A Proposed Quick Response Code System in the Tool Room of Aeronautical Engineering Students of Holy Angel University

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Abstract- Aeronautical Engineering, precision and meticulous attention to detail are paramount. Educational environments dedicated to cultivating the skills of future aviation technicians understand the significance of effective tool management. One innovative solution proposed in this study involves integrating a sophisticated QR code system into the tool room infrastructure of aircraft maintenance technology programs. This work proposes an inventory management system that manages stock details with various agents and factors making up the inventory. The respondents are the First- and Second-Year Aeronautical Engineering Students at Holy Angel University for the academic year 2024–2025, as they are the ones who will test the proposed QR code system. Frequency distribution and weighted mean are used to summarize and interpret the data. The results showed that the QR code system provides significant convenience, especially in efficiently accessing information and enhancing accountability through clear records of tool usage, as well as enabling real-time tracking of tool usage and availability. To further improve the QR code system, the researchers recommend enhancing workflow efficiency by making it easy for users to request tools or report issues, streamlining operations and reducing downtime.

Indexed Terms- Aeronautical Engineering, QR Code System, Tool Management, Inventory Management, Real-Time Tracking

I. INTRODUCTION

1.1 Background of the Study

In the field of aviation, especially in Aeronautical Engineering, the tool room is one of the most vital places for mechanics to store and grab their equipment. Having efficient tool management is also essential for increased productivity, worker safety, and strict compliance with industry standards. The tool room is also present in aviation schools where it serves a critical purpose by ensuring Aeronautical Engineering students can access, store, and manage all kinds of tools and equipment required in aircraft maintenance duties. However, traditional manual systems in managing tools and equipment require manual tracking systems, which also provide numerous discrepancies in inventory, tool misplacement and mismanagement, and inefficient tracking methods.

In order to address these challenges, the implementation of a QR code system for the tool room in Holy Angel University is proposed. Recent studies have shown some of the benefits that QR code systems may provide in various settings. According to Lifang, M., Yonghung, M., Ling, W., & Xiumei, W. (2021), QR codes carry information that can be viewed by simply scanning. They provide a high recognition rate, low cost, large storage capacity for information, and ease of use. Additionally, the stored information in the QR code can be obtained by scanning the code directly with a mobile phone. Moreover, Shettar, I. (2016) states that QR codes are a product of great technology that aids in inventory management and reduces administrative burdens in several educational institutions and libraries. QR code systems are easy to use since smartphone usage is prevalent nowadays.

To relate this study to Aeronautical Engineering learning, implementing QR code systems in the tool room of Holy Angel University can provide several advantages for both students and instructors. Tools can be assigned a certain QR code that holds information about the tool and inventory management. Through

this setup, students can easily borrow tools for specific practical activities and return them with ease. The tools can also be tracked using real-time inventory tracking and automated notifications to ensure that they are kept in good condition and well-stocked for educational purposes. Integrating a QR code system in the tool room signifies the university's commitment to technological advancement and being an innovation-driven educational institution. By installing digital solutions on campus, Holy Angel University can improve the learning experience of Aeronautical Engineering students and help prepare them for the world of aviation.

1.2 Objective of the Study

General Objective:

To propose and evaluate the implementation of a QR code system in the tool room for Aeronautical Engineering students, aiming to improve tool management efficiency, accuracy, and convenience.

Specific Objectives:

1. To determine the sociodemographic characteristics of Aeronautical Engineering students in terms of their year level.
2. To identify the existing problems encountered by students in the tool room, specifically in:
   2.1. Tool identification
   2.2. Tool room processes
3. To assess students' anticipation of the QR code system in terms of:
   3.1. Accuracy
   3.2. Efficiency
   3.3. Convenience
4. To explore the potential benefits of implementing a QR code system in the tool room for Aeronautical Engineering students.
5. To gather suggestions and recommendations for improving the proposed QR code system.

1.3 Significance of the Study

This research is highly significant for multiple stakeholders. Students. This study is significant to Aeronautical Engineering students as they would benefit from easier access to tools and equipment necessary for their program. The QR code system could help organize the process of checking out tools,

ensuring they have what they need for their practical activities. Instructors. This study provides educational guidance in implementing the QR code system. Instructors will be responsible for setting up and managing the system, teaching students how to use it, analyzing data for improvements, gathering feedback, and effectively integrating it into the curriculum. Their involvement ensures that the QR code system functions smoothly in the tool room and supports student learning. Tool Keeper. The results of this study will benefit tool keepers by providing a more organized tool management system. It will reduce the time spent tracking down missing tools, ensure proper maintenance, and streamline the process of checking tools in and out. Institutions. Educational institutions can benefit from implementing QR code systems in tool rooms by enhancing inventory management, improving student learning efficiency, enabling better data collection and analysis, increasing safety and compliance, and modernizing their facilities.

II. METHODOLOGY

2.1 Research Design

The survey design used for this study is descriptive quantitative research, which focuses on A Proposed Quick Response Code System in the Tool Room of Aeronautical Engineering Students of Holy Angel University. This study utilizes an experimental survey research design, employing questionnaires with the objective of evaluating the impact of the Quick Response (QR) code system on efficiency, accuracy, and overall tool room operations. It provides explanations about unexplored aspects of the subject, along with details about the what, how, and why related to the research questions.

The purpose of quantitative research is to attain greater knowledge and understanding of the social world. Researchers use quantitative methods to observe situations or events that affect people. According to Traci Williams (2021), quantitative research produces objective data that can be clearly communicated through statistics and numbers. This is done in a systematic and scientific way so that studies can be replicated by others.

2.2 Population and Sample of the Study

The researchers will create and distribute questionnaires to selected respondents. The respondents are the First- and Second-Year Aeronautical Engineering students of Holy Angel University. The researchers will employ Convenience Sampling, as the selection of these respondents is based on the rationale that they are the primary users of the tool room and will significantly benefit from the implementation of a QR code system.

According to Nikolopoulou (2022), Convenience Sampling is a type of Non-Probability Sampling that involves selecting a sample based on the accessibility and availability of participants to the researcher. This method is commonly used due to its promptness, simplicity, and cost-effectiveness. Members of the sample are often readily approachable and willing to participate.

2.3 Research Instruments

In this research, survey questions will be used to gather data on the effectiveness and efficiency of implementing a QR code system in the tool room for Aeronautical Engineering students. A survey is a method of gathering information using relevant questions from a sample of people with the aim of understanding populations as a whole. Survey forms will be distributed to the 1st and 2nd year students of Aeronautical Engineering.

To gather data for evaluating the proposed QR code system in the tool room for Aeronautical Engineering students, a structured survey instrument was developed. The survey utilizes a Likert scale to assess various dimensions of student feedback. The questionnaire will be divided into sections to cover various aspects related to the proposed QR code system. These sections may include:

The respondents are requested to indicate how much they agree or disagree with each item in the questionnaire. Each statement within the sections is rated on a four-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree).

2.4 Data Collection Procedure

The researchers will ask permission from an instructor who excels in programming, like in QR code systems, to be the facilitator who will grade the effectiveness and accuracy of the particular QR code system. The researchers will use convenience sampling to obtain the respondents for the study. The questionnaire will then be formulated, after which it will be proposed for validation by three instructors who have abundant knowledge in aircraft tools and equipment in the tool room. Upon permission, the researchers, together with the facilitator, will initiate the data gathering procedure in which the respondents' skills will be graded by the instructor based on the criteria in the questionnaire, then retrieve it for analysis.

2.5 Statistical Treatment

This part will exhibit the process to be applied to the data that will be gathered and the statistical treatment to be used, so the researchers will receive the results they search for. In analyzing and interpreting the data gathered for this study, the following statistical methods will be applied:

1. Frequency Distribution and Percentage will be used to determine the highest percentage of cases gathered and the following variables of the study.
2. Weighted Mean will be used to analyze survey data collected from students. Typically, this involves assessing participants' satisfaction or usability feedback about the QR code system.

The assigned points, together with the corresponding numerical range and verbal interpretation, are as follows:

Assigned Points	Numerical Range	Verbal Interpretation
4	(3.25 – 4.00)	Strongly Agree
3	(2.50 – 3.24)	Agree
2	(1.75 – 2.49)	Disagree
1	(1.00 – 1.74)	Strongly Disagree

III. RESULT AND DISCUSSION

This chapter of the paper presents the data gathered from the insights of the 1st and 2nd year Aeronautical Engineering Students. The survey instrument was distributed and collected by the researchers using

Google Forms. It also provides the analysis and interpretation of data on the proposed Quick Response Code System in the Tool Room of Aeronautical Engineering Students. Each item on the questionnaire was measured using a five-point Likert scale, with values ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Section 1: What are the sociodemographic characteristics of Aeronautical Engineering Students in terms of their year level.

Gender	Frequency	Percentage
1st Year	71	55.5%
2nd Year	57	44.5%
Total	128	100%

Table 1 shows that there are more 1st year respondents (55.5%) than 2nd year respondents (44.5%).

Section 2: What are the problems faced by Aeronautical Engineering Students in the Tool Room:

2.1 Tools Identification

Questions	Weighted Mean	Interpretation
I often find myself relying on others to help me in identifying the correct tools in the tool room	2.90	Agree
Finding the required tools quickly is a challenge	2.87	Agree
The tool room doesn't have any available visual guides to identify the correct tools to use in laboratory	2.71	Agree
General Weighted Average	2.83	Agree

Table 2.1, Tools Identification, illustrates the responses for each question, along with the calculated weighted mean value and the general weighted average of the responses. The highest weighted mean value was for question no. 1, with a total of 2.90, which falls under the category of Agree. Students have

agreed that they are quite challenged in identifying the right tools to be used. Followed by question no. 2, which has a weighted mean value of 2.87, also falling under the category of Agree. This suggests that the students have agreed that they are having a hard time finding the required tool quickly. Next, question no. 3 has a weighted mean value of 2.71, indicating that students are in agreement that there are no visual guides in the tool room to help identify the correct tools for laboratory use.

2.2 Process

Questions	Weighted Mean	Interpretation
The tool borrowing process is quick	2.98	Agree
The steps required to borrow tools are easy to follow	3.13	Agree
There is a clear system in place to track which tools are borrowed and returned	3.13	Agree
General Weighted Average	3.08	Agree

Table 2.2, Process, provides a comprehensive overview of the responses received for each individual question. It also includes the calculated weighted mean values for each response, allowing for a detailed understanding of the data. Lastly, the table summarizes the overall weighted average of all responses, offering a broader perspective on the participants' feedback regarding this section. The highest weighted mean value came from both questions no. 2 and no. 3, totaling 3.13, which falls under the category of Agree. This shows that the students agree that the steps needed to borrow tools are simple and easy to understand. They feel the process is clear, making it quick for them to know what they need to do to borrow the tools they want. Additionally, they see that there is a clear system in place for keeping track of which tools are borrowed and returned. Overall, this agreement highlights how effective the tool borrowing process is in making things simple and straightforward for the students. Followed by question no. 1, which has a weighted mean value of 2.98, also falling under the category of

Agree. This implies that the students collectively acknowledge and agree that the process of borrowing tools is efficient and fast.

Section 3: How do Aeronautical Engineering Students anticipate the introduction of a QR code system in the tool room in terms of:

3.1 Accuracy

Questions	Weighted Mean	Interpretation
The QR code system provides accurate inventory reports	3.39	Strongly Agree
Implementing a QR code system will enhance my overall experience in the tool room	3.38	Strongly Agree
The QR code system is more accurate than the previous system	3.35	Strongly Agree
General Weighted Average	3.38	Strongly Agree

Table 3.1: Accuracy is the analysis of the respondents' degree of agreement with the statement "The QR code system provides accurate inventory reports," which had a weighted mean of 3.39, interpreted as the "highest" mean rating among them all. On the contrary, the statement "The QR code system is more accurate than the previous system" had a weighted mean of 3.35, interpreted as the "lowest" mean rating. Additionally, it can be seen in the table that the majority of the statements were rated "Strongly Agree." This means that the respondents' role for Accuracy in the introduction of a QR code system in the tool room was strongly agreed upon, with an overall mean of 3.38.

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3.2 Efficiency

Questions	Weighted Mean	Interpretation
The QR code system will minimize error in tool check-out and check-in	3.31	Strongly Agree
The QR code system will enable real-time tracking of tool usage and availability	3.39	Strongly Agree
The implementation of QR ode reduces the chance of tools being lost or misplaced	3.32	Strongly Agree

General Weighted Average	3.34	Strongly Agree

Table 3.2: Efficiency is the analysis of the respondents' degree of agreement with the statement "The QR code system will enable real-time tracking of tool usage and availability," which had a weighted mean of 3.39, interpreted as the "highest" mean rating among them all. On the other hand, the statement "The QR code system will minimize errors in tool check-out and check-in" had a weighted mean of 3.31, interpreted as the "lowest" mean rating. It can be seen in the table that the majority of the statements were rated "Strongly Agree." This means that the respondents' role for efficiency in the introduction of a QR code system in the tool room was strongly agreed upon, with an overall mean of 3.34.

3.3 Convenience

Questions	Weighted Mean	Interpretation
It is more convenient in loggin in and out using the QR code system than manually logging in and out	3.34	Strongly Agree
Accessing the information of tools through the use of QR code system is efficient and convenient	3.41	Strongly Agree
The QR code system will enhance accountability by providing a clear record of usage of each tool	3.41	Strongly Agree
General Weighted Average	3.39	Strongly Agree

Table 3.3: Convenience is the analysis of the respondents' degree of agreement with the statements "Accessing the information of tools through the use of QR code system is efficient and convenient" and "The QR code system will enhance accountability by providing a clearer record of usage for each tool," both of which had a weighted mean of 3.41, interpreted as the "highest" mean rating among them all. Conversely,

the statement "It is more convenient in logging in and out using the QR code system than manually logging in and out" obtained a weighted mean of 3.34, interpreted as the "lowest" mean rating. In addition, most of the statements were rated "Strongly Agree." Thus, the respondents' role for convenience in the introduction of a QR code system in the tool room was strongly agreed upon, with an overall mean of 3.39.

Section 4: What are the potential benefits of implementing a QR code system in the tool room specifically for Aeronautical Engineering Students?

Questions	Weighted Mean	Interpretation
The QR code system will enhance the accountability of students using the tools	3.34	Strongly Agree
The QR code system will facilitate faster identification of missing or misplaced tools	3.41	Strongly Agree
Using the QR code system helps our environment by making it paperless	3.41	Strongly Agree
General Weighted Average	3.40	Strongly Agree

Table 4: Potential Benefits is the analysis of the respondents' degree of agreement with the statements "The QR code system will facilitate faster identification of missing or misplaced tools" and "Using the QR code system helps our environment by making it paperless," both of which had a weighted mean of 3.41, interpreted as the "highest" mean rating among them all. Conversely, the statement "The QR code system will enhance the accountability of students using the tools" obtained a weighted mean of 3.34, interpreted as the "lowest" mean rating. In addition, most of the statements were rated "Strongly Agree." This means that the respondents' role for the potential benefits of introducing a QR code system in the tool room was agreed upon, with an overall mean of 3.40.

IV. SUMMARY, CONCLUSIONS AND
RECOMMENDATIONS

4.1 Summary of Findings

The primary objective of the study was to determine the focus on enhancing efficiency and ease in tool management: Insights of Aeronautical Engineering Students of Holy Angel University. The study was undertaken at Holy Angel University. employing first-year and second-year Aeronautical Engineering students as respondents. We used the sample size of 128 respondents during computation for the convenience random sampling technique. The 128 respondents were given online questionnaires to gather data on the demographic profile. After the data were gathered, these were analyzed using the following statistical tools: Frequency Distribution and Percentage, Weighted Mean.

1. What are the sociodemographic characteristics of Aeronautical Engineering students in terms of:

It shows that there are more 1st-year respondents (55.5%) than 2nd-year respondents (44.5%).

2. Challenges Faced by Aeronautical Engineering Students in borrowing tools in terms of:
2.1 Tool Identification:
The lowest weighted mean value is 2.71, stating that "The tool room doesn't have any available visual guides to identify the correct tools to use in laboratory". The highest weighted mean value is 2.90, which belongs to the statement, "I often find myself relying on others to help me in identifying the correct tools in the tool room."
2.2 Process:
The lowest weighted mean value is 2.98, stating that "The tool borrowing process is quick". While the highest weighted mean value is 3.13, for "The steps required to borrow tools are easy to follow" and "There is a clear system in place to track which tools are borrowed and returned."

3. How do Aeronautical Engineering students anticipate the introduction of a QR code system in the tool room in terms of:
3.1 Accuracy:

The highest weighted mean value is 3.39, stating that "The QR code system provides accurate inventory reports". The lowest weighted mean value is 3.35, stating "The QR code is more accurate than the previous system."
3.2 Efficiency:
The highest weighted mean value is 3.39, stating that "The QR code system will enable real-time tracking of tool usage and availability". The lowest weighted mean value is 3.31, stating "The QR code system will minimize errors in tool check-out and check-in."
3.3 Convenience:
The highest weighted mean value is 3.41 for "Accessing the information through the use of the QR code system is efficient and convenient" and "The QR code system will enhance accountability by providing a clear record of usage for each tool". The lowest weighted mean value is 3.34, which belongs to the statement "It is more convenient in logging in and out using the QR code system than manually logging in and out."

4. What are the potential benefits of the system in our institution?
In the ranking of the weighted mean, the highest weighted mean value of 3.41 states "The QR code system will facilitate faster identification of missing or misplaced tools" and "Using the QR code system helps our environment by making it paperless." The lowest weighted mean value, 3.34, states "The QR code system will enhance the accountability of students using the tools."

5. What are the suggestions and recommendations of the respondents?
The highest percentage of suggestions and recommendations among the 128 respondents' states that the place QR codes visibly on tools, equivalent to 65.6%. The lowest percent, which is "Gather user feedback for improvements", is equivalent to 39.1%.

4.2 CONCLUSIONS

Conclusions based on the findings of the study; the following conclusions are drawn:

1. Generality of the Participants: The majority of participants were first-year students, with a total of 71 or 55.5% out of 128 respondents.
2. Challenges Faced by Aeronautical Engineering Students in Borrowing Tools:

2.1 The researchers found out that the participant are having a hard time identifying the tools they need in laboratory. Additionally, participants needed assistance or someone that knows the specific tool they need.
2.2 The participants found it easy to borrow tools by following the steps provided by the system
3. How do Aeronautical Engineering students anticipate the introduction of a QR code system in the tool room in terms of:

3.1 The researchers found that the QR code system is effective in providing accurate inventory reports, as indicated by the highest weighted mean. However, participants were slightly less convinced that the QR code system is more accurate than the previous system. Despite this, the overall perception is that the QR code system enhances accuracy in managing tool inventories.

3.2 The researchers concluded that the QR code system is highly efficient in enabling real-time tracking of tool usage and availability, as shown by the highest weighted mean. Although its ability to minimize errors in check-out and check-in received a slightly lower score, it remains positively regarded.

3.3 The researchers determined that the QR code system provides significant convenience, especially in efficiently accessing information and enhancing accountability through clear records of tool usage, both receiving the highest ratings. While the convenience of logging in and out using the QR code system was rated slightly lower, it was still determined to be more efficient than manual methods.

4. The results indicate that students see significant benefits in using the QR code system for managing tools, particularly in its ability to quickly locate missing items and promote a paperless environment. These features suggest that the system can enhance efficiency and sustainability. The system may also improve student accountability when using tools. Overall, these findings support the implementation of the QR code system as a means to improve tool management while fostering a more environmentally friendly approach.

5. The feedback from the respondents shows a strong preference for placing QR codes visibly on tools, highlighting the importance of making them easy to see for better usability. Meanwhile, gathering user feedback for improvements is viewed as less critical. Overall, these findings suggest that focusing on the visibility of QR codes can significantly enhance user interaction, while also acknowledging that collecting feedback can help with future improvements.

4.3 RECOMMENDATIONS

The recommendations on the study:

1. Attach QR codes to tools such as torque wrenches, with links to safety guides, usage videos, and specifications. This ensures students know exactly how to use each tool correctly.
2. Use QR codes to direct students to digital manuals or safety sheets, reducing paper clutter and allowing easy updates.
3. Enhance workflow efficiency by making it easy for users to request tools or report issues, streamlining operations and reducing downtime.
4. Provide QR codes on tools that link to detailed specifications, usage guidelines, and safety instructions.
5. Ensure that QR codes work on all devices for accessing tools and instructions.
6. Make QR codes larger and easier to scan, placing them near the tools.
7. Test and update the system regularly to avoid errors.
8. Perform regular tool checks to keep inventory accurate and prevent loss.
9. Future researchers can expand on our work to improve the field.

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