positive goals with the technology and lessen its negative impact on the community.

The Sentiments of the Participants on the Implementation of RFID Technology. Figure 4 shows the participants' sentiments on implementing RFID technology. Views can be categorized as positive, negative, or neutral.
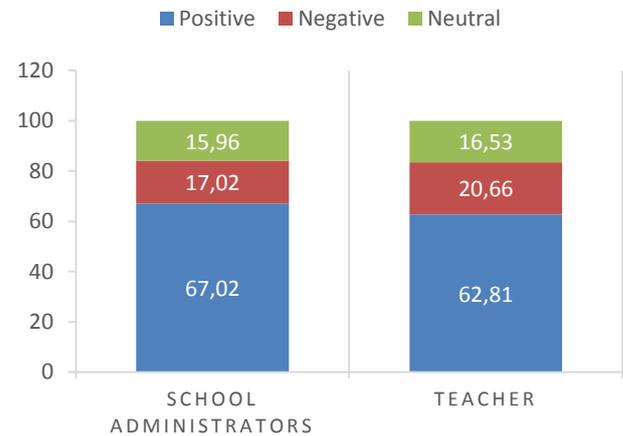

Figure 4 – Sentiments on the Implementation of RFID Technology

According to the findings of the sentiment analysis that was carried out, it was discovered that the participants have favourable feelings regarding the utilization of RFID technologies in academic institutions. According to the number shown above, it was clear that 67.02% of the school officials and 62.81% of the educators accept the technology positively. The participants' optimistic perspectives lend credence to putting such technology in place to maximize its advantages on the educational institution, its students, and other external stakeholders.

On the other hand, 17.02% of school officials and 20.66% of educators feel unhelpful about the technology. This result can serve as a foundation for improving the technology's implementation. These unfavourable feelings shouldn't be interpreted as an indication of rejection of the technology; instead, they should be seen as a potential to hone and perfect the process of putting it into practice. The unfavourable emotions that have been communicated can also serve as a foundation for addressing the difficulties encountered to lessen and eventually reduce them.

All positive, negative, or neutral responses contribute to a better understanding of how teachers and school administrators feel about implementing new technology. This can also serve as the foundation for intervention strategies and solutions that aim to lessen the prevalence of negative feelings and, ultimately, eliminate them.

CONCLUSIONS

This study aimed to research the acceptance of RFID-based solutions among private and public

schools in Nueva Ecija, Philippines, to understand better how teachers and school administrators feel about implementing the technology. The results of the open-ended questions asked to the participants were analyzed using a "word-cloud" tool, which allowed for a visual representation of the words used most frequently in those responses. In addition, Azure Machine Learning was used to conduct sentiment analysis to understand better how the participants felt about the technology. Positive, negative, and neutral are the three categories that describe people's feelings.

A word cloud was utilized to help illustrate the findings, demonstrating that the participants' responses included favourable terms related to their acceptance of the technology. In addition, the responses revealed a greater prevalence of positive feelings. This indicates that most school administrators and teachers favour implementing technology in school and the teaching-and-learning process.

In light of these findings, the following suggestions were provided as possible next steps:

Word clouds and sentiment analysis can be beneficial tools for determining how various stakeholders feel about a particular technology. After this, it is suggested to potential future researchers that they validate the acceptance using multiple other methods.

In future studies, in addition to the views and opinions of school administrators and teachers, the perspectives and feelings of students and their parents may also be incorporated.

The significance of this study is that it contributes to a deeper comprehension of the perspectives held by educational institution administrators and teachers regarding the application of technological advances in educational settings. Since this particular group of stakeholders is generally open to incorporating technological advancements in schools, implementing other technologies becomes much more straightforward.

Further, positive acceptance of technology may lead to better delivery of instructions and improve the quality of the teaching and learning process.

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