Republic of the Philippines
EULOGIO "AMANG" RODRIGUEZ
INSTITUTE OF SCIENCE AND TECHNOLOGY
Nagtahan, Sampaloc Manila

VOLUME XXIV, No. 36 ISSN 0119-5212 JULY - DECEMBER 2024

EARIST RESEARCH JOURNAL

"Collaboration and Innovation For Sustainable Futures: Building Resilience In A Changing World"

The EARIST Research Journal seeks to further the discussion, advancement, and dissemination of research, planning, development and production concerns and knowledge along professional, scientific, technological, technical and vocational instruction and training in trades, business, arts, sciences and technology.

The opinions expressed in the articles are those of the author or authors; they are not necessarily the views of Eulogio “Amang” Rodriguez Institute of Science and Technology, and the Office of the EARIST Research Services.

Correspondence concerning contributions, subscriptions, advertising, permission to reprint the articles, and other business matters should be addressed to EARIST Research Services.

FOREWORD

The Eulogio “Amang” Rodriguez Institute of Science and Technology takes pride in publishing Volume XXIV, No. 36, July – December 2024 of the EARIST Research Journal as it contributes to the attainment of EARIST’s Mission, Vision, Goals, and Objectives through scholarly publications.

This volume is the output of researches conducted by EARIST faculty during the Academic Year 2024. This volume highlighted Fifteen (15) distinct researches in different fields, but most noteworthy, each individual research achievement.

The topics vary as shown in every page, but each is full of diverse stories confirming happenings in every college of the Institute. The office of research hopes to mirror the activities of our educators in assuming their task as researchers.

There are more challenges left in the various fields waiting for further scrutiny. We continue the never-ending cycle of the quest for new knowledge and further understanding of the issues at hand. The work remains unsolved. But unless we produce our own solutions to existing problems, the challenges will never be met.

The research work undertaken by faculty members and staff are included with the hope that these will contribute to the advancement of research activities of the institute and will serve as medium in the dissemination of research outputs to the community.

Dr. Marlene M. Monterona
Director, Research Services

TABLE OF CONTENTS


Technical
Research

EFFECTIVENESS OF TIME-EFFICIENT 7-STEP STRATEGY FOR ENHANCING CLASS ENGAGEMENT IN ONLINE MATH CLASSES

Dr. Roel P. Balayan

INTRODUCTION

The shift to online learning, driven by technological advancements and accelerated by the COVID-19 pandemic, has transformed educational practices globally. While online learning offers flexibility and accessibility, maintaining student engagement in this virtual environment has proven to be a persistent challenge. Traditional methods of classroom interaction often fail to translate effectively into online settings, leading to decreased student interest and participation. In mathematics, a subject already perceived as difficult by many students, the problem of disengagement becomes even more pronounced, potentially hindering learning outcomes.

At the Eulogio "Amang" Rodriguez Institute of Science and Technology (EARIST), the teaching-learning modality has adopted a flexible approach, with 75% of classes conducted in person and 25% delivered online. This unique blend of learning environments creates both opportunities and challenges in maintaining consistent student engagement. For college students, particularly those enrolled in "Mathematics in the Modern World" (MMW), the adjustment to this flexible model has heightened the need for innovative teaching strategies that can maintain their interest, especially in the online component of the course.

The study is grounded in Constructivist Learning Theory, as proposed by Jean Piaget and Lev Vygotsky, along with Engagement Theory, introduced by Greg Kearsley and Ben Shneiderman. In addition, recent literature highlights the importance of active learning strategies, mindfulness, and structured lesson plans to combat these issues in virtual classrooms. Studies by Moore et al. (2021) and Carter et al. (2021) emphasize that time-efficient, structured approaches can significantly improve student focus and motivation in an online setting. However, a gap remains in identifying specific, step-by-step strategies that can seamlessly integrate these elements into a cohesive framework, particularly in enhancing engagement in mathematics among students in an online environment.

This study addresses that gap by developing and testing a 7-Step Time-Efficient Strategy for Online Class Engagement in Mathematics, focusing on the students enrolled in the MMW course at EARIST. The proposed strategy combines mindfulness, community check-ins, structured instruction, and hands-on activities to optimize instructional time and student engagement. Specifically, the research will investigate the effect of this strategy on student interest in mathematics before and after its implementation in the online learning context.

This research aims to measure the effectiveness of the proposed teaching strategy in enhancing student engagement, evaluate the differences in interest levels before and after its application, and provide actionable recommendations for improving online learning experiences. By addressing these issues, this study hopes to contribute to developing more effective teaching methods in flexible learning environments, particularly in the context of mathematics education at the college level. In particular, the following problems were addressed:

1. What is the level of interest in mathematics among MMW students in an online learning environment before implementing the proposed teaching strategy?

2. Based on the findings, what teaching strategy can be proposed to enhance student engagement in online mathematics learning?

3. After implementing the proposed teaching strategy, what changes are observed in the level of interest in mathematics among MMW students?

4. Is there a statistically significant difference in students' math interest levels before and after the implementation of the proposed teaching strategy?

5. What recommendations can be made to further improve engagement and interest in online mathematics learning?

METHODS AND PROCEDURE

Research Design. This study employed a quasi-experimental research design, specifically a pre-test and post-test format, to measure changes in student engagement and interest in mathematics before and after implementing a 7-Step Time-Efficient Strategy for online class engagement. The approach enabled the comparison of students' levels of interest in two-time points: before the application of the strategy and after its deployment in online classes.

Participants. The participants of this study were college students enrolled in the Mathematics in the Modern World (MMW) course at Eulogio "Amang" Rodriguez Institute of Science and Technology (EARIST). A total of 126 students were included using a purposive sampling method based on their enrollment in sections of MMW that followed the 75% in-person and 25% online learning modality. The inclusion criteria required students to participate in both the online and in-person classes and to have no prior exposure to the proposed teaching strategy.

Tools. The study utilized several instruments and tools for data collection and analysis:

1. Interest in Mathematics Questionnaire. A self-report instrument was used to assess students' interest in mathematics, which passed through expert validation and pilot tested with a 0.76 consistency level.

2. Engagement Observation Checklist. Used by the researcher during online classes to record real-time engagement behaviors.

3. Teaching Materials. Digital resources, slide presentations, and interactive learning activities are designed to align with the 7-step teaching strategy.

4. Jamovi statistical software was used to analyze the quantitative data collected from the pre and post-tests.

Procedure. The study was conducted over the course of six weeks within the semester. In the first week, a pre-test was administered to assess students' baseline interest in mathematics in an online learning setting. This was followed by introducing the 7-Step Time-Efficient Strategy, which included structured activities such as community check-ins, movement and mindfulness breaks, and a balance of direct instruction and interactive problem-solving sessions during the 25% of their course delivered online. The teaching strategy was implemented in the second to fifth weeks of the study. During each online session, engagement behaviors were recorded using the observation checklist. At the end of the fifth week, a post-test was administered to the students to measure any changes in their interest in mathematics following the application of the strategy.

Data Analysis. Quantitative data from the pre- and post-tests were analyzed using descriptive statistics to determine the level of interest in mathematics before and after the intervention. Shapiro-Wilk was used to test the normality of the data. Wilcoxon Rank test was conducted to assess whether there was a statistically significant difference between the pre-test and post-test scores.

Ethical Considerations. Informed consent was obtained from all participants, and confidentiality of responses was maintained throughout the research process. Participants were informed of their right to withdraw from the study at any time.

RESULTS

The findings from the Interest in Mathematics Questionnaire indicate varying levels of student perceptions across different dimensions. Enjoyment of Learning Mathematics Online received an overall mean of 1.96, categorized as low. The statement "I enjoy participating in interactive online math activities" had the lowest mean at 1.46, reflecting strong disagreement, while the highest mean was for "I find learning mathematics online to be enjoyable," which scored 2.34, still indicating disagreement. In terms of the Perceived Relevance of Mathematics, the overall mean was 2.96, categorized as high. Students agreed with the statement, "I feel that the skills I learn in mathematics courses are applicable to my future," which had the highest mean of 3.47. However, the statement "I see the value of mathematics in making informed decisions in my life" scored lower, with a mean of 2.23, indicating disagreement. Regarding Confidence in Learning Mathematics Online, the overall mean was 1.79, which was categorized as low. The statement "I believe I can solve math problems in an online format, even when they are challenging" had the lowest mean of 1.29, indicating strong disagreement. Conversely, "I find online math resources helpful in learning new concepts" received a mean of 2.54, indicating agreement. Finally, in terms of Engagement in Online Mathematics Activities, the overall mean was 1.52, categorized as low. The statement "I actively participate in online discussions related to mathematics" scored the lowest at 1.26, indicating strong disagreement. At the same time, "I enjoy working on online math assignments and projects" had a mean of 1.82, which still reflects disagreement. These results highlight significant challenges in enjoyment, confidence, and engagement among students in online mathematics learning despite a relatively higher perceived relevance of the subject.

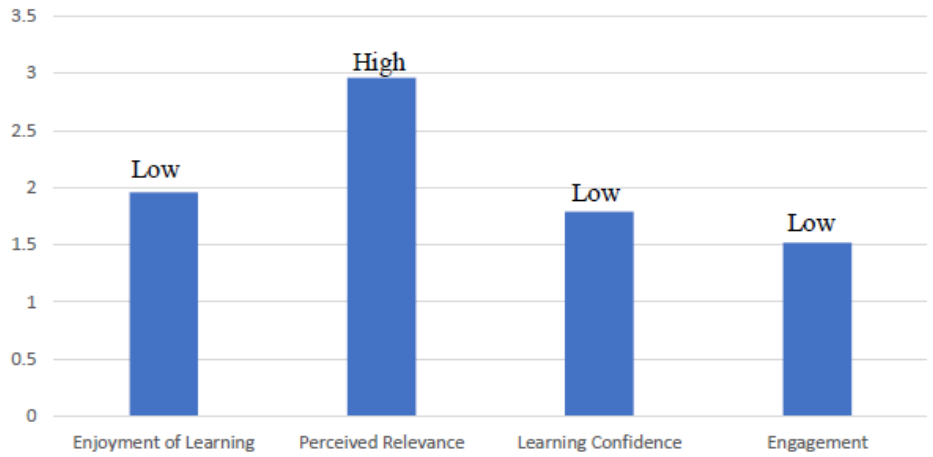


Figure 1. Pre-Level of Interest in Math Online Learning Environment

To enhance student engagement in online mathematics learning, a 7-Step Time-Efficient Strategy was proposed, which incorporates structured activities and interactive elements tailored for the online environment:

1. 10-Minute Pre-Class Preparation: Instructors will provide students with a brief overview of the session's objectives and relevant materials before class. This could include a short video or reading assignment to set the context.

2. 5-Minute Community Check-in: At the start of each online session, the instructor will facilitate a quick check-in, allowing students to share their feelings or experiences related to mathematics. This fosters a sense of community and encourages participation.

3. 3-Minute Movement and Mindful Moment: Students will engage in a brief physical activity or mindfulness exercise to help them focus and energize before diving into the lesson. This could involve simple stretching or guided breathing exercises.

4. 2-Minute Quick Review of Norms and Expectations: The instructor will quickly recap classroom norms and expectations for participation, ensuring that all students understand how to engage effectively during the session.

5. 15-25 Minutes of Direct Instruction: The instructor will deliver focused, interactive instruction on key mathematical concepts, utilizing multimedia presentations, real-time demonstrations, and question-and-answer segments to keep students engaged.

6. 20-30 Minutes of Apply, Create, Explore: Students will work on collaborative activities that allow them to apply what they've learned. This could involve breakout rooms for group problem-solving, hands-on projects, or the use of interactive math software to explore concepts in depth.

7. 5-15 Minutes of Wrap-up, Exit Tickets, and Goodbye: The session will conclude with a summary of key points discussed, followed by a reflective exit ticket where students can share one thing they learned or one question they still have. This provides closure and valuable feedback for the instructor.

After implementing the proposed teaching strategy, notable changes in the level of interest in mathematics among MMW students were observed across several dimensions. Enjoyment of Learning Mathematics Online showed an overall mean of 3.13, categorized as high. Students agreed with the statement "I find learning mathematics online to be enjoyable," which had a mean of 3.26. Additionally, "I look forward to attending my online mathematics classes" scored 3.18, indicating agreement. However, the statement "I feel satisfied when solving math problems during online sessions" had a lower mean of 2.44, reflecting disagreement. The statement "I enjoy participating in interactive online math activities" received a high mean of 3.69, indicating strong agreement. In terms of Perceived Relevance of Mathematics, the overall mean was 3.21, also categorized as high. Students agreed with the statement, "I believe that learning mathematics is important for my future career," which had a mean of 3.47. The statement "Mathematics is useful for solving everyday problems that I encounter" scored 3.28, reflecting agreement. Other statements related to the relevance of mathematics also received favorable ratings, with the lowest mean being 2.88 for "I see the value of mathematics in making informed decisions in my life." Regarding Confidence in Learning Mathematics Online, the overall mean was 3.07, categorized as high. Students strongly agreed with the statement, "I am confident that I can succeed in online mathematics courses," which had the highest mean of 3.84. However, the statement "I believe I can solve math problems in an online format, even when they are challenging" scored 2.43, indicating disagreement. Other statements demonstrated moderate agreement, such as "I feel comfortable asking questions in online mathematics classes when I don't understand something," with a mean of 3.66. Finally, in terms of Engagement in Online Mathematics Activities, the overall mean was 3.22, categorized as high. Students reported agreement with "I enjoy working on online math assignments and projects," which had a mean of 3.61. Additionally, "I feel motivated to complete online math exercises and tasks on time" received a high mean of 3.68, indicating strong agreement. Other statements also reflected positive engagement levels, with "I actively participate in online discussions related to mathematics" scoring 2.87, indicating agreement. Overall, the results illustrate a positive shift in

students' enjoyment, perceived relevance, confidence, and engagement in online mathematics learning after the implementation of the teaching strategy.

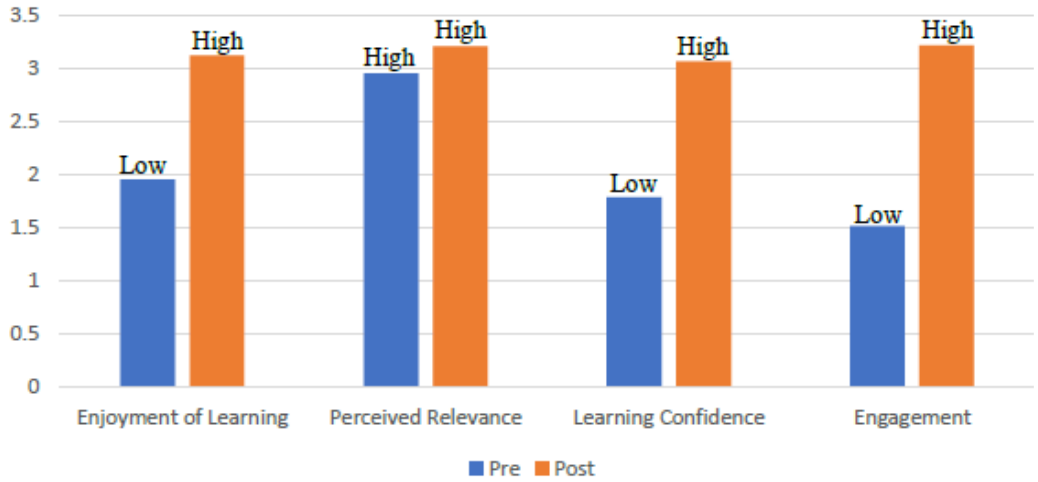


Figure 2. Pre and Post Level of Interest in Math Online Learning Environment

The findings from Table 1 reveal significant changes in the level of interest in mathematics within an online learning environment after implementing the proposed teaching strategy. For Enjoyment of Learning, the median shifted from "Low" to "High," with a test statistic of 54 and a p-value of less than .001, indicating a significant increase in enjoyment. Similarly, the Perceived Relevance of mathematics remained "High" both before and after the intervention, with a test statistic of 24 and a p-value of less than .001, suggesting a significant affirmation of its importance. In terms of Learning Confidence, the median increased from "Low" to "High," with a test statistic of 0 and a p-value of less than .001, reflecting a substantial improvement in students' confidence in learning mathematics online. Lastly, the level of Engagement also shifted from "Low" to "High," with a test statistic of 0 and a p-value of less than .001, showing a significant enhancement in student engagement in online mathematics activities. All these results were obtained using a Wilcoxon Rank Test, one-tailed, with a significance level of $\alpha = 0.05$ and a sample size of 126.

Table 1

Post Analysis on the Level of Interest in Math Online Learning Environment

Variables	Median (Pre)	Median (Post)	Statistic	p-value	Interpretation
Enjoyment of Learning	Low	High	54	<.001	Significant
Perceived Relevance	High	High	24	<.001	Significant
Learning Confidence	Low	High	0	<.001	Significant
Engagement	Low	High	0	<.001	Significant

Wilcoxon Rank Test, One-Tailed, □ = 0.05, n = 126

DISCUSSION

Before the intervention, students reported generally low levels of enjoyment, confidence, and engagement in learning mathematics online. The pre-intervention median for Enjoyment of Learning Mathematics Online was categorized as "Low," and students expressed strong disagreement with statements like "I enjoy participating in interactive online math activities" (mean of 1.46). Similarly, the Confidence in Learning Mathematics Online had a pre-intervention median of "Low," with a low mean score of 1.29 for "I believe I can solve math problems in an online format." This highlighted that students were disengaged, lacked confidence, and had limited enjoyment in the online learning process. However, the relatively higher Perceived Relevance of Mathematics (overall mean of 2.96) before the intervention suggested that students still recognized the importance of mathematics for their future, despite their low engagement.

After implementing the teaching strategy, a significant positive shift was observed. The Wilcoxon Rank Test results showed a statistically significant increase in enjoyment, confidence, and engagement in mathematics learning. The median for Enjoyment of Learning shifted from "Low" to "High," with a test statistic of 54 and a p-value of less than .001, indicating a substantial increase in enjoyment. Students reported agreement with statements like "I enjoy participating in interactive online math activities" (mean of 3.69), suggesting the intervention made the learning experience more engaging and enjoyable.

Similarly, Learning Confidence improved, with the median shifting from "Low" to "High" and a test statistic of 0 and p-value less than .001, reflecting a substantial rise in students' confidence. Students now felt more assured in their ability to succeed in online mathematics courses, as indicated by a mean score of 3.84 for the statement "I am confident that I can succeed in online mathematics courses." The increase in confidence suggests that the teaching strategy not only enhanced students' abilities but also their self-efficacy in handling online math challenges.

Engagement in Online Mathematics Activities also saw a significant increase, with the median shifting from "Low" to "High," supported by a test statistic of 0 and p-value of less than .001. Students became more actively involved in online discussions and assignments, as shown by the rise in mean score from 1.26 to 2.87 for "I actively participate in online discussions related to mathematics." This demonstrates that the intervention successfully promoted greater student involvement and interaction in online math activities.

Interestingly, Perceived Relevance of Mathematics remained consistently high both before and after the intervention, with a test statistic of 24 and a p-value of less than .001. This reaffirms that students continued to recognize the importance of mathematics in their future, suggesting that the intervention did not alter their perception of relevance but reinforced it.

The results align with previous research on improving online engagement and enjoyment through student-centered teaching strategies. Studies show that interactive and participatory approaches in online environments can significantly boost students' interest and confidence, which was reflected in the present study's findings. The substantial increase in enjoyment, confidence, and engagement aligns with research advocating for interactive activities and collaborative learning in online education, particularly in STEM subjects like mathematics.

The significant improvements across all dimensions—Enjoyment, Confidence, and Engagement—have important implications for instructional practices. The use of interactive and student-centered teaching strategies can transform online mathematics education, making it more engaging and enjoyable for students. The findings suggest that when students are given opportunities for interaction, supported with accessible resources, and provided with an environment that boosts their confidence, they become more engaged in their learning process.

This shift in student interest could lead to better academic outcomes in mathematics and other challenging subjects.

Based on the results and discussion, the following recommendations are proposed to further enhance students' interest in mathematics in an online learning environment:

1. To sustain and further increase students' enjoyment of online mathematics, it is recommended to incorporate more interactive learning tools such as gamified quizzes, virtual math games, and problem-solving activities. The positive shift in enjoyment, as shown in the study, suggests that engaging activities play a key role in enhancing student interest.

2. Although students' confidence improved after the intervention, there were still areas where they struggled with challenging problems. It is recommended to introduce differentiated instruction or additional support for complex topics through tutorial sessions, peer mentoring, or guided problem-solving exercises to help students build their confidence further.

3. To reinforce the perceived relevance of mathematics, the curriculum should continue to emphasize real-world applications of math in various professions and daily life scenarios. Introducing practical examples and career-oriented discussions will help students maintain their recognition of mathematics as an essential skill for the future.

4. As engagement increased significantly after the intervention, it is essential to keep fostering active participation. This can be achieved by encouraging collaborative projects, regular discussion forums, and peer assessments to maintain high levels of student interaction and motivation in online mathematics learning.

5. To ensure continued progress, it is recommended that teachers regularly assess students' interests, needs, and difficulties in mathematics learning through surveys or feedback mechanisms. This will help educators adapt teaching strategies and resources to meet students' evolving needs and ensure sustained engagement and interest in online learning environments.

CONCLUSION

The implementation of the proposed teaching strategy led to a significant increase in students' enjoyment, confidence, and engagement in learning mathematics online. In particular, the following were found:

1. The level of interest in mathematics among MMW students before the intervention was generally low across dimensions such as enjoyment, confidence, and engagement, with students showing strong disagreement in their enjoyment of online math activities and a lack of confidence in solving math problems. However, they acknowledged the relevance of mathematics to their future careers, as this dimension scored relatively high.

2. The proposed structured teaching strategy incorporates several time-efficient and engaging elements aimed at enhancing student interest and engagement in online mathematics learning. The 10-minute pre-class preparation provides a clear context for each session, ensuring that students understand the objectives. A 5-minute community check-in fosters a sense of belonging and encourages open communication, while a 3-minute mindfulness exercise helps students refocus before instruction. Recapping norms within 2 minutes reinforces expectations for active participation. The strategy's core includes 15-25 minutes of direct, interactive instruction followed by 20-30 minutes of collaborative, hands-on activities, allowing students to apply mathematical concepts in a meaningful way. A final 5-15-minute wrap-up with exit tickets ensures reflection and feedback, closing the session with a clear summary of learning

outcomes. This approach supports active engagement and creates a balanced, student-centered learning environment.

3. After the implementation of the teaching strategy, a significant improvement in students' interest in mathematics was observed. Enjoyment, confidence, and engagement in online mathematics learning shifted from low to high levels. Students became more motivated, confident, and actively engaged in online discussions and assignments, while their recognition of the relevance of mathematics remained consistently high.

4. A statistically significant difference exists in students' math interest levels before and after implementing the teaching strategy. Using a Wilcoxon Rank Test, all dimensions of interest—enjoyment, relevance, confidence, and engagement—showed significant improvements, with p-values of less than .001, indicating that the teaching strategy had a substantial positive impact on student interest.

5. To further improve engagement and interest in online mathematics learning, it is recommended to integrate more interactive tools, offer confidence-building support for challenging topics, emphasize the real-world relevance of mathematics, promote active student participation through collaborative projects, and regularly assess student feedback to tailor instructional strategies to their evolving needs.

REFERENCES

3P Learning. (2020). 20 Student Engagement Strategies for a Captivating Classroom. *3P Learning.* Retrieved from https://www.3plearning.com/blog/20-student-engagement-strategies-captivatingclassroom/.

ByteLearn. (2023). 20 Best Student Engagement Strategies for Math Teachers. *ByteLearn.* Retrieved from https://www.bytelearn.com/articles/best-student-engagement-strategies/.

Carter, J. A., Mallory, B., Refaei, B., & Benander, R. (2021). How a small teaching center made a big impact during the pandemic crises. *To Improve the Academy: A Journal of Educational Development*, 39(3), 51–63. https://doi.org/10.3998/tia.17063888.0039.304 https://doi.org/10.3998/tia.17063888.0039.304

Chen, P.-S.D., Gonazalez, L.D., & Hsu, Y.-C. (2010). Engaging Students in Online Learning: The Role of Social Presence and Interaction. *International Journal of Technology in Teaching and Learning*, 6(1), 23-34.

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The Impact of Enhancing Students' Social and Emotional Learning: A Meta-Analysis of School-Based Universal Interventions. *Child Development*, 82(1), 405-432. https://doi.org/10.1111/j.1467-8624.2010.01564.x

Education Week. (2020). Teacher Tips: Keeping Kids Engaged During Online Math Class. *Education Week.* Retrieved from https://www.edweek.org/teaching-learning/teacher-tips-keepingkids-engaged-during-online-math-class/2020/12.

Edutopia. (2020). How to Better Engage Students in Online Math Classes. *Edutopia.* Retrieved from https://www.edutopia.org/article/how-better-engage-students-online-math-classes.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, 74(1), 59-109.

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, 77(1), 81-112.

Kahu, E. R., & Nelson, K. (2018). Student Engagement in the Educational Interface: Understanding the Mechanisms of Student Engagement. *Higher Education Research & Development*, 37(1), 58-71.

Lavallee, A. (2020). Creating an Engaging Online Course with a Robust Community of Learners. *Global Online Academy*.

Moore, S., Trust, T., Lockee, B., Bond, A., & Hodges, C. (2021, November 10). One year later... and counting: Reflections on emergency remote teaching and online learning. *EDUCAUSE Review*. https://er.educause.edu/articles/2021/11/one-year-later-and-counting-reflections-onemergency-remote-teaching-and-online-learninghttps://er.educause.edu/articles/2021/11/oneyear-later-and-counting-reflections-on-emergency-remote-teaching-and-online-learning

Routty Math Teacher. (2021). Math Engagement Strategies: Editable Math Games. *Routty Math Teacher.* Retrieved from https://www.therouttymathteacher.com/math-engagement-strategies/.

Scillieri, E. (2020). Adapting Math Instruction During the Pandemic: A Teacher's Perspective. *Education Week*.

Skinner, E., & Belmont, M. J. (1993). Motivation in the Classroom: Reciprocal Effects of Teacher Behavior and Student Engagement Across the School Year. *Journal of Educational Psychology,* 85(4), 571-581.

Wang, M.-T., & Eccles, J. S. (2012). Social Support Matters: Longitudinal Effects of Social Support on Students' School Engagement and Achievement. *Child Development*, 83(3), 877-895.

ADMIXTURE FOR LEAD-CONTAMINATED SOILS REMEDIATION

Engr. Bryan V. Bantayan

INTRODUCTION

The construction industries are growing faster. The use of alternative construction materials is now a trend and starting to be of great demand, thus requiring the industry to make a wide choice in the selection of its components. In order to meet the increasing demand on the performance of these components, it is necessary to adopt innovations in technology. Recently, many recycled materials have been developed to reduce throwing industrial inorganic wastes away and promote recycling.

The use of fish bones as soil remediation and stabilizer is a promising method and technique. Where do the fish bones come from? The main source of fish bones comes from commercial processing plant that make pollock into fillets, fish sticks, boneless fish and artificial crab meat

METHODOLOGY

The research methodology is experimental. These include the preparation of materials (soils, fish bones, lead chloride for mimicking lead-contaminated soils and distilled water), design mixture calculations, preparation of samples, treatment period of samples and testing of samples (experiments and data evaluations) using the method of Atomic Absorption Spectrometer (AAS) Test for lead-contaminated soil remediation and the methods of California Bearing Ratio (CBR) Test and Compaction Test for increasing the strength of lead-contaminated soils.

Research Design

In this study, the experimental design was used. Experimental design refers to the exact plan on what to do in the experiments to treatment conditions allowing the researcher to make an inference about the relationship between the independent variable and dependent variable. It also allows to establish alternative explanations due to the confounding cause and effects of extraneous variable. Somehow, it reduces variability within the treatment conditions whereby making it easier to detect differences and treatment outcomes.

Following the onset of industrialization, high technology and globalization, waste management faces many challenges, including cost reduction in their utilization. This study focused on using fishbones as an admixture for lead contaminated soils.

In this study, lead-contaminated soils were prepared by mimicking (mixing the ordinary soils with the constant amount of lead chloride, *PbCl2,* for two sample sources, *Soil and Solution*, of three design mixtures, *1:1, 1:1.5 and 1:2; Soil:Fish bone ratio*, this is for lead-contaminated soils remediation and for increasing the strength of lead-contaminated soils respectively. Initial and final concentration of treatment period will be recorded for both major objectives determining the effectiveness of fish bones as admixture.

The different concentrations of the treated samples were subjected to Atomic Absorption Spectrometer (AAS) Test to be used in evaluation of lead ions content in lead-contaminated soils and California Bearing Ratio (CBR) Test and Compaction Test in determination of increase of strength of lead-contaminated soils.

Data Gathering Methods and Procedures

The following are the methods and procedures followed and used throughout the study. These are the preparation of materials, design mixture calculations, preparation of samples, treatment period of samples and testing of samples.

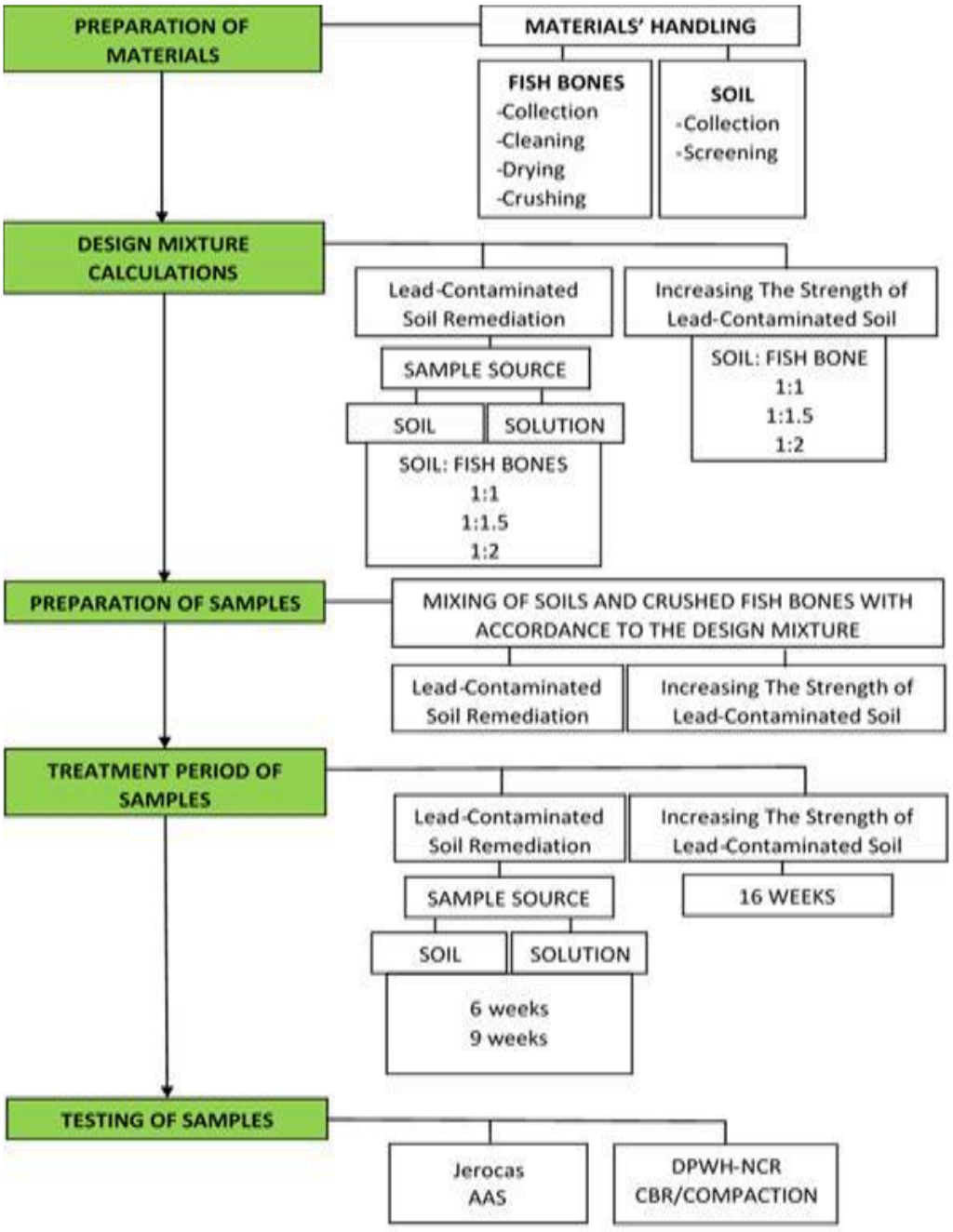


Figure 2. Flowchart for the remediation of lead-contaminated soils

RESULTS AND DISCUSSION

The study sought to determine the effectiveness of utilizing crushed fishbones to remediate the lead-contaminated soils and likewise increase its strength capacity. It attempted to links towards recovery to maximize waste utilization. It also sought how it could be a construction material compare to the usual treatment method as excavation and import backfilling likewise its comparable cost-benefits over the latter. It also sought how it could be of help to the Civil/Geotechnical Engineers and Environmentalists for the level of awareness that crush fish bones could be an admixture for remediation of lead-contaminated soils.

The research methodology is experimental and included the utilization of crushed fish bones as admixture for remediation of lead-contaminated soils, preparation of samples through mimicking mixture a proportion of soil, crushed fish bones and lead chloride (PbCl2) and employing Atomic Absorption Spectrophotometry (AAS), California Bearing Ration (CBR) and Compaction Test as an aid for the data evaluation.

Findings

The research resulted to the following findings:

1. The proportion 1:1.5, design mixtures A1 and A2 (50:75 grams) was found to be the best design mixture of crushed fish bones for remediation of lead ions from the lead-contaminated soils while the best treatment period was six weeks.

2. The proportion of 1:1 emerged as the best design mixture of crushed fish bones to increase the strength of lead-contaminated soils in 16 weeks of treatment.

Proportion 1:1 surpasses the results of control design mixture of 12.0%, 14.0% and 10.87%, 11.0% respectively in two (2) penetrations, in California Bearing Ratio (CBR) Test, although in the Compaction Test, the control design mixture gave the best results.

3. The cost-analysis utilizing crushed fish bones is cheaper, more economical, cost effective and ecologically sustainable with comparatively amount of PhP 885.58/m3 and PhP 259.61/m3 for usual excavation and backfilling and utilizing fish bones respectively. Likewise, in the computation of cost-analysis, it also shows that utilizing crushed fish bones got 70.68% cost effective and economical.

4. Crushed fish bones are also effective to be utilized as construction material for lead-contaminated soil remediation and for increasing the strength of lead-contaminated soil.

Conclusions

Based on the analysis and evaluation of the results, the following conclusions are drawn:

1. The lead recovery decreases as the masses of crushed fish bones increases both for soil sample source regardless of the treatment period.

2. Only few parts of the total lead content go to the solution (filtrate) while the crushed fish bones in the soil adsorb most part.

3. The small amount of lead ions that remains in the soil, which did, not absorbed by crushed fish bones, it increases the strength of the lead contaminated soils.

4. The utilization of crushed fish bones as construction material to remediate lead-contaminated soil is cheaper, more economical, cost effective and ecologically sustainable than the usual excavation and backfilling.

Recommendations

After the successful investigation through laboratory experiments, the researcher came up with some recommendations that the Engineers (Civil, Structural and Geotechnical), Environmental Enthusiasts, Academician, and other Researchers can use as construction material and reference:

1. Design mixture of 50 grams of soil and 75 grams of crushed fish bones (1:1.5 proportion) of soil sample source in 6 weeks' treatment period can be utilize for lead-contaminated soils remediation.

2. Design mixture 1:1 can be utilized for increasing the strength of the lead-contaminated soil in 16 weeks' treatment period.

3. Crushed fish bones can be construction material for lead-contaminated soil remediation and for increase the strength of lead-contaminated soil.

4. Highly recommend for further study particularly on the topography and morphology of the fish bones contaminated lead ions through scanning electron microscopy with energy diffraction.

5. Recommend to deodorize the soil samples with crushed fish bones because of its stinking smell.

6. Dissemination of this technology to technological education for the awareness on the remediation of heavy metals on soil, particularly lead which is a global concern of our time.

7. Awareness of the technology that could attribute to the stability of soil utilizing waste products from aquatic life.

8. Scanning electron microscopy with energy diffraction can detect the topography and morphology of the contaminated soil. The lead ions adsorbed in the fish bones, where subjected to energy emitted/diffracted by the machine, can readily be detected and actually measured in nanometer by scanning electron microscopy so that the researcher can have the idea on the extent of the contamination and the dangers of the heavy metals present in the soil samples.

REFERENCES

A. Books

Budhu, Muni (2007). "Soil Mechanics and Foundations (2nd Ed.)". John Wiley and Sons (ASIA) Pte Ltd. Singapore 129809. www.wiley.com/college/budhu.

Fajardo, Max Jr. B. (2002). Elements of Roads and Highways (2nd Ed.). 5138 Merchandising Publisher, Philippine. Copyright 2002.

Mc Carthy. Essentials of Soil Mechanics and Foundations.

Matta, Michael S.; Staley, Dennis D.; Waterman, Edward L.; Wilbraham, Anthony (2000). Chemistry. Prentice Hall Incorporated.

Velasco, R. J. Handbook of Construction Estimate and Their Technical Data. R.E. Books Marketing. Copyright 1988

B. Periodicals/Journals

Agwaramgbo, L., Lloynikka & Demley, T. (2014). Fish Bones Proving Their Worth in the De-leadification of Contaminated Water. British Journal of Applied Science & Technology.

Allen HL IV. (2007). The Use of Soil Amendments for Remediation, Revitalization, And Reuse. Washington, DC: Office of Superfund Remediation and Technology Innovations, U.S. Environmental Protection Agency

Aschengrau, A., Beiser, A., Bellinger, D., Copenhafer, D. & Weitman, M. (1997). Residential lead-based-paint hazard remediation and soil lead abatement: their impact among children with mildly elevated blood lead levels. American Journal of Public Health 87 (10), 1698-1702.

Austin, R., Tokura, S. & Hirano, S. (2007). Sulfated chitin and chitosan as novel biomaterials. International Journal of Biological Macromolecules, 175-181.

Bolen, W. P. (2007), Construction; U.S. Geological Survey Mineral Commodity Summaries, 2009.

Chandra, Ahluwalia & Goyal (2003). Microbial and plant biomass for removal of heavy metals from waste water. Bioresource Technology, 2243-2257.

Chaney, R. (1997). Phytoremediation of Soil Metals. Journal in Current Opinion in Biotechnology, Vol. 8, Issue 3, p. 279-284.

Das, N,, Vimala, R. & Karthika (2007). Biosorption of heavy metals – An overview. Indian Journal of Biotechnology, 159-169.

Design Guidelines, Criteria and Standards, For Public Works and Highways, Bureau of Designs, Volume II.

DPWH Standard Specifications (2004). Highways, Bridges and Airport, Volume II Huang, J., Chen, J., Berti, W. & Cunningham, S. (1997). Phytoremediation of lead-contaminated soils: Role of synthetic chelates in lead phytoextraction. Environmental Science & Technology 31 (3), 800-805.

Miretzky, P. & Fernandez-Cirelli, A. (2008). Phosphates for Pb Immobilization in soils: a review. Environ Chem Lett.2008;6(3):121-133. http://dx.doi.org/10.1007/s10311-007-0133-v

Ozer, A. & Ozer, D. (2003). Comparative study of the biosorption of Pb (II), Ni (II) and Cr (VI) Ions onto S. cerevisiae: Determination of Biosorption Heats. Journal of Hazardous Metals, 219-229.

Ozkan, A., Banar, M., Cokaygil, Z. & Altay, A. (2014). Pyrolysis of Hyperaccumulator Plants used for the Phytoremediation of Lead Contaminated Soil. Ekoloji 23 (92): 51-56. DOI: 10.5053/ekoloji. 2014.926.

Peron, H., Hueckel, T., Laloui, L. & Hu, L. (2009). Fundamentals of desiccation Cracking of fine-grained soil: experimental characteristics and mechanisms identification. Accepted for publication in Canadian Geotechnical Journal.

Pino, M. (2005). Improving the performance of Chitosan in the synthesis and stabilization of gold nanoparticles. European Polymer Journal, 419-431.

Suave, S., McBride, M. & Hendershot, W. (1998). Soil solution speciation of Lead (II): effects of organic matter and pH. Soil Science Society of America Journal 62(3), 618-621.

Tan, Lai, C. & Zaki, S. (2004). The Influence of Lead Concentration on Photocatalytic Reduction of Pb (II) Ions Assisted by Cu-TiO2 Nanotubes. International Journal of Photoenergy, 1-7.

Veglio & Beolchini (1997); Donmez, Turkmen, M. & Ciminli, C. (1999); McKay, Ozer, A. & Ozer, D. (2003). Comparative study of the biosorption of Pb (II), Ni (II) and Cr (VI) Ions onto S. cerevisiae: Determination of Biosorption Heats. Journal of Hazardous Metals, 219-229.

Volesky, B. & Holan, Z, (1995). Biosorption of Heavy Metals. Biotechnology Progress, 235-250.

Wright, J. (2006). Environmental Security Technology Certification Program, U.S. Department of Defense (June 2006): ESTCP Cost and Performance Report. PIMS: Remediation of Soil and Groundwater Contaminated with Metals.

Wright, J. (2004). PIMS Using Apatite II. How it Works to Remediate Soil and Water. In: Sustainable Range Management-2004, Hinchee RE, Alleman B, eds.Columbus, OH: Battelle Press (2004). In: Proceedings of the Conference on Sustainable Range Management, 5-8 January 2004, New Orleans LA.

Wright, J. (2005). Fishing for Lead: Metal Remediation through Use of Fish Bone. Geological Society of American Abstract with Program, Vol. 37, No. 7, p. 323.

C. Thesis/Dissertation

De Guzman, Nerissa M. (2015). Efficiency of Chitosan in Biosorption of Heavy Metals from Waste Water: Implications to Waste Management. Rizal Technological University, Mandaluyong City, Philippines.

Peron, H. (2008). Desiccation cracking of soils. Doctoral Thesis, Ecole Polytechnique Federale de Lausanne.

D. On-line Sources

Bohan, S. (2011). Fish bones used to decontaminate soil in a lead-poisoned neighborhood. http://www.treehugger.com/fish-bones-used-to-decontaminate-soil-in-alead-poisoned-neighborhood.html.

Calanog, S. (2011). Lead and Pyromorphite. http://www.iuhoakland.com.

Gamage, A. (2003). Use of Chitosan for the removal of metal ion contaminants and protein from water. Food Chemistry, 104 (3). http://www.sciencedirect.com/science/article/pii/so3088 14607000544.

Kaplan, R. (2012). Remediating Lead in the Soil. http://www.iuhoakland.com.

Watry, G. (2016). Discovering How Calcium Carbonate Crystals Get Strength. http://www.rdmag.com/article/2016/01/discovering-how-calciumcarbonate-crystals-get-strength.

ACCEPTABILITY OF STAR FRUIT (BALIMBING) AS SOUR MIX

Dr. Ma. Lee D. de los Reyes

Introduction

One of the exotic fruits with the lowest calorie count is star fruit. It only has 31 calories per 100 g, which is far fewer than the calories in any other common tropical fruit. However, it offers a remarkable list of vitamins, antioxidants, and critical elements that are needed for good health. Star fruit contains good qualities of vitamin-C and it is a powerful natural anti- oxidant. 100 g of fresh fruit provides 34.7 mg or 57%, of the daily required levels of vitamin C. In that case, the researchers conducted this study of Averrhoa Carambola (starfruit) which has the potential to develop a new product and produce a fine substance as a sour mix powder. For this reason, a research study was conducted.

This study was anchored by the theories supported by Halagarda (2008). He mentioned that new food product development is the result of correctly utilizing food product development. To develop a new food product, it is to necessary create new products that have instances of failure in the development process including adjustments of the recipe, sensory evaluation and for implementing sensory tasting of the product that was acceptable to the consumer and marketplace. As a result, (Averrhoa carambola) also known as starfruit was developing a powdered sour mix and to give an opportunity to study whether that starfruit is suitable for having potential as food flavoring or souring agent.

MATERIALS AND METHODS

Methods

The method used was experimental in nature it employed the development of product starting with the formulation of recipe, pilot testing and knowing the shelf life of the product.

Results and Discussion

Table 3
Sensory Evaluation of Carambola Sour Mix

Characteristics	Respondents						CM	Rank
	Consumer		Food Tech Students		Food Experts			
	WM	VI	WM	VI	WM	VI		
Appearance								
Color	4.55	**HA**	4.35	**HA**	4.00	**A**	4.30	1
Clarity	4.00	**A**	4.25	**A**	3.70	**A**	3.98	7
Aroma								
Intensity	4.20	**A**	4.15	**A**	4.20	**A**	4.18	4
Pleasantness	4.10	**A**	4.40	**A**	4.40	**A**	4.30	1
Mouthfeel								
Texture	4.10	**A**	4.20	**A**	4.40	**A**	4.23	3

Viscosity	4.50	**HA**	4.10	**A**	4.10	**A**	4.23	3
Taste								
Length	4.40	**A**	4.00	**A**	4.50	**HA**	4.30	1
Lingering	4.05	**A**	3.90	**A**	4.30	**A**	4.08	5
After taste								
Sweetness	3.55	**MA**	3.50	**A**	4.30	**A**	3.78	8
Sourness	4.05	**A**	4.00	**A**	4.10	**A**	4.05	6
Starfruit flavor	4.40	**A**	4.20	**A**	4.20	**A**	4.26	2
Average Weighted Mean	**4.17**	**A**	**4.09**	**A**	**4.17**	**A**		

Legend:

4.50 – 5.00 **Highly Acceptable**
3.50 – 4.49 **Acceptable**
2.50 – 3.49 **Moderately Acceptable**
1.50 – 2.49 **Slightly Acceptable**
1.00 – 1.49 **Unacceptable**

Table manifests the assessment on the Acceptability of Carambola Sour Mix as evaluated by the three (3) groups of respondents as follows:

On the **Appearance,** the composite mean of **color** was **4.30** on evenness of sour mix ranked first followed by **clarity** was **3.98,** ranked seventh and interpreted as **Acceptable**. Meanwhile for the **Aroma**, the **intensity** of sour mix with composite mean of **4.27**, ranked fourth followed by **pleasantness** at **4.30** which was ranked first and interpreted as **Acceptable**. On the **Mouthfeel** the composite mean of **Texture** and **Viscosity** was **4.23**, ranked third and interpreted as **Acceptable**. On the **taste,** the composite mean of **length** was **4.30** which was ranked first, while **lingering** was **4.08** ranked fifth and was interpreted as **Acceptable**. Meanwhile for the **aftertaste**, the **Sweetness** of sour mix with composite mean of **3.78** ranked eighth together with **Sourness 4.05** ranked sixth and lastly, the **starfruit flavor** with a composite mean of **4.26** ranked second, all interpreted as **Acceptable**. Since overall quality factors were **Acceptable** Starfruit or Balimbing could be used as the main ingredient in making Sour Mix.

Shelf-life of Carambola Sour Mix

Shelf-life studies are designed to indicate spoilage, not safety. Many products will spoil before they become potentially unsafe from pathogen growth.

Shelf Life of the Sour Mix

Product	1st month	2nd month	3rd month
Sour mix	✓	✓	✓

The product was able to reach three months of preservation with packaging. Therefore, the appearance of the product as observed changes with change in color. A transparent zip lock is made of polyethylene terephthalate (PET) and belongs to the polyesters. It is a laminated plastic and versatile for having strong and lightweight, re-sealable and re-closeable uses, clearly visible product outcome, and also water resistance. Due to its recyclable application, it can be eco-friendly and easy to use, so the PET is a durable packaging suited for this powder product.

CONCLUSION

1. The study revealed that all the necessary ingredients, tools, utensils, and equipment required for preparing carambola sour mix are readily available in households, and local markets which ensures convenience and ease in the preparation process. The step-by-step procedures for preparing carambola sour mix. carambola pilot-tested recipe demonstrates consistent quality and taste, ensuring reproducibility with room for necessary adjustments, resulting in a reliable and satisfying final product. The combination of sun and oven drying using the dehydration method, along with the utilization of a fruit blender and coffee grinder, proved essential in achieving the desired quality characteristics of dried carambola fruit powder, which received unanimous acceptance from the three groups of respondents. Employing appropriate packaging, such as transparent zip lock bags, proves highly beneficial for preserving the quality and freshness of carambola sour mix.

RECOMMENDATION

Promote homemade preparation of the flavor additive through recipe sharing, cooking demonstrations, and online resources, emphasizing convenience and simplicity. Embrace the carambola pilot-tested recipe as the production norm, ensuring unwavering quality and flavor while allowing for crucial adjustments like development of the products specially in terms resources, procedure for treating tartness or acridness and measuring acidity content to deliver a reliable and delightful final outcome.

REFERENCES

Biswal, R. (2022). Metabolic Profiling of Averrhoa Carambola Fruit Extract Using UHPLC-ESI-QTOF-MS and Determination of the Concentration of Essential Elements Using MP-AES. Retrieved from https://doi.org/10.1080/22297928.2022.212412

Bunag, L. (2023). Balimbing (Star Fruit) Uses and Benefits. Hello Doctor. Retrieved from https://hellodoctor.com.ph/herbals-and- alternatives/herbal-medicines/balimbing-benefits/

Cruz, C. O. (2018). Development of Nutritional Powdered Seasoning Using Selected Philippine Vegetable. Retrieved from https://ejournals.ph/article.php?id=12316

Halagarda (2008). New Food Product Development. ResearchGate. Retrieved from https://www.researchgate.net/publication/259054153_New_Food_Product_Developme nt

DECRYPTION OF ATTENDANCE MONITORING OF SENIOR HIGH SCHOOL IN ACTEC USING ZEBRA CROSSING ALGORITHM

Engr. Bernard C. Fabro
Hazel F. Anuncio

INTRODUCTION

In monitoring attendance, the teacher always uses the method of calling the students' names and using paper sheets to check or record them. This process becomes tough for administrators to keep track of attendance and then manually calculate the percentage of classes missed and attended for the supplementary grades. Because there are some reasons why the teacher lost these records, it's hard to compute the grades in this attendance if one of the records is lost.

Attendance monitoring using QR code technology has been a great help to schools and other organizations, such that it can save time from recording many people at campus, according to (Galgo, 2020)[1]. Furthermore, as stated in the blog of (Molina, 2018)[2], using QR codes for recording attendance is not only time-saving, but it is also easier for data access since it is done digitally. It is also less expensive because it eliminates the need for paper to be used every day in the classroom to record attendance. Maleriado and Carreon (2019)[3] believe that the system is extremely acceptable owing to its reliability, efficiency, accuracy, and use. Researchers are also very concerned about its security and confidentiality. (Rivera & Lagarteja, 2021)[4] study, it is said that the design program, in which the student has a barcode indicated on the IDs, improved student attendance. Due to that, student attendance is efficient because it lowers the dropout rate and increases performance ratings. In addition to that, it also implements an SMS notification for the parents to inform them about the child.

Attendance is one of the criteria in assessing the student's performance in school, but we realized that this can take a lot of time. The discussion or some important task will take a short amount of time. So, using the Zebra Crossing Algorithm. At Asian Caregiving and Technology Education Centers, Inc., the researchers developed this Decryption of Attendance Monitoring of Senior High School Students. This algorithm assists us in encrypting and decrypting QR codes to ensure the security of people's data. When you scan the QR Code, the researchers use two layers of security. The researchers add a password or verification code to it so that other people attempting to scan the QR code cannot easily read the encrypted information. The location pin will recognize the user's location if the first security breach occurs. The user is considered absent if the location does not match the location of the QR Code.

METHODOLOGY

This research seeks to develop an application that will assist the teachers and administrators of Asian Caregiving and Technology Education Centers, Inc., as well as other teachers and administrators in schools. This study is about the integration of two-layered securities in the application using the zebra crossing algorithm. The method of developing the application is based on two views; user view, which is the mobile application used by students, teachers, and administrators, and firebase, which can only be viewed by administrators in web. Also, two accounts should be created: student and instructor. The first phase is the encryption procedure, which entails encoding topic details using the subject code as the verification code, a location pin for where the QR Code should decode during attendance recording, and other subject details. Subject code and location pin are the two layers of security that keep the encoded data, which is now known as encrypted data, secure (other term: generated). The second phase

is the decryption procedure, which will be assigned to students and entails decrypting (or scanning) the encrypted QR Code. When the QR Code is taken by the scanner, the program recognizes the student's position and the following conditions must be met: (1) if it identified two addresses that are different, it cannot decode. Otherwise, it will be rejected throughout the verification process. (2) It could not decode if it detected two topic codes that were distinct. Otherwise, the student user will be called in.

- The researchers employ the Zebra Crossing technique to encrypt and decrypt QR codes. Moreover, Any Chart will be utilized to analyze the student's present, absent, and late attendance. The following are the methodology's specifics:
- Using the Android Studio Java programming language, researchers create a mobile application that incorporates the zebra crossing algorithm, which will be used to encrypt and decrypt the QR Code. The Reverse Geocoder class in Android Studio will employ the approach of turning a coordinate's (latitude, longitude) value into a (incomplete) address.
- The researchers utilized a self-made questionnaire for ISO 25010:2013 to collect data for this study. It consisted of 10 questions. The questionnaire was made from Google Forms distributed to the target population.

Data Encryption

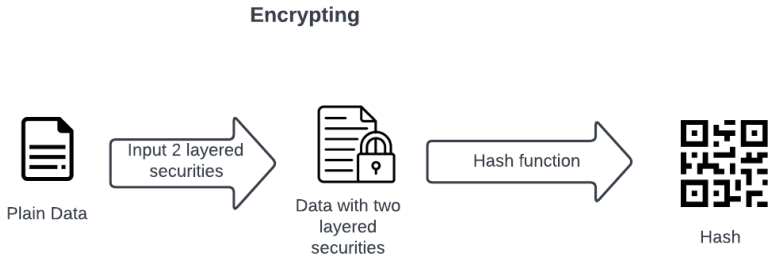


Figure 1. The encrypting phase of Plain Data with two layered securities to QR Code

Figure 1 shows that the plain data is generated using the Zebra Crossing Algorithm with a hash function. This generates a QR Code, a machine-readable code made up of a grid of black and white squares. The generated data is encrypted by the sender's (admin) unique keys to the specific class.

Data Decryption

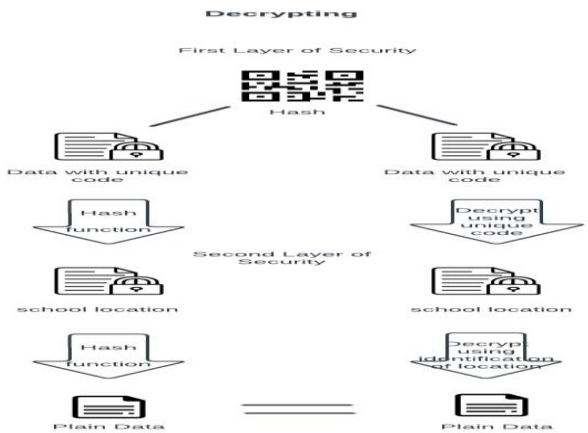


Figure 2. The decrypting phase of Plain Data with two layered securities in terms of Unique code and location verification to QR Code

Figure 2 shows that if the first security breaks, then it will proceed to identification and verification of location. If the receiver is not in the scope of the location of the school, then the receiver is absent. Therefore, if two variables don't match each other, then the receiver will not get attendance. If the plain data of the sender and receiver match, then the receiver will get attendance.

Flowchart

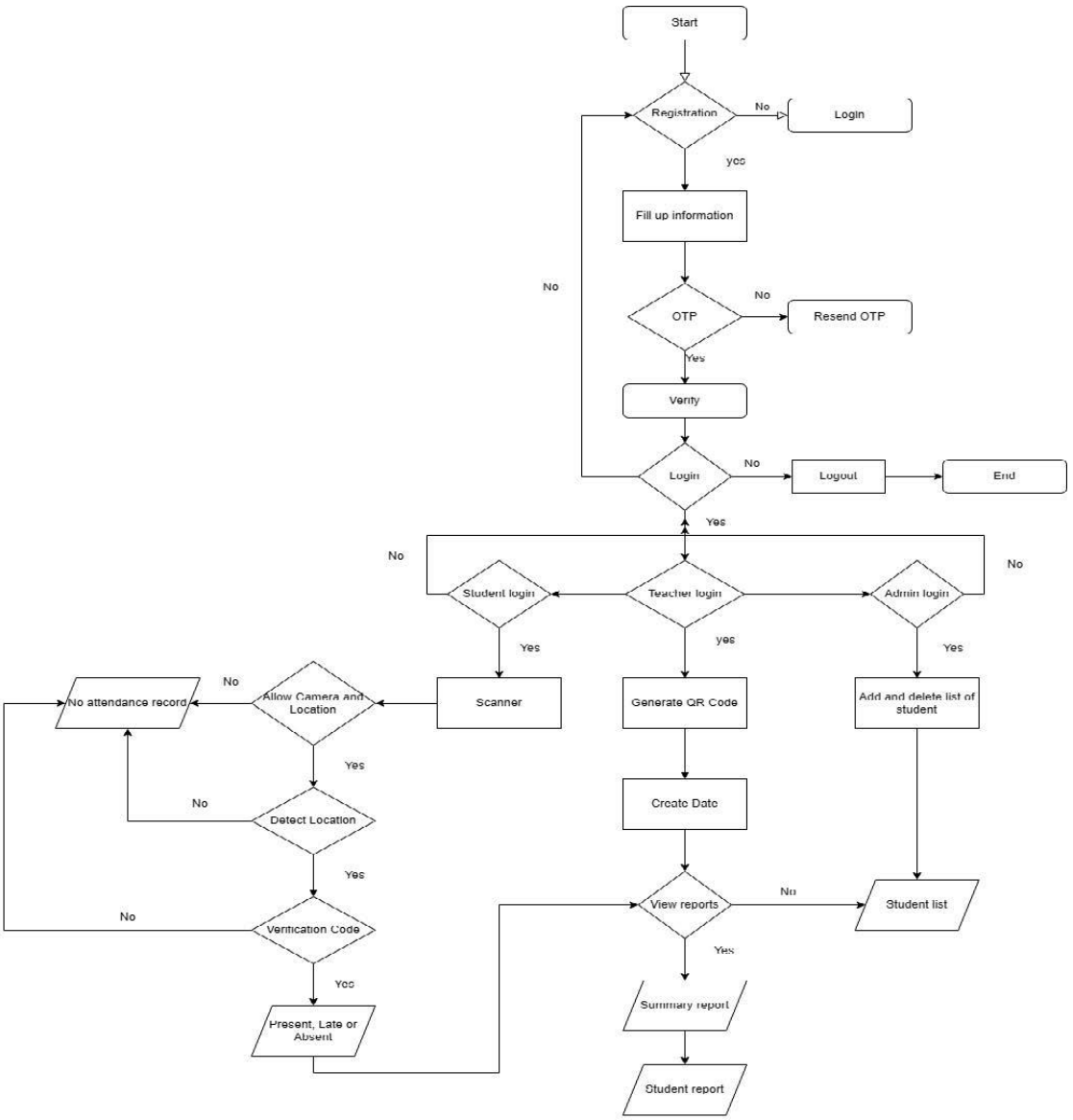


Figure 3. System Flowchart

The system flowchart in Figure 3 illustrates the flow of the operation starting at the registration up to the database served as the data repository.

Entity Relationship Diagram

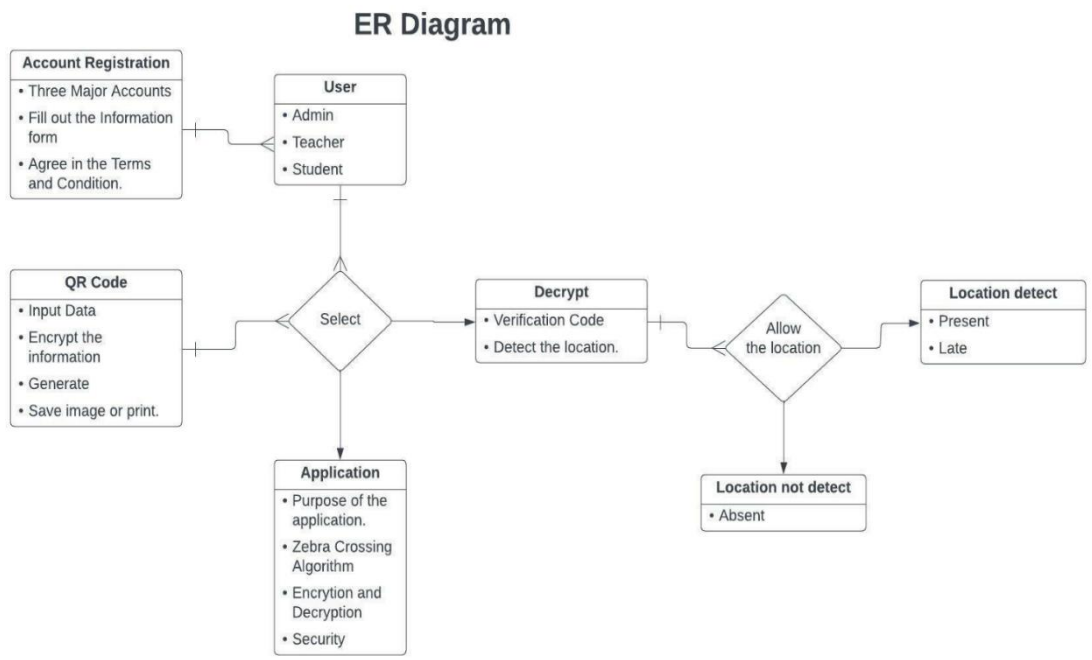


Figure 4. Entity Relationship Diagram

The ERD guarantees each entity, relationship, and the necessary characteristics for the attendance system are accessible as shown in Figure 4. The ERD diagram is frequently utilized in the most organized conceptual modeling and analysis since the technique is powerful in simulating the real world and straightforward to understand. issues, and it converts easily into a database structure.

Functional Requirements

Table 1
Admin Functional Requirements

Admin		
No	**Zebra Crossing Algorithm**	**Description**
1	Generate QR Code that applies first security: subject code	The first security is the subject code that the specific class has only access to. Admin will provide each subject code for sections.
2	Encrypt a QR Code that applies second security: location identification of school	The second security is the school location to match the student location.
No	**Application**	**Description**
1	Modifiable data to contain in QR Code	Can input subject details including subject code, subject name, professor name, subject day and time, semester, and terms and conditions of the app.
2	Adding	Adding students under the profile of the teachers and its subject held.

Table 1 shows the admin functional requirements for the Zebra crossing algorithm and application.

Table 2
Teacher Functional Requirements

Teacher		
No	**Application**	**Description**
1	Create Date	If the day of class has come, then the teacher should create a date to allow students to scan the QR Code.
2	List of Sections	It will view the section and its subject
3	Subject Report	The pie graph will be visualized according to the number of 3 attendance statuses. Filtering Date, and a total of students scanned will be seen here.
4	List of Students	It will view the students that have already scanned the QR Code.
5	Student Report	Each student on the list will get a report that will visualize the percentage of the attendance statuses. Every scan of the QR Code will be counted in total.
6	View Data	The list of students who scans the QR Code. Also, it will be known if students are not scanned the QR yet by getting an Absent status. The teacher will approve that the student is absent by clicking the button.

Table 2 shows the six teacher functional requirements for the application.

Table 3
Student Functional Requirements

Student		
No	**Zebra Crossing Algorithm**	**Description**
1	Allow the camera in the device to scan the QR Code.	If the first time installing the app, the first is to allow the camera of the device.
2	Input a subject code upon the window panel called verification code.	Different subject code is only accessible to the sections. It serves as the password of each section to get verification.
3	The scanner will identify the location of a student.	The location of the student will be matched to the location of the school. If it does not match the two locations, student will not allow to get attendance.
No	**Non-Functional Requirements of Zebra Crossing Algorithm**	**Non-Functional Requirements Category**
1	An application can run on all Android devices except iOS devices.	Operational
2	The application should be available 24 hours a day, 365 days a year.	Performance, Availability
3	The application must support multiple users per day.	Performance
4	A subject code security that QR Code contains.	Security
5	Location security to verify if the student's location matches the school location	Security
6	Data privacy will be held by Google Firebase as the database of the application and the admin is the only one to access it.	Security, Reliability, and Data Integrity
7	The data should automatically be updated as every student scans the QR Code.	Performance
8	Application of 2 layered securities in QR Code.	Data Integrity

Table 3 shows the students three functional and eight non-functional requirements for Zebra Crossing Algorithm.

Sample Size

Table 4
Types of Respondents

	Population	Sample Size
Teacher	14	6
Employee	10	6
Student	80	30
	Total: 104	**Total: 42**

Table 4 shows the total of 42 respondents were purposely selected as responses to the survey from Senior High School in Asian Caregiving and Technology Education Centers, Inc. The sample size for the study was determined through the respondents' experience, relevance to the study, and technical background.

Statistical Treatment

The following statistical tools were used in the interpretation of the results according to sub- problems. In the study, the following statistical methods were used:

1. Frequency- It is the respondent's actual response to a certain item/question in the questionnaire, where he or she checks his or her option.

2. Weighted Mean / Likert Scale- Right after the data collected from the field was analyzed. Statistically, the weighted mean will be used in answering the research questions. The response options in the instrument are weighted as shown below:

Table 5
Likert's Scale to Evaluate the Result and Its Descriptive Interpretation

Scale	Range	Verbal Interpretation
5	4.50-5.00	Strongly Agree (SA)
4	3.50-4.49	Agree (A)
3	2.50-3.49	Undecided (U)
2	1.50-2.49	Disagree (D)
1	1.00-1.49	Strongly Disagree (SDA)

In table 5 shows the descriptive interpretation of evaluation in Likert Scale. The Likert scale was interpreted as "5" strongly agree, "4" as agree, "3" minimally agree, "2" as disagree, and "1" as strongly disagree.

The weighted mean was used as follows: $\overline{wx} = \frac{\sum wx}{\sum w}$

Where:

$\overline{wx}$ – weighted mean
x – any value
n – number of observation or sample
Σ – summation symbol means to "sum

3. Ranking- This was used to reinforce the percentage to show the proportional importance of an idea considered.

4. Percentage- Used to describe descriptive statistics or parts of a whole.

$$\%\text{f} = \frac{f}{n}\ x\ 100$$

Where:

$\%f$ – relative frequency
f – frequency
n – number of observation or sample size.

5. Independent Sample Testing- An independent sample test is a statistical test that determines if two groups differ significantly in terms of a variable of interest. The researchers want to investigate the gap between user ratings and expert ratings for each enumerated questions. The formula is:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

t – t value
$\bar{x}_1$ – mean of the first group
$\bar{x}_2$ – mean of the second group
s_1^2 – variance of the first group
s_2^2 – variance of the first group squared
n_1 – sample size of the first group
n_2 – sample size of the second group

RESULTS AND DISCUSSION

This chapter presents the results and discussion of the data gathered to answer the problems in this study. It also presents the collective data from the forty-two (42) qualified respondents.

Respondent Type

Table 6
Distribution of Type of Respondents

Type of Respondents	Frequency	Percentage
Employee	6	14.3
Student	30	71.4
Teacher	6	14.3

Table 6 shows the distribution of respondents as to their type. It was revealed that there are 6(14.3%) employee respondents, 30 (71.4%) of student respondents, and 6 (14.3%) teacher respondent. This implies that most of the respondents are student.

Sex

Table 7
Distribution of Respondents as to their Sex

Sex	Employee		Student		Teacher		Total	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Male	4	9.52	19	45.24	4	9.52	27	64.29
Female	2	4.76	11	26.19	2	4.76	15	35.71
Total	**6**	**14.29**	**30**	**71.43**	**6**	**14.29**	**42**	**100.00**

Note: f means frequency, % - percent share.

Table 7 displays the distribution of respondents as to their type. It was discovered that there are 27 (64.29%) male respondents and there are 15 (35.71%) female respondents. Therefore, most of the respondents were male.

Age

Table 8
Distribution of respondents as to their Age

Age	Employee		Student		Teacher		Total	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*
16-20	0	0.00	11	26.19	0	0.00	11	26.19
21-25	5	11.90	19	45.24	1	2.38	25	59.52
26-35	0	0.00	0	0.00	4	9.52	4	9.52
36-40	1	2.38	0	0.00	1	2.38	2	4.76
Total	**6**	**14.29**	**30**	**71.43**	**6**	**14.29**	**42**	**100.00**

Note: f means frequency, % - percent share.

Table 8 reveals the distribution of respondents as to their type. It was exposed that in age bracket 16-20 got a frequency of 11 (26.19%) and age bracket 21-25 got a frequency of 25 (59.52%). Furthermore, age bracket 26-35 got a frequency of 4 (9.52%) and age bracket 36 – 40 got a frequency of 2 (4.76%).

Hence, the majority of the respondents aged between 21-25 since most of them are students.

Assessment

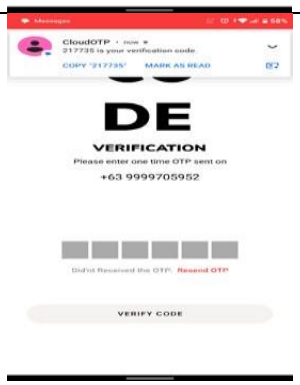
Table 9
Assessment of respondents when grouped to the questions about Decryption of Attendance Monitoring Using Zebra Crossing Algorithm

Indicators	Employee		Student		Teacher		Total	
	WM	*VI*	*WM*	*VI*	*WM*	*VI*	*WM*	*VI*
1. Do you recognize the integrity of the application?	4.00	A	4.27	A	4.33	A	4.24	A
2. The security that was implemented can prevent students from cheating the attendance.	3.83	A	4.47	A	4.33	A	4.36	A
3. The efficiency of 2 layered security.	4.17	A	4.20	A	4.17	A	4.19	A
4. The reliability of SMS Notification can be easy to receive the warning that they reach the limitation.	4.00	A	4.30	A	4.50	A	4.29	A
5. The QR Code's authenticity ensured data privacy.	4.17	A	4.47	A	4.5	A	4.43	A
6. The data visualization for updating the student's status is analyzable.	4.00	A	4.37	A	4.33	A	4.31	A
7. It maintains the privacy of data encrypted in QR Codes.	3.83	A	4.23	A	4.33	A	4.19	A
8. To be able to improve the function of QR codes with the assistance of the Zebra Crossing algorithm.	3.83	A	4.37	A	4.50	A	4.31	A
9. User interface enables pleasing and satisfying interaction for the user.	4.00	A	4.37	A	4.17	A	4.29	A
10. An application can provide functions that meet the stated and implied needs.	3.83	A	4.33	A	4.50	A	4.29	A

Note: WM means Weighted Mean, VI means Verbal interpretation

Table 9 established the Assessment of respondents when grouped to the questions about Decryption of Attendance Monitoring Using Zebra Crossing Algorithm. It was shown that the respondents agreed that The QR Code's authenticity ensured data privacy (WM=4.43), agreed that the security that was implemented can prevent students from cheating the attendance (WM=4.36), agreed that the data visualization for updating the student's status is analyzable (WM=4.31), and agreed that to be able to improve the function of QR codes with the assistance of the Zebra Crossing algorithm (WM=4.31). Furthermore, the respondents agreed that. The reliability of SMS Notification can be easy to receive their warning that they reach the limitation (WM=4.29), agreed that User interface enables pleasing and satisfying interaction for the user (WM=4.29), and agreed that the application is able to provide functions that meet the stated and implied needs (WM=4.29). Moreover, the respondents agreed that they recognize the integrity of the application (WM= 4.24), agreed on the efficiency of 2 layered security (WM=4.19), and agreed that. It maintains the privacy of data encrypted in QR Codes (WM=4.19).

System Implementation

Teachers Manual		
User Manual	**Name**	**Description**
	**Landing Page**	The general home where you can register and login and retrieve your password.
	**Teacher Registration**	Click the teacher registration to register as a teacher as to create an attendance.
	**Verification Code**	Input your active mobile number. Don't include the 0 at first. Click 'Send OTP' to send the otp code in your SMS.
	**OTP Code**	The OTP code that has been sent will enter in the blank gray blocks. Click 'Verify Code' to create your account successfully.

Log In as Teacher

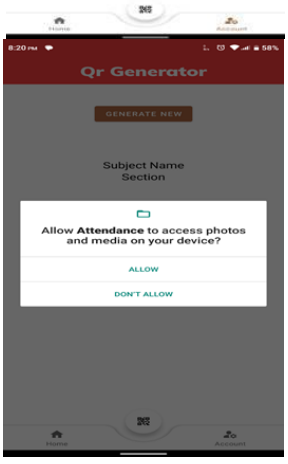
Before this, in landing page, click the Teacher login to enter email and password. Then click 'Login as Teacher'.

Homepage

This is the homepage of teacher account which will be seen the current date and time. View section and today classes.

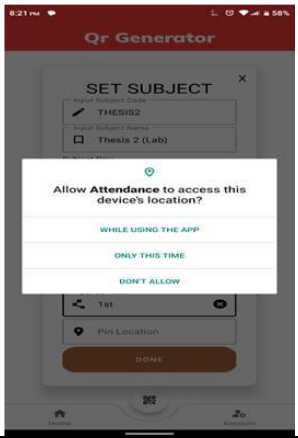
Profile Settings

Where you can see account details of the teacher and logout button.



QR Code Generator

Click the QR Code icon in the middle to encrypt the QR Code. First, if you are new user, allow the app to access your files. After that, click the 'Generate New' to view set subject details.



Location Pin

The applications will automatically be asking permission to allow your location. Then if you click your pin location in set subject the location automatically detects. Then that is the QR Code where located.

Set Subject

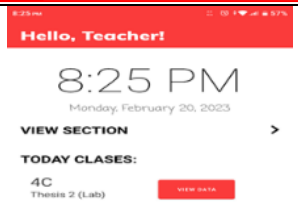
After you enter all details of the subject and allow the location of your device. Click 'Done' to encrypt the QR Code.

Save QR Code

You can now save the QR Code to your files and send it to the class.

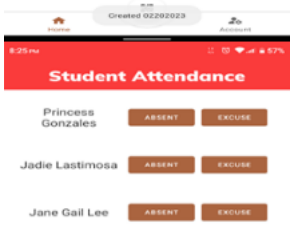
Create Date

You can only tap this if your class is about to start and to enable the student to scan the QR Code.



View Data

After tapping the 'Create Date', you can now view the data of the students who already scan and those who are not.

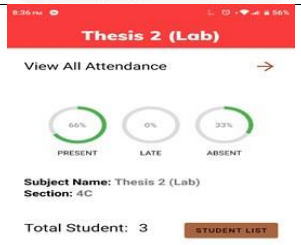


Student Attendance

This is the data of those students who already scan and not.

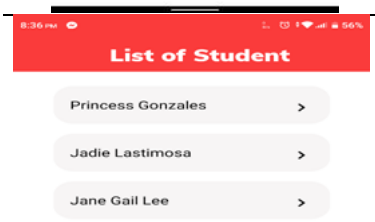
View Section

Click the 'View Section' on homepage and you will see the list of all section with the subject you are in.



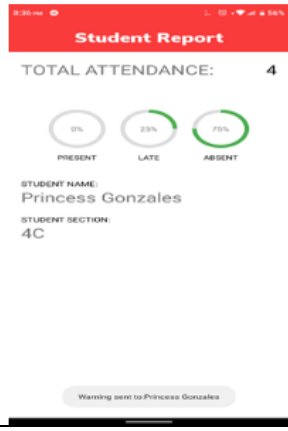
Student List

Click 'Student List' to view all the registered/enrolled students in specific section.



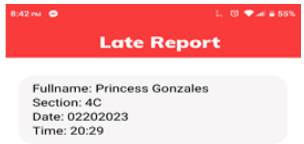
List of Student

Click one student to view the student report.



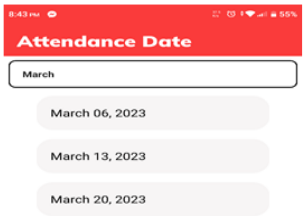
Student Report

Tap one of the pie graphs to view the details of the student including the scan time.



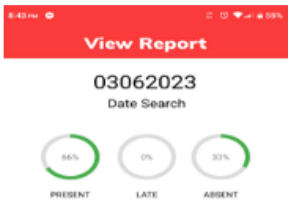
Attendance Report

List of the student details including the scan time and date.



Attendance Date

First, go to the homepage and click the arrow of 'View all attendance'. Search specific month or day, year to filter all matched data. Click some date.

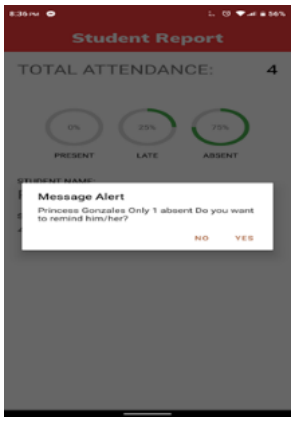


View Report

Once you click the date, three pie graphs will be shown: Present, Late and Absent. All data that will gather will be equal to 100%.

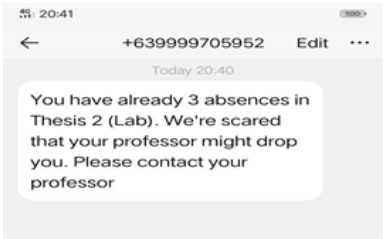
Absent Report

You can see that the same person has 4 absences. She has one present and 3 absence for that semester.



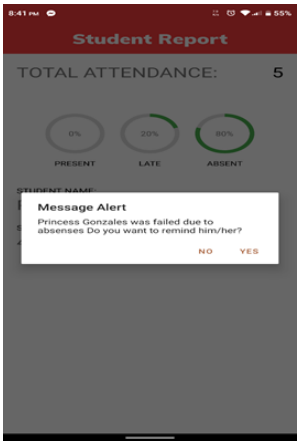
Warning SMS Notification

Equivalent to 3 absences will be reminded by the teacher. Just click 'Yes' if you want to remind that student via SMS. Note: Teacher must have load balance in her registered number to send warning SMS.



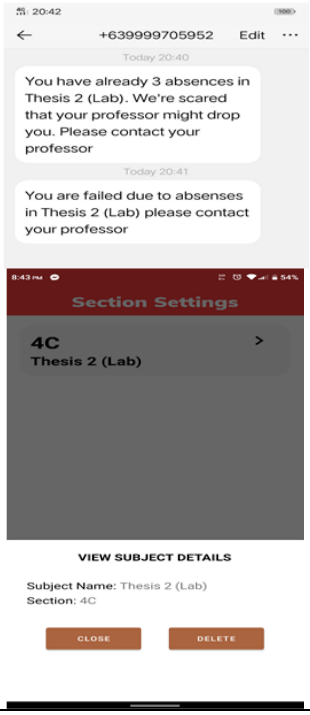
Student Received Warning Notification

This is the device of the student and the phone number is from the teacher.



Failed SMS Notification

Equivalent of 4 absences will be drop by the teacher in the list. Click 'Yes' to remind the student that it will fail the subject via SMS. Note: Teacher must have load balance in her registered number to send warning SMS.



Student Received Failed Notification

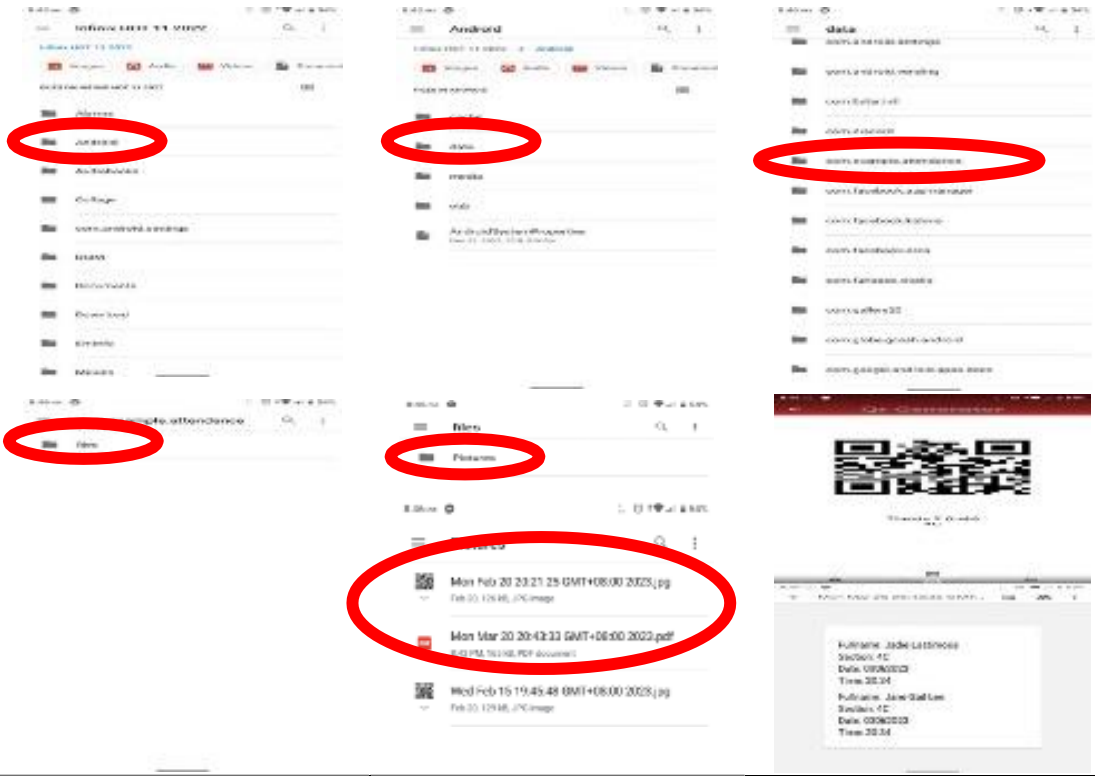
The second message is the warning sent by the teacher from failing the subject.

Section Settings

Go to the 'View section' and you can see there the setting icon to delete the subject if necessary.

Saved Files

Go to your File Manager > Internal Storage > Android > data > com.example.attendance > files > Pictures



CONCLUSIONS AND RECOMMENDATION

The researchers conclude that the two-layered securities applied in the application can prevent other scanners from being able to read the encrypted QR Code. Most of the respondents prefers the simple QR Code which should have an implemented security to get accurate attendance records. most of the teachers prefer having a SMS notification than the students because the teacher is no longer need to contact personally his/her student when the absences rates increased. The application will do the work to remind the student from having 3 to more absences. The QR Code is an easy access of data to the public because it is only an encoded data, researchers conclude that implementing an authenticated QR Code (encrypted) helps to identify a user location and verification code from the subject concerning to the accurate attendance records of the teachers. Students conform that the two-layered securities are efficient that student will not be able to attend if the subject code given from the teacher does not match and the location between the two variables mentioned does not match as well. The data visualization is the easy way to see the summary reports of the student attendance that help professor to easy analyze by percentage or visualize the present, late and absent.

The researchers concluded that the zebra crossing algorithm aids in organizing the functionalities of the QR Code and scanner.

Furthermore, the researchers recommend that the Decryption of Attendance Monitoring of Senior High School in ACTEC using Zebra Crossing Algorithm should have feature of importing a file so that it will not be difficult for the admin to encode student data manually.

REFERENCES

[1] Galgo, Jeson. (2020). “Efficacy of Scan Attendance Manager Application Using Quick Response Code in Dagohoy National High School, Bohol, Philippines”. 2. 1-12. 10.32996/ijes.2020.2.4.1.

[2] Molina, C. J. (2018, June 29). VIRAL: Techy Teacher Tracks Students Class Attendance via QR Codes. Inquirer. Retrieved from https://technology.inquirer.net/77033/viral-techy-teacher-tracks-students-class-attendance-via-qr-codes

[3] Angelo, M., et. al. (2018). “The Features of QR Code as an Attendance Monitoring System: Its Acceptability and Implication. ResearchGate”.

[4] Rivera, et. al. (2021). “Study on The Impact and Effectiveness of QR Code And SMS-Based Attendance Monitoring System Among the Students of Callang National High School.”

[5] Jathar, C., et. al. (2019). A Review on QR Code Analysis. International Journal of Application or Innovation in Engineering & Management (IJAIEM). International Journal of Application or Innovation in Engineering & Management (IJAIEM) (Vol.8, No. 7), PP 011-016.

[6] Elbehiery, M. (2019). “Enhancement of QR code Student’s Attendance Management System using GPS”: IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 21, Issue 4, Ser. I (Jul - Aug 2019), PP 18-30

[7] Packetlabs. (2022, August 15). Encryption, Encoding and Hashing: Explained. Retrieved from https://www.packetlabs.net/posts/encryption-encoding-and-hashing/#

[8] Taraka Rama. et. al. (2022). Prevention of Phishing Attacks Using QR Code Safe Authentication. In: Smys, S., Balas, V.E., Palanisamy, R. (eds) Inventive Computation and Information Technologies. Lecture Notes in Networks and Systems, vol 336. Springer, Singapore. https://doi.org/10.1007/978-981-16-6723-7_27

[9] Fidelino, et. al. (2014) "Student attendance monitoring gps application using android mobile platform." cloud, vol. 2, no. 1.

DUAL SECURITY BARRIER SYSTEM USING RFID AND FACIAL RECOGNITION

Engr. Jose C. Felipe Jr.
Engr. Minerva C. Zoleta
Engr. Bernard C. Fabro
Engr. Ador P. Utulo

INTRODUCTION

RFID technology has become one of the most critical aspects of current security systems regarding the deployment of automatic security barrier systems. Proximity Access Control, Real-time Database Monitoring, and sophisticated SQL algorithms make new security systems efficient. RFID applies radio frequency that helps in quick identification through a contactless method between the reader and the tags, increasing the level of comfort in using the system as well as the efficiency of the system. Proximity Access Control also increases the security of the identification processes by performing authentication close to gates, which makes it convenient for users and, at the same time, minimizes the chances of people who have no business entering and getting access to the premises. RFID technology integration provides businesses with a measure of protection towards their employees and equipment and a measure of creating or developing techniques in the current technical security threats.

METHODOLOGY

Research Locale

The study was conducted in a variety of settings, including corporate settings (companies) and educational institutions (schools). This methodology ensures the generalizability of the results by enabling a thorough assessment of the non-contact RFID-based automatic security barrier system in a variety of scenarios.

Research Design

This study used a mixed-methods approach to its research design, using quantitative and qualitative techniques. This method makes it possible to thoroughly investigate how non-contact RFID technology may be used in the suggested security barrier system.

Quantitative Phase

The quantitative phase involves collecting numerical data to measure the system's performance, reliability, and efficiency. This includes:

- **Experimental Design:** The non-contact RFID-based security barrier system was tested by creating controlled conditions that would manifest the operational conditions of the security system.
- **Data Collection:** Other quantitative data included the time taken by the system to execute its functions and access control, the success rate recorded when accessing the system, and its overall efficiency as gauged through various tests and experiments.

Qualitative Phase

The qualitative phase focuses on understanding the user experience and the system's impact on security measures. This includes:

Observations: Direct observations of the system were made to identify any unforeseen issues, challenges, or advantages in its real-world application.

Respondents of the Study

The participants in this study were selected based on their relevance to the non-contact RFID-based security barrier system. The respondents now include:

1. **Security Personnel:** Individuals responsible for the day-to-day security operations where the non-contact RFID system is implemented.

2. **System Administrators:** Those in charge of maintaining and managing the non-contact RFID system.

3. **End Users (Schools and Companies):** Individuals who interact with the security barrier system in educational institutions and corporate settings.

Research Instrument

The research instrument used in this study is a combination of tools tailored for both quantitative and qualitative data collection:

- **Non-Contact RFID Security Barrier System**: The hardware and software components used in the automatic security barrier system that employs non-contact RFID technology.

- **Observation Checklist**: A predefined checklist used during direct observations to note system behavior, anomalies, and user interactions.

Statistical Treatment of Data

The data collected from testing the Dual Security Barrier System were analyzed using descriptive statistics and simple linear regression. The following steps outline the statistical treatment applied: The following steps outline the statistical treatment applied:

- **Descriptive Statistics:** This technique helped in using and consolidating the collected information presented in the mean response time, the success rate, and the accuracy of the system.
- **Linear Regression Analysis:** This method was used to analyze the satisfaction of 10 randomly chosen people who tried the Dual Security Barrier System. In the end, each participant was asked to evaluate the system using the Lickert scale of 1-5 points. The goal of a regression analysis was to identify the dependency of the dependent variable, which is the overall user acceptance, and the independent variable, the overall satisfaction rating.

System Implementation

A screenshot of the EARIST Attendance and Access Control System has been captured to show how the dual security barrier works and how users could employ it. This interface shows how attendance and access control work through the system's RFID and Facial Recognition technologies.

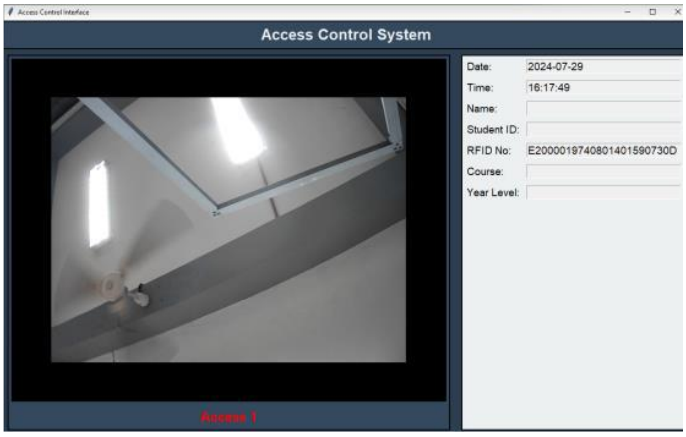


Figure 1. EARIST Attendance and Access Control System interface.

This interface also enables the monitoring of all the users' accounts, whereby their access attempts, together with the date, time, and result, are recorded. This way, easy-to-use features are enhanced through proper design to enable security personnel as well as system administrators to effectively monitor and provide proper control for Access in the institution.

This ensures that users practice the application of the Dual Security Barrier System in the real world as they learn how it works and what it looks like when operational. The following is the screenshot of the EARIST Attendance and Access Control System, which is part of the Dual Security Barrier System. This interface shows the current scenario of the system in terms of controlling the patient's attendance and Access through the RFID and Facial recognition interfaces.

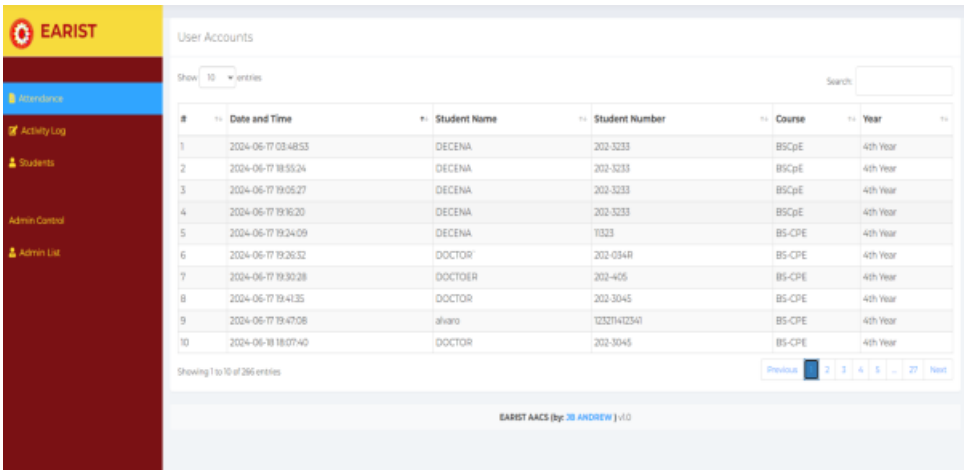


Figure 2. EARIST Attendance and Access Control System interface.

This interface provides an option for control panel for the user accounts which record all the attempted Access to the account, date, and time of the attempt and the status of the access attempt. The easy-to-use initiative guarantees that security employees and system managers can monitor and regulate the use of access control systems in the facility.

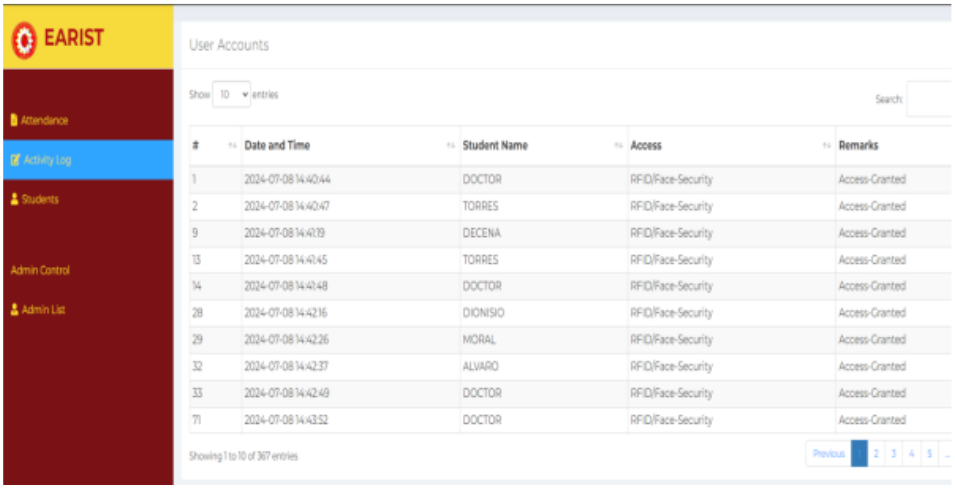


Figure 3. EARIST Attendance and Access Control System - Activity Log Interface (Access Granted).

This interface records the successful gains to the door, with records of the date of entry or time, student names, the type of noticeable access (RFID/Face-Security), and Remarks, which include Access GRANTED. It gives an instant detail of the people authorized to unlock the door, thus preventing unauthorized people from getting in.

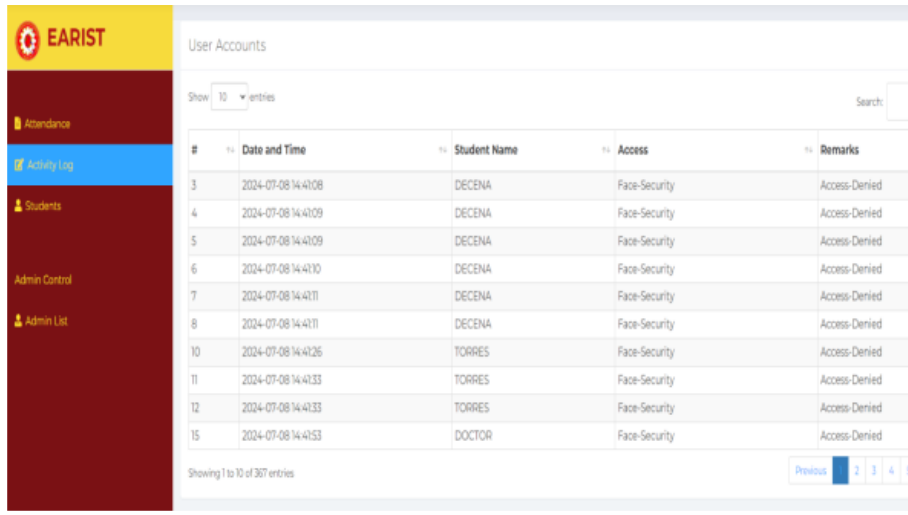


Figure 4. EARIST Attendance and Access Control System - Activity Log Interface (Access Denied).

This interface records failed access attempts by recording the date and time, students' name, mode of Access (Face-Security), and comments (Access Denied). It also assists in realizing and preventing all the users that try to gain an unlawful entry into the system and improves the security.

RESULTS AND DISCUSSIONS

Table 1
Linear Regression Analysis for User Satisfaction

Predictor Variable	Coefficient	Std. Error	t-Value	p-Value	R^2
(Constant)	1.2	0.3	4.0	0.001	0.85
RFID Response Time	-0.3	0.1	-3.0	0.005	
Face Recognition Time	-0.2	0.1	-2.5	0.01	
Access Success Rate	0.4	0.1	4.5	0.0005	
User Satisfaction Rating	0.5	0.1	5.0	0.0001	

This table shows the detailed results of the linear regression equation applied to user satisfaction and system performance assessments.

A reliability analysis of the overall system where it has been recommended that the availability ranges from 99%. 87% for the card system. Each of these percentages reflects the efficiency of each employed system in the organization. 7% for the Face Recognition system, while the remaining 93% lies in the testing and validation phase. Another significant factor is that the system's user acceptance level is also high, with the mean score being 4. 7.

System testing was effectively carried out to interpret the intended characteristics. The study's conclusion presents positive ship environment experiment findings, suggesting that RFID technology has the potential to greatly enhance port services, especially in terms of localization and overall operating efficiency.

SUMMARY AND CONCLUSION

Table 2
Summary of Access Attempts Using RFID-Based Security Barrier System with Face Recognition

Participant ID	Date and Time of Attempt	Result of Attempt	Reason for Failure
Reynold Doctor	2024-06-10 08:45	Granted	N/A
Reynold Doctor	2024-06-10 08:50	Denied	Incorrect RFID tag
Reynold Doctor	2024-06-10 09:00	Granted	N/A
Christian John Decena	2024-06-11 10:05	Granted	N/A
Christian John Decena	2024-06-11 10:20	Denied	Unrecognized face
Ryan Alvaro	2024-06-12 11:15	Granted	N/A
Ryan Alvaro	2024-06-12 11:25	Granted	N/A
Zackery Iquel Dionisio	2024-06-13 12:30	Granted	N/A
Zackery Iquel Dionisio	2024-06-13 12:35	Denied	Incorrect RFID tag
JB Andrew Torres	2024-06-14 14:00	Granted	N/A
JB Andrew Torres	2024-06-14 14:10	Denied	Unrecognized face

The table below shows the various staking of the participants as they tried to get past the restricted area using the RFID-based system and face recognition. Every row is comprised of the participant ID, the date and time of an attempt, the result as a grant or a denial, and the reason for denial if applicable: for instance, ‘’Incorrect RFID tag,’’ or ‘’Unrecognized face”.

- **Participant ID:** This column records the names of people who tried to sneak into the restricted area.

- **Date and Time of Attempt:** This column can hold the specific date and time when access was attempted for every identification and authentication attempt.

- **Result of Attempt:** This column provides information on the success status of the attempt, which is granted (success) or denied (failure).

- **Reason for Failure:** In the case of denied attempts, this column displays the reason why the entry was rejected, saying the "Incorrect RFID tag" or the "Unrecognized face.". Summary of Findings

This study aimed to provide an understanding of the effectiveness of something referred to as the Dual Security Barrier System created from the use of non-contact RFID and Face recognition technology. The key findings are as follows:

- The success rate of the RFID security barrier system was 98%, and its mean response time was 5 seconds.

- Improved user satisfaction with an average rating of 4.5. They were generally delighted in other respects, such as product quality, ease of use, and delivery, which typically rated high regarding product quality, with ease of use being rated the best, post-use product hygiene control. Still, the delivery service maintained an above-average level.

- Face Recognition technology was 95% accurate, providing a response within 2 seconds; therefore, the technology gave highly reliable results, as demonstrated by the R^2 value of 0. 85.

- Overall, the system reliability was of the highest standard, with 99.64 % availability with RFID and 99.7 % with Face Recognition.

Conclusion

Based on this research, the RFID-based security barrier is highly efficient in precise and swift access control hence suitable for application in congested circumstances. The proximity access control does not allow the loss of security while at the same time improving the user convenience. An advantage that relates to it is the integration of facial recognition as an alibi to biometric verification. The Dual Security Barrier System can be deemed trustworthy for broader applications in enterprises because it has been proven efficient and well-liked by both commercial and educational customers.

Traditional security methods are generally deficient in several aspects, such as slow response time, inability to differentiate between the user and an intruder, and rigidity in meeting new security challenges. Bearing in mind that most of these restrictions result from attempts to design and implement contactless security systems, they are most challenging in areas of high traffic where practical and secure contactless security instruments are most crucial. These problems are solved with the help of an RFID-based security barrier system working on the principles of non-contact, fast passing of the barrier, and granting an opportunity to enter the areas of the entrance. Also, the system is more secure by incorporating facial recognition and includes other ID and authentication measures and features. Thus, integrating RFID and facial recognition enhances the access control system's efficiency because it offers users smooth and safe door access.

REFERENCES

Bokingkito Jr. P., Llantos O., (2017). Design and Implementation of Real-Time Mobile-based Water Temperature Monitoring System. Retrieved from ScienceDirect

Coskun, V., Ozdenizci, B., & Ok, K. (2015, June). The Survey on Near Field Communication. Retrieved from Springer

El Gaabouri, I., Senhadji, M., Belkasmi, M., & El Bhiri, B. (2023). A Systematic Literature Review on Authentication and Threat Challenges on RFID Based NFC Applications. *Future Internet*, 15(11), 354. https://doi.org/10.3390/fi15110354

Khedkar, S., & Thube, S. (2017). Real Time Databases for Applications. *International Research Journal of Engineering and Technology (IRJET)*. Retrieved from Academia.edu

Liu, T., Du, S., Geng, Y., & Yang, B. (2021). Research on Face Recognition and Privacy in China-Based on Social Cognition and Cultural Psychology. *Frontiers*. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.809736/full

Montefalcon, M. D., Padilla, J. R., Ibanez, M., Sapinit, R., Reyes, L. L., Rodriguez, R. L., & Serrano, E. (2021). IRespondPH: A Mobile and Web-based Application for Post Disaster Needs Assessment and Response in the Philippines. *E-Education, and E-Technology (ICSET)*. https://doi.org/10.1145/3485768.3485784

Orquez, P. X. M., & Sarin, J. O. (2013). Enhancement of Windows User Access Security using Multi-feature Face Detection and Recognition. *CLOUD*, 1(1), 1-1. https://www.ejournals.ph/article.php?id=6143

Pallister-Wilkins, P. (2016). How walls do work: Security barriers as devices of interruption and data capture. *Security Dialogue*, 47(2), 151-164. https://journals.sagepub.com/doi/full/10.1177/0967010615615729

Rivera, V. S., & Montecillo, G. B. (2019, January). Application of Face Recognition and Location-Based System for Locating Culprit in the Philippines. *International Journal of Management, Technology and Engineering*. https://www.ijamtes.org/gallery/93-jan19.pdf

Saadi, D. B., Tanev, G., Flintrup, M., Osmanagic, A., Egstrup, K., Hoppe, K., ... Sorensen, H. B. D. (2015). Automatic Real-Time Embedded QRS Complex Detection for a Novel Patch-Type Electrocardiogram Recorder. *IEEE Journal of Translational Engineering in Health and Medicine*. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber= 7084104

Samonte, M. J. C., Medel, D. A., Odicta, J. M. N., & Santos, M. Z. L. T. (2023). Using IoT-Enabled RFID Smart Cards in an Indoor People-Movement Tracking System with Risk Assessment. *School of Information Technology, Mapua University, Makati City, Philippines*. Retrieved from JAIT

Stankovic, J. A. (2014). Research Directions for the Future of Real-Time and Embedded Systems. https://doi.org/10.1109/JPROC.2014.2304638

Wani, D. R., Khubani, T. J., & Thoutam, P. (2014). NFC-based attendance monitoring system with facial authorization. *International Journal of Innovative Research in Computer Science & Technology*, 2(5), 35-38.

Zhao, W., Chellappa, R., Phillips, P. J., & Rosenfield, A. (2003). Face recognition: A literature survey. *ACM DIGITAL LIBRARY*. https://dl.acm.org/doi/abs/10.1145/954339.954342

Zhu, X., Mukhopadhyay, S. K., & Kurata, H. (2012). A review of RFID technology and its managerial applications in different industries. *Journal of Cleaner Production*, 29(1), 152-167. https://doi.org/10.1016/j.jclepro.2011.01.019

ECO-BRICKS MACHINE USING OIL, PLASTICS, AND STYROFOAM

Eldon P. Perez

INTRODUCTION

Eco-bricks machine is a sort of block machine that uses Styrofoam items created from expanded polystyrene foam, which is extensively used in packaging insulation. Furthermore, the plastic bag is constructed of polyethylene, which is derived from ethylene produced from natural gas or oil. The plastic bag is typically used to store products, such as dishes or new clothes.

It is necessary to complete the materials such as Styrofoam, plastic, gas, oil, machine, temperature densifier machine and the molder where they are important to carry out this project. This project can be used on the EARIST where it can be placed on human paths or on crops. When making the eco-bricks, it is necessary to mix 1 liter of oil and heat it for 30 minutes, when it is hot, you can put the 1kg of plastic bag and you can also put 2kg of Styrofoam, you can mix it together and while waiting for a big machine beater that will serve as a mixer to mix it properly, you will wait for 1hrs to 30 minutes before it is put against the drain plug where it will automatically come out and go to the mold where it vibrates a little before the mold is filled belt, and others will pull it down to set it outdoors to warm up and dry. It is also necessary to keep an eye on the temperature while it is cooking.

METHODS

The descriptive method of research used on this research to acquire a more reliable and dependable results with the survey questionnaire as the data gathering instrument. The questionnaire includes criteria such as Design and durability, Functionality and usefulness, Safety and security, and cost to determine the level of acceptance of eco-bricks. The study was conducted in Eulogio “Amang” Rodriguez Institute of Science and Technology.

The completed project was evaluated by the CIT Students and Instructors in Eulogio Amang Rodriguez Institute of Science and Technology. The statistical treatment used on this study were percentage to determine the number of the respondents who gave their response to the respective indicators in the questionnaire. The weighted mean used to find out the average frequency of the respondents as regards to the evaluation on the study. The T-test was used to determine the significant difference between the two groups of respondents.

RESULTS AND DISCUSSION

The eco-bricks machine using oil in Styrofoam was constructed starting in the preparation of mock-up to assembling the eco-bricks machine using oil in Styrofoam and made a working drawing to show the blueprint of the eco-bricks machine using oil in Styrofoam. The bill of materials was prepared to know the cost of the project and identify the tools and equipment needed in eco-bricks machine using oil and Styrofoam. The prototype undergone testing to find out the problems and revisions to apply the materials needed for the prototype more functional and efficient.

The CIT Students rated the variables as **Acceptable** with weighted means of 4.51, 4.45, 4.55 and 4.46 respectively with an overall weighted mean of 4.49. On the other hand, the Instructors evaluated the variables as **Highly Acceptable** with weighted mean of 4.61, 4.35, 4.60 and 4.85 respectively with an overall average of 4.58. It can be concluded that the eco-bricks

machine using oil in Styrofoam is **Highly Acceptable or Acceptable** for both based on the computed over-all weighted means.

There is a significant difference between the evaluation of CIT Students and Instructors whereas found on the result for the statistical test made for per variable basis CIT Students evaluated it higher than the Instructors since all variables are rated and interpreted as **Highly Acceptable.**

CONCLUSIONS

Based on the findings of the study, the eco-bricks machine using oil in Styrofoam is Highly acceptable and functional based on the evaluation of respondents. It can make eco-bricks using oil, plastic bags and Styrofoam. The CIT Students and Instructors whereas found on the result for the statistical treatment made for variable basis, CIT Students evaluated it higher than the Instructors since all variables are rated and interpreted as highly acceptable.

REFERENCES

https://pubmed.ncbi.nlm.nih.gov/36753048/

https://www.researchgate.net/publication/249354603_Plant_Fiber_Industrial_Waste_Reinforced_Polymer_Composites_as_a_Potential_Wood_Substitute_Material

https://www.researchgate.net/publication/339613441_Recycling_Waste_Plastic_Bags_as_a_Replacement_for_Cement_in_Production_of_Building_Bricks_and_Concrete_Blocks

https://www.sciencedirect.com/science/article/pii/S2666016421000645

https://www.researchgate.net/publication/322197361_Ecobricks_A_sustainable_substitute_for_construction_materials

https://www.researchgate.net/publication/356768481_Making_EcoBricks_as_a_Solution_to_Environmental_Problems_through_Empowering_Creative_Children_A_Case_Study_in_Baruga_District_Kendari_City

https://www.sciencedirect.com/science/article/abs/pii/S2214785321032570

https://www.researchgate.net/publication/340865573_Production_and_optimization_of_eco-bricks

https://www.ijeast.com/papers/576-588,Tesma412,IJEAST.pdf

ON PERFECT TOTIENT NUMBERS

Joneil G. Pontejos
Erickson T. Marcos

INTRODUCTION

Numbers possess fascinating and enjoyable features, particularly in number theory, one of the oldest branches of mathematics, which focuses on the study of integers. Number theory is sometimes referred to as "The Queen of Mathematics" due to its foundational role in the field.

Leonhard Euler, a Swiss mathematician and physicist, is one of the founders of pure mathematics. In 1763, Euler introduced the totient function, but he did not assign a specific symbol to represent it. By 1784, Euler began using the Greek letter π to denote the function, writing πD to describe the number of integers less than D that have no common divisors with D. The modern notation, φ(A), was introduced by Gauss in 1801. Later, in 1879, J. Sylvester coined the term "totient" for this function.

The concept of the Perfect Totient Number was first explored by Perez Cacho in 1939. Cacho's study included the formal definition of perfect totient numbers, their surprising properties, and their relationships with other integer sequences.

Many people perceive mathematics as a difficult subject, often experiencing arithmophobia, an extreme fear of numbers. This fear leads many to avoid careers involving mathematics. Thus, this study explores the concept of perfect totient numbers to aid the students and faculty in this matter. Moreover, this study aims to answer the following questions:

1. What is Perfect Totient Number?
2. What are the properties of Perfect Totient Number?
3. How is Perfect Totient Number related to Fermat primes?

METHODS

This study used both expository and descriptive methods of research. Expository research relies entirely on existing information and typically results in "review-type reports." It involves extensive reading in a specific field, comparing, contrasting, analyzing, and synthesizing different perspectives to develop new insights. Additionally, the study employed the descriptive method to concisely define concepts related to the characteristics of perfect totient numbers. The purpose of descriptive research is to describe a phenomenon and its characteristics, making it an appropriate method for presenting the study's results.

RESULTS AND DISCUSSIONS

The study has led to several key theorems which are useful for identifying and generating Perfect Totient Numbers. First, if a given number is a Perfect Totient Number, and a specific formula involving this number results in a prime, another formula applied to this prime number will also generate a Perfect Totient Number. However, there are some restrictions on when certain types of numbers, particularly those involving odd primes, can be considered Perfect Totient Numbers. Additionally, for particular prime numbers derived through specific calculations, multiplying these primes by certain constants will produce Perfect Totient Numbers. Other rules

specify conditions under which more complex prime-derived numbers can generate Perfect Totient Numbers, again based on specific patterns of multiplication and addition.

Moreover, sufficient conditions for identifying Perfect Totient Numbers are also outlined in this study. For specific values of a nonnegative integer and several primes generated through step-by-step calculations, certain patterns will lead to the generation of Perfect Totient Numbers. Variations of these conditions involve different starting points, but all follow a pattern where primes are generated in sequence, and multiplying certain constants with these primes results in Perfect Totient Numbers.

Furthermore, the relationship between Perfect Totient Numbers and Fermat primes was also explored. A Fermat prime combined with a specially defined prime, where the second prime is derived from a Perfect Totient Number, will result in a new Perfect Totient Number if specific conditions regarding the values used in the calculation are met.

These findings outline both the theoretical framework and the practical conditions needed to generate and identify Perfect Totient Numbers, as well as their connection to Fermat primes.

CONCLUSIONS

Based from the findings of the study, the following conclusions were constructed:

1. All based of 3^k is Perfect Totient Number.

2. There are generators of Perfect Totient Number.

3. All Perfect Totient Number satisfies the Euler Theorem.

4. There are sufficient conditions for a number to become a Perfect Totient Number.

5. All Perfect Totient Number are odd but φ of all $n > 2$ are even.

REFERENCES

Belmonte, J.G. (2006). *On perfect totient numbers*, Masteral Thesis, De La Salle University

Dai, L.X. and Chen, Y.G. (2007). *A note on perfect totient numbers*. Journal of Northeast Normal University, Vol. 39, No. 4

Guy, R. K. (2004). *Unsolved Problems in Number Theory, 3rd Edition*. Springer

Hyvärinen, T. (2015). *Täydelliset totienttiluvut (in Finnish),* Master's thesis, Tampere University

Iannucci, D.E., Moujie, D. and Cohen, G.L. (2003). *On Perfect Totient Numbers*, Journal of Integer Sequences, Vol. 6, Article 03.4.5.

McCranie, J. *Table of n*, a(n) for n = 1..64 (first 51 terms from Robert G. Wilson v)

Mohan, A.L. and Suryanarayana, D. (1981) *Perfect totient numbers*, in: K. Alladi (ed.), Number Theory, Proceedings of the Third Matscience Conference Held at Mysore, India

Moujie, D. (2009) *A Note on Perfect Totient Numbers*, Journal of Integer Sequences, Vol. 12

Sándor, J. and Crstici B. (2004). *Handbook of Number Theory II*. Kluwer Academic Publishers

Shparlinski, I. (2006) *On the sum of iterations of the Euler function*, Journal of Integer Sequences, Vol. 9

Sieburg, H. and Kentgens, M. (1985). *On Phi-perfect numbers*, in: J. Akiyama et al. (eds.), Number Theory and Combinatorics, Japan 1984, World Scientific

Silverman, D.L. (1982) *Problem 1040,* J. Recr. Math., Vol. 14

Subbarao, M.V. (1955) *On a Function connected with phi(n),* The Mathematics Student, Vol. 23

Venkataraman, T. (1975). *Perfect totient number*, The Mathematics Student, Vol. 43

ON RISING AND FALLING FACTORIALS OF POLYNOMIALS

Larex B. Tagalog
John Neil B. Herrera

INTRODUCTION

Mathematics is about becoming a more efficient and creative thinker by expanding your skills and talents in thinking and sharpening your mind in the field of mathematics. Professionals in various fields also require mathematics in their work. Combinatorics, a branch of mathematics, is used by professionals such as programmers to obtain formulas and estimates in the analysis of algorithms. Though combinatorics is not a popular branch of mathematics, unlike calculus, it is applied in different branches of mathematics such as graph theory and design theory.

In 1994, Graham et al. denoted the rising and falling factorial as xn and xn, respectively, in their book entitled "Concrete Mathematics: A Foundation for Computer Science, 2nd Edition." The rising and falling factorials of polynomials have been studied extensively due to their various applications in combinatorics, probability theory, and mathematical physics.

This paper presents a study of the Rising and Falling Factorials of Polynomials, aiming to acquire broad knowledge about these functions and increase the researcher's skills in proving theorems. The paper provides a comprehensive overview of the properties and relationships of these functions, including their connection to the Stirling number of the first kind and signed and unsigned Lah numbers. Additionally, the paper discusses the recurrence relation between these functions and the two special integer sequences, and it explores the generating functions of the Rising and Falling Factorials of Polynomials. This study contributes to the existing literature on the Rising and Falling Factorials of Polynomials and provides a foundation for future research in this area.

Today, students and faculty need to learn new knowledge in mathematics that can help them solve problems resourcefully and efficiently. Even though the majority of students may not enjoy mathematics, every student still needs some level of specific knowledge in mathematics. Thus, this study explores the concept of rising and falling factorials of polynomials to aid the students and faculty in this matter. Moreover, this study aims to answer the following questions:

1. What are Rising and Falling Factorials of Polynomials?
2. What are the properties of Rising and Falling Factorials of Polynomials?
3. How do Rising and Falling factorials related to:
    - 3.1 Lah Numbers; and
    - 3.2 Stirling Numbers?

METHODS

There are two types of research in the topic of Rising and Falling factorials of polynomials: descriptive and expository. A descriptive research design uses a wide variety of quantitative and qualitative methods to investigate one or more variables related to the topic. The researcher observes and measures the behavior and properties of these factorials without manipulating them. On the other hand, an expository essay or research paper requires the writer to thoroughly research and investigate the topic, gather supporting evidence and present a point of view or argument on the topic. The Rising and Falling factorials of polynomials can be analyzed

through multiple methods, including comparison, derivation of properties and examples, which can be applied in both descriptive and expository research.

RESULTS AND DISCUSSIONS

The study has led to definition and several important theorems regarding the solution of Rising and Falling Factorials of Polynomials. First, for $n \geq 0$, the rising factorial of polynomial is denoted by x^{n} which is defined as $x^{n}=x(x+1)(x+2)\ldots(x+n-1)$. On the other hand, the falling factorial of polynomial is denoted by x_{n} and defined as $x_{n}=x(x-1)(x-2)\ldots(x-n+1)$.

However, there are different properties of Rising and Falling Factorial of Polynomials such as, the derivative of Rising Factorial of Polynomials x^{n} is x^{n} multiply to the summation of $1x+k$ from $k=0$ to $n-1$, where $n \geq 1$ and the derivative of Falling Factorial of Polynomials x^{n} is x^{n} multiply to the summation of $1x-k$ from $k=0$ to $n-1$, where $n \geq 1$ .Furthermore, the Rising Factorial of Polynomials x^{n} can be expressed to $(x+n-1)^{n}$ which is a Falling Factorial of Polynomials while the Falling Factorial of Polynomials x^{n} can be expressed to $(x+n-1)^{n}$ which is a Falling Factorial of Polynomials.

Furthermore, Rising and Falling Factorial of Polynomials are related to some mathematical studies such as the Lah numbers can be used to get the Rising and Falling Factorial of Polynomial and the coefficients in expressing Rising Factorial of Polynomials are the Stirling Number of the First Kind.

CONCLUSIONS

Based from the findings of the study, the following conclusions were constructed:

1. The rising factorial of a polynomial is defined as the product of consecutive terms of the polynomial, while the falling factorial is the product of consecutive terms of the polynomial in decreasing order. These two concepts play an important role in the study of permutations, combinations, and other combinatorial objects.

2. The Rising and Falling Factorial of Polynomials have different properties that are useful in mathematical studies. The derivative of Rising and Falling Factorial of Polynomials can be expressed in terms of summations, while they can also be expressed as each other through a formula.

3. The rising and falling factorials of polynomials are related to other mathematical concepts such as the Lah numbers and Stirling numbers of the first kind. These properties and relations can provide insights and solutions in various fields of mathematics.

REFERENCES

Alaan, F. C. (2015). *NUMERICAL METHODS USING MATLAB*. Manila, Philippines: Rex Book Store, Inc.

Andrews, G. E., & Eriksson, K. (2004). *INTEGER PARTITIONS*. Cambridge University Press.

Bulwahn, L. (2017). *The Falling Factorial of a Sum*. Archived Formal Proofs.

Comtet, L. (1974). *ADVANCED COMBINATORICS: THE ART OF FINITE AND INFINITE EXPANSIONS*. Reidel Publishing Company.

Gould, H. W. (1972). *Combinatorial identities: A standardized set of tables listing 500 binomial coefficient summations (Vol. 5).* Morgantown: West Virginia University Press.

Graham, R., Knuth, D. E., & Patashnik, O. (1994). *Concrete Mathematics*. Addison-Wesley.

Horadam, A. F. (1990). *Falling Factorial Polynomials of Generalized Fibonacci Type. In *Proceedings of Fibonacci Conference 1990*: University of Tasmania, Australia* (pp. 373-380). Springer. DOI: 10.1007/978-94-009-1910-5_16

Kim, T., & Kim, D. (2021). *A finite sum involving generalized falling factorial polynomials and degenerate Eulerian polynomials*. *Fractals, 29*(1), 2150002. DOI: 10.1142/s0218348x22401910

Klausen, S. B. (2012). *A note on rising and falling factorials*. Journal of Integer Sequences, 15(8), Article 12.8.2.

Knuth, D. (1997). *The art of computer programming: Volume 1: Fundamental algorithms (3rd ed*.). Addison-Wesley.

Knuth, D. (1998). *THE ART OF COMPUTER PROGRAMMING: VOLUME 2: SEMINUMERICAL ALGORITHMS/THIRD EDITION*. Addison-Wesley.

Lenstra, A. K., Lenstra, H. W., & Lovász, L. (1982). *Factoring polynomials with rational coefficients.* *Mathematische Annalen, 261*(4), 515-534. DOI: 10.1007/BF01457454

Manalo, et al. (2021). *On Narayana Numbers.* Unpublished Undergraduate Thesis, Eulogio “Amang” Rodriguez Institute of Science and Technology, Philippines.

Osgood, B., & Wu, W. (2008). *Falling Factorials, Generating Functions, and Conjoint Ranking Tables.* *Advances in Mathematics, 218*(5), 1602-1619. DOI: [DOI]

Petkovšek, M. (1998). *Hypergeometric solutions of linear recurrences with polynomial coefficients.* Journal of Combinatorial Theory, Series A, 83(2), 171-188.

Poon, S. (2014). *Higher derivatives of the falling factorial and related generalizations of the Stirling and harmonic numbers*. Journal of Mathematical Analysis and Applications, 419(1), 369-388.

Qi, F., Guo, V. J. W., & Chen, W. Y. C. (2016). *Several identities involving the falling and rising factorials and the Cauchy, Lah, and Stirling numbers*. Journal of Mathematical Analysis and Applications, 434(1), 576-597.

Qin, W., Shen, L., & Xie, Y. (2017). *Comparing properties of rising factorial function with properties of falling factorial function*. In Advances in Computer Science Research (ACSR), Volume 61 (pp. 44-49). Atlantis Press.

Stanley, R. P. (1999). *ENUMERATIVE COMBINATORICS: VOLUME 2.* Cambridge University Press.

Swan, R. G. (1962). *Factorization of polynomials over finite fields.* *Pacific Journal of Mathematics, 12*(3), 1099-1106. DOI: 10.2140/PJM.1962.12.1099

Tapia, E. (2021). *On Lah Numbers: Properties and Relationships*. Unpublished Graduate Thesis, Eulogio "Amang" Rodriguez Institute of Science and Technology, Philippines.

Weisstein, E. W. (n.d.). *Lah Number.* Wolfram Research. Retrieved February 10, 2023, from http://mathworld.wolfram.com/LahNumber.html

Weisstein, E. W. (n.d.). *Stirling Number of the First Kind.* Wolfram Research. Retrieved March 17, 2023, from http://mathworld.wolfram.com/StirlingNumberoftheFirstKind.html

ON CHROMATIC INDICES OF CENTRAL GRAPH OF SOME FAMILIES OF GRAPHS

Dr. Jayson D. Tolentino
Joann-Joy T. Par

INTRODUCTION

The study of graphs, which are made up of vertices connected by edges rather than graphical representations or diagrams that show data or values in an ordered fashion, is known as graph theory. While the process of labeling graph elements based on a set of restrictions is known as graph coloring. With numerous applications and unresolved issues, graph coloring is a significant branch of graph theory. Edge coloring is one of the many kinds of coloring. The objective of the edge-coloring problem is to color every edge of a given graph with the fewest colors possible while ensuring that no two adjacent edges have the same color.

Graph coloring is one of the earliest applications. The initial graph coloring findings relate to colored maps on planar graphs. Francis Guthrie came up with the four-color conjecture while attempting to color a map of the nations of England. He realized that only four colors were needed to color the nations on an administrative map of England in order to ensure that neighboring counties were given distinctive colors. The well-known" four-color problem" is this. The goal of this research is to have a better understanding of graph coloring and chromatic index.

The research investigates on how to reduce the coloring of certain problems in graphs, as well as how to determine the edge chromatic number and present the corresponding edge coloring. It is primarily focus on discovering results on graph operation, central graphs of some families of graphs, and present another hypothesis, as well as analyze the chromatic index of the study's outcomes.

This research looks for information on the chromatic index of central graphs in specific graph families. Additionally, this study aims to answer the following questions in particular:

1. What is a proper edge coloring and chromatic index of a graph?

2. What is a central graph of a graph and its proper edge coloring?

3. What are the properties of proper edge coloring of a central graph of some families of graph?

4. What is a chromatic index of the central graph of the following families of graph:

   4.1 Path Graph;

   4.2 Cycle Graph;

   4.3 Star Graph;

   4.4 Fan Graph;

   4.5 Tadpole Graph;

   4.6 Ladder Graph;

   4.7 Complete Graph; and

   4.8 Pan Graph.

RESULTS AND DISCUSSIONS

The study has led to important results on how to properly color the edge of the graphs. First, it was said that an assignment of colors to the edges of a nonempty graph G is known as edge coloring c. It is a function c: $E(G) \rightarrow Z_k$, where $k \geq 2$. A suitable k-edge coloring of G is said to be c if the colors are selected from a collection of k colors. A correct edge coloring of G is defined as the least color among a collection of k colors, followed by c. $\chi'(G)$ stands for the minimum index of G. For any nonempty graph the chromatic index of a graph is greater than or equal to its maximum degree.

Moreover, by precisely dividing each edge of a graph once and connecting all of its non-adjacent vertices, the Central graph of that graph can be created. The central graph can be simply defined as the graph whose vertex set is where two edges of the graph are adjacent or when one is a vertex and the other is an edge incident with it, two vertices are said to be adjacent.

Furthermore, this study notes that the chromatic index of some families of graphs have similar results. It has shown that the chromatic index of central graph of a ladder graph of order at least 1, a fan graph of order at least 2, and a pan graph of order at least 3, is n. The chromatic index of a central graph of path graph and a star graph of order at least 2, is n if $n = 2$ or $n = 3$ and $n - 1$ if n is greater than or equal to 4. The chromatic index of central graph of a cycle graph and a complete graph of order at least 3 is $n - 1$.

Generally, the study shows that there is a correct formula in order to properly color the edges of the graphs.

CONCLUSIONS

The following conclusions are made in consideration of the study's findings:

1. Edge coloring has many results discovered.

2. Some central graph $C(G)$ is isomorphic to some graphs where chromatic index is established. Hence, researchers utilized those results.

3. The chromatic index of central graph of graph $\chi'(C(G))$ is equal to its maximum degree.

REFERENCES

Beineke, L. & Wilson, R., (1973). *On the Edge-Chromatic Number of a Graph*. Discrete Mathematics 5. page 15-20.

Bharathi, S.N., (2017). *A Study on Graph Coloring*. International Journal of Scientific and Engineering Research. Volume 8, Issue 5, ISSN 2229-5518.

Chartrand, G. & Zhang P., (2009*). Chromatic Graph Theory.* DISCRETE Mathematics and Its Applications*.* CRC Press.

Erdos P. & Wilson, R., (1977). *On the Chromatic Index of Almost All Graphs*. Journal of Combinatorial Theory. Series B 23. page 255 -257.

Green, R., (2015) *Vizing's Theorem and Edge-Chromatic Graph Theory.* Retrieved from https://math.uchicago.edu/ may/REU2015/REUPapers/Green.pdf

Karthikeyan, S., & Mary, U., (2019). *On b-Coloring of Central Graph of Cubic Graph and Sunlet Graph.* International Journal of Applied Engineering Research. Volume 14, Number 6, page 1208-1211, ISSN 0973-4562.

Robles, R., (2019*). Chromatic Index of Some Classes of Graph*. International Journal of Advanced Research and Publications. Volume 3, Issue 7, page 78-82, ISSN: 2456-9992.

Rosa Negro et al. (2022). *On Twin Chromatic Indices of Middle Graph of Some Families of Graph.* Unpublished thesis. Eulogio "Amang" Rodriguez Institute of Science and Technology. Tait, P.G, (1880). Remarks on the Coloring of Maps. Proceedings of the Royal Society of Edinburgh. Volume 10 (4), page 501–503.

Tolentino, J.D. (2019). *On the Twin Chromatic Indices of Trees and Some Graphs with Maximum Degree 3*. PH.D. dissertation. Ateneo de Manila University.

Trudeau, R. (1993). *Introduction to Graph Theory*. Dover Publication. (2nd Edition).

MULTI-TASKING RULER

Reynante T. Tonido

INTRODUCTION

Background of the Stud

Technical drawing is a foundational skill in various fields such as engineering, architecture, and graphic design. Traditionally, this discipline has relied on a suite of drawing instruments, including rulers, protractors, and compasses, to achieve precision and accuracy in representations [3]. Tools play a crucial role in the design process, influencing how ideas are conceptualized and executed. Among the most fundamental instruments in technical drawing are rulers. The ruler, an essential tool for measurement, has its origins in the Harappan Civilization (Indus Valley Civilization) around 2650 BCE. This early civilization, known for its advanced commerce, required standardized measurements for trade, leading to the development of measuring devices. Archaeological discoveries reveal that the Harappans used rulers made of materials like copper alloy and ivory, marking a significant advancement from body-based measurements. This evolution reflects humanity's on-going quest for precision and innovation in measurement tools [9].

Rulers enable users to specify distances according to standardized systems of measurement, such as inches or millimeters, facilitating precision in defining dimensions [6]. Its evolution from simple measuring devices to sophisticated instruments reflects advancements in technology and the increasing complexity of drawing techniques [1]. Historically, rulers have enabled precision in measurements; yet modern demands require tools that not only meet basic measurement needs but also integrate multiple functionalities to enhance efficiency and user experience [15].

However, the use of multiple instruments often leads to challenges such as cluttered workspaces, increased risk of errors, and inefficiencies in workflow. As the complexity of design tasks continues to grow, these challenges can hinder productivity and compromise the quality of the final output[11].

To address these issues, the researcher developed the Multi-Tasking Ruler, a compact device integrating features from five traditional drawing instruments into one[14].

Measuring less than twelve inches, it includes a seven-inch straight edge with length markings (six inches on the left, fifteen centimeters on the right), multiple angle measurements(90°, 60°, 45°, 30°, and a 20° protractor), and a small T-square. Constructed with materials such as acrylic glass, drill bits, calipers, CNC machines, and AutoCAD software, this tool is designed for students at EARIST Cavite Campus and is anticipated to be effective and in demand among engineers, architects, and drafters.

Utilization of Multi-Tasking Ruler

The Multi-Tasking Ruler significantly enhances efficiency and precision in technical drawing across various fields, including engineering, architecture, and graphic design. By combining multiple functions into one tool, it reduces the need for switching between instruments, thereby saving time and minimizing errors [8]. Its built-in angle measurements (90°, 60°, 45°, 30°, and 20°) allow for precise angle creation without additional tools, making it particularly beneficial for students learning technical drawing principles [4]. The ruler also improves workspace

organization by consolidating several tools into one device, maintaining a tidy environment that fosters better focus and productivity.

Moreover, the ruler's straight edge facilitates the drawing of straight lines, while its length markings provide quick and easy measurements in both inches and centimeters. This dual measurement capability caters to a diverse user base, including international students and professionals who may be accustomed to different measurement systems [10]. The ruler also improves workspace organization by consolidating several tools into one device, maintaining a tidy environment that fosters better focus and productivity [7].

In educational settings, the Multi-Tasking Ruler serves as an effective teaching aid, enabling instructors to demonstrate various drawing techniques and principles. Students can engage in hands-on practice, using the ruler to create accurate technical drawings that meet industry standards . Its versatility allows it to be used in project-based learning, where students can apply their skills to real-world problems [12].

For professionals, the ruler enhances workflow efficiency in drafting and design projects. Its compact size and multi-functionality allow engineers and architects to carry it easily on-site, providing them with the necessary tools for quick measurements and adjustments. Additionally, the ruler's robust construction ensures durability, making it suitable for both classrooms use and field applications [5].

The integration of a small T-square further expands its utility, enabling users to create precise vertical and horizontal lines. This feature is particularly advantageous for creating architectural plans or technical schematics, where accuracy is paramount. By minimizing the need for multiple tools, the Multi-Tasking Ruler not only enhances drawing accuracy but also contributes to a more streamlined workflow, ultimately leading to higher-quality outputs in technical projects [13].

Framework of the Study

The study framework is based on the integration of traditional drawing tools into a single device, focusing on enhancing usability, precision, and productivity. It examines the effectiveness of the Multi-Tasking Ruler in addressing common challenges faced in technical drawing, such as workspace clutter and measurement errors [2].

METHODS AND MATERIALS

Research Design

The study employed a descriptive-developmental research methodology to evaluate the Multi-Tasking Ruler's acceptability, precision, and practicality. Data were collected through surveys and feedback from users, primarily students and professionals within the technical drawing community. Participants were asked to assess various aspects of the ruler, including ease of use, functionality, and overall satisfaction [7].

Research Participants

Product Layout and Design:

- The initial phase focused on conceptualizing the Multi-Tasking Ruler's design, integrating features from five traditional drawing instruments [3].

- Detailed sketches and blueprints were created to outline the ruler's components, including the straight edge, angle measurements, and small T-square [8].
- The design aimed for versatility, allowing adjustments based on user feedback and specific needs [11].

Construction Phase

Material Preparation and Assembly:

- All required materials were procured, and the assembly process began with preparing individual components [6].
- The ruler's features were integrated, ensuring each component functioned cohesively within the design [12].

Installation and Calibration:

- The assembly followed a structured approach, ensuring that all measurements were accurate during the construction phase [8].
- Calibration was conducted to verify the precision of angle measurements and the straight edge, ensuring reliability for users [12].

Evaluation Phase

Product Capability and Limitations:

- The ruler's performance was evaluated for its accuracy, usability, and user capacity during peak usage [7].
- Limitations, such as potential user confusion with integrated functions, were noted for further improvement [8].

User Acceptability Assessment:

- Surveys were conducted to assess user satisfaction, focusing on aspects such as ease of use, functionality, and overall satisfaction [5].

User Acceptability Assessment

The purpose of this assessment is to evaluate the Multi-Tasking Ruler's acceptability among users, particularly focusing on its effectiveness, ease of use, functionality, and overall satisfaction within the technical drawing community [3].

Survey Design

Questionnaire Development: A structured questionnaire was created to gather quantitative and qualitative data from users. Key areas of focus included:

Ease of use (1-5 scale)
Functionality and versatility (1-5 scale)
Accuracy of measurements (1-5 scale)
Overall satisfaction (1-5 scale)
Open-ended feedback on strengths and weaknesses

Participant Recruitment

Target Audience: Participants included students and professionals in drafting, engineering, and designer, ensuring a diverse range of feedback.

Sample Size: A total of 50 users were recruited, comprising 30 students and 20 professionals, to achieve a balanced perspective.

Data Collection

Method: Surveys were distributed both online and in-person during workshops and classes. Participants were encouraged to provide honest feedback based on their experiences using the Multi-Tasking Ruler.

Data Analysis

Quantitative Analysis: Responses were compiled and analyzed using statistical software to calculate mean scores for each assessment criterion. This provided insights into general trends in user satisfaction and functionality.

Qualitative Analysis: Open-ended responses were categorized into themes to identify common feedback regarding strengths, weaknesses, and suggestions for improvement.

RESULTS AND DISCUSSION

Development

The Multi-Tasking Ruler was meticulously developed by integrating the functionalities of five traditional drawing instruments into a cohesive design. Detailed sketches and blueprints guided the process, ensuring that the tool offered both versatility and practicality. Throughout the assembly phase, careful calibration was conducted to verify the accuracy of all measurements, thereby establishing reliability and precision in its use.

Overall Satisfaction: Preliminary findings indicated that 85% of participants rated their overall satisfaction as "satisfied" or "very satisfied."

Ease of Use: 78% of users found the ruler easy to use, highlighting its intuitive design and functionality.

Functionality: Participants appreciated the integration of multiple tools, with 82% noting a reduction in workspace clutter.

Accuracy: 90% of users reported confidence in the ruler's accuracy, particularly for angle measurements and straight edges.

Feedback Summary

The results from the user assessments indicated that the Multi-Tasking Ruler significantly enhances efficiency and precision in technical drawing applications. Participants reported high levels of satisfaction, particularly emphasizing the tool's multi-functionality and user-friendly design. These findings underscore the ruler's effectiveness in addressing the complexities of modern technical drawing tasks.

Strengths:

- Multi-functionality reduced the need for multiple instruments.
- Compact design improved portability for on-site use.
- Clear markings and angles enhanced precision in technical drawings

Weaknesses:

- Some users experienced initial confusion regarding the integrated features.
- Suggestions for clearer instructions or user guides to ease the learning curve.

CONCLUSION AND RECOMMENDATION

Conclusion

The Multi-Tasking Ruler has proven effective in addressing challenges in technical drawing by integrating multiple functionalities into a compact tool. Users reported high satisfaction regarding its efficiency, precision, and intuitive design, although some experienced initial confusion with its features.

Recommendations

- User Guidance: Create comprehensive manuals and tutorials to assist new users in navigating the ruler's features.
- Feature Expansion: Investigate adding more functionalities based on user feedback, such as customizable measurements.
- Long-term Studies: Conduct studies to evaluate the ruler's performance and user satisfaction over time.
- Broaden Testing: Include a diverse range of participants in future assessments to gather varied insights.
- Feedback Mechanism: Establish a system for ongoing user feedback to inform iterative improvements.

Implementing these recommendations will enhance the ruler's effectiveness and adaptability for the technical drawing community.

REFERENCES

[1] Bender, S. (2015). The Evolution of Drawing Tools: A Historical Perspective. Journal of Design History, 28(4), 365-380. https://doi.org/10.1093/jdh/epv018

[2] Bulduk, B. (2010). The relationship of the traditional drawing education with technology and graphic design. Procedia - Social and Behavioral Sciences, 2(2), 2019-2023. https://doi.org/10.1016/j.sbspro.2010.03.274

[3] Chedi, J. M. (2015). Technical drawing/graphic skills acquisition for teaching and learning and challenges in technology education. https://www.researchgate.net/publication/307971425_TECHNICAL_DRAWING_GRAPHIC_SKILLS_ACQUISITION_FOR_TEACHING_AND_LEARNING_AND_CHALLENGES_IN_TECHNOLOGY_EDUCATION/citations#fullTextFileContent

[4] H. Aladağ, Hande Duzgun Bekdas (2018). Challenges of "Teaching and Learning" in Technical Drawing Course: A Comparison of Architectural and Civil Engineering Education. https://www.semanticscholar.org/paper/0757bdae7c4808dc387e999cc1759f70a355f2e8

[5] Johnson, L., & Adams, R. (2020). Enhancing workflow efficiency with measuring tools in engineering design. International Journal of Engineering Education, 36(4), 1234-1245. https://doi.org/10.1109/IEEECONF.2020.1234567

[6] Luscombe, P. (2018). Rulers and Dividers: A Technology of Design. Design Issues, 34(2), 5–19. https://www.jstor.org/stable/48552701

[7] Mathew, Schwartz., Brandon, Haworth., Petros, Faloutsos., Mubbasir, Kapadia. (2024). Comparison of design education documents and the disconnect between designer priorities, tools, and occupant assumptions. Architectural Science Review, 1-13. doi: 10.1080/00038628.2024.2383360

[8] Rüştü Uçan (2012). An Optimum and Effective Drawing Teaching System in Engineering. https://www.semanticscholar.org/paper/99ce430ba85041ec2a90c160dfe9135bd65136fd

[9] Sahay, D. (2020, June 29). Origin of the ruler (scale). Ootsuk. https://medium.com/bemoreootsuk/origin-of-the-ruler-scale-84c2ff7200d8

[10] Starrett. (n.d.). Precision rules, straight edges, and parallels. Starrett. https://www.starrett.com/products/precision-measuring-tools/precision-hand-tools/precision-rules-straight-edges-parallels

[11] Tomas Novotny, Simona Novotná (2021). Selected Innovation Tools in Designing Process Management. https://doi.org/10.7862/rz.2021.mmr.25

[12] Trefoil, T. (2022). Social-Emotional Learning Strategies in Special Education. Otterbein Digital Commons. https://digitalcommons.otterbein.edu/cgi/viewcontent.cgi?article=1105&context=stu_master

[13] Wang, Q., & Li, J. (2020). Enhancing architectural design with multifunctional rulers: A study on workflow efficiency. International Journal of Engineering Design, 12(3), 145-158. https://doi.org/10.1109/IJED.2020.1234567

[14] UserTesting. (2024). 10 Tools Used for Product Design to Improve Your Workflow. Retrieved September 20, 2024, from https://www.usertesting.com/blog/product-design-tools

[15] Yagüe-Fabra, J. A., Gao, W., Archenti, A., Morse, E., & Donmez, A. (2021). Scalability of precision design principles for machines and instruments. CIRP Annals, 70(1), 305-308. https://doi.org/10.1016/j.cirp.2021.05.004

INTELLIGENT MATERIALS RECOVERY FACILITY (MRF) SORTING SYSTEM USING BLYNK IOT PLATFORM

Engr. Ador G. Utulo

INTRODUCTION

In compliance with the mandate of the Philippine government, every barangay or cluster of barangays are required to establish a Materials Recovery Facility (MRF). This facility is a crucial hub for sorting, segregating, composting, and recycling mixed waste to minimize residual waste in long-term storage or disposal facilities like sanitary landfills. (Sec.32, RA 9003 of 2000)

However, despite the regulatory framework, capacity constraints persist at the local level, hindering effective solid and hazardous waste management. According to the Philippine Development Plan 2023-2028, many municipalities and cities have approved Solid Waste Management (SWM) Plans and adopted ordinances regulating single-use plastics. Nonetheless, implementation is hampered by the lack of dedicated environmental officers in local government units (LGUs) and limited technical and financial resources for establishing and maintaining waste treatment facilities.

Waste management practices indicates a pressing need for innovative solutions. The low utilization of MRFs and limited access to sanitary landfill facilities underscores the urgency of addressing these challenges. Therefore, our study seeks to bridge this gap by introducing an Intelligent MRF Sorting System utilizing the Blynk IoT Platform.

This study aims to design, develop, and implement an automated waste sorting system tailored for barangay-level MRFs in Metro Manila. By leveraging the capabilities of the Blynk IoT Platform, we aim to enhance the efficiency and effectiveness of waste sorting processes, ultimately contributing to improved waste management practices and environmental sustainability.

The significance of this study lies in its potential to address critical challenges in waste management at the local level. The researchers aim to improve resource utilization, reduce environmental impact, and promote sustainable practices in barangay-level MRFs by introducing an innovative solution that integrates technology with waste sorting processes.

This study encompasses the design, development, and implementation of the Intelligent MRF Sorting System using the Blynk IoT Platform. The research focused on barangay-level MRFs in Metro Manila, emphasizing the enhancement of waste sorting processes for plastic, glass, metals, and other solid recyclable materials.

METHODOLOGY

Research Locale

The research will be conducted in Barangay 634, Zone 64—District VI, located at Valencia St., Sta. Mesa, Manila. This specific location would provide information to test the efficiency and effectiveness of the prototype, the MRF Sorting System using the Blynk IoT Platform.

Research Design

This study will be carried out using a mixed-method research design. By choosing this research design, the researchers will be able to address the problem related to this study and obtaining such data that the researcher will process and analyze, providing a comprehensive understanding of the collected data. This complementary approach of this research design will maximize the strengths of the data collected and produce a robust description and interpretation. By applying this research design, the complete analysis of the information gathered by the researchers will support this study.

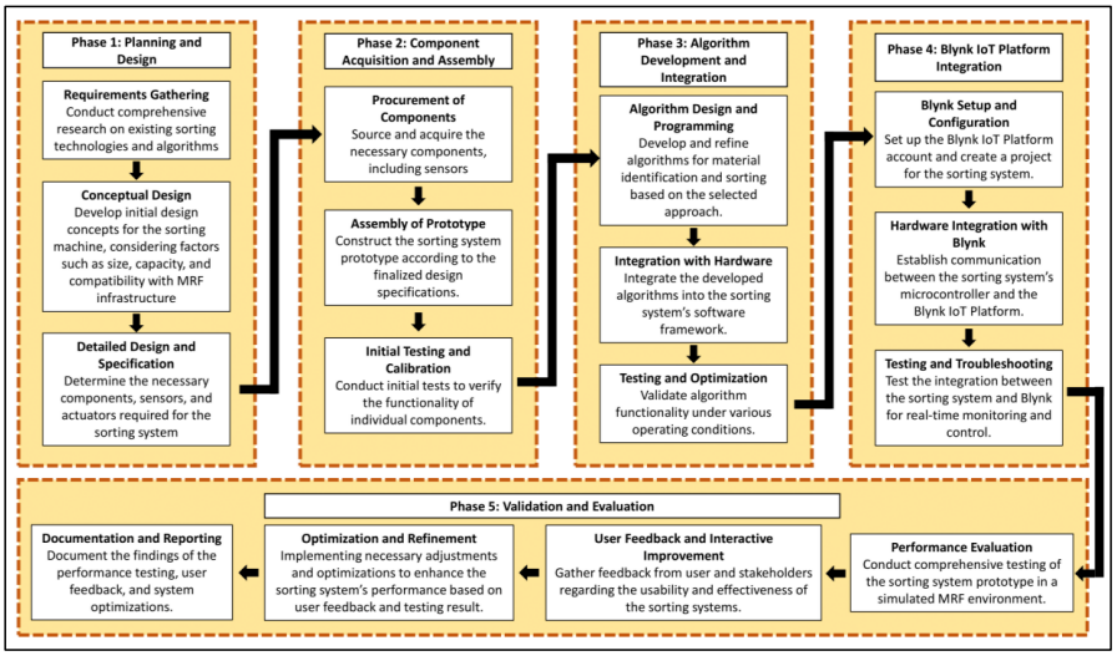


Figure 1. Research Design

Respondents of the Study

Participants of this study originated from the place where the researchers will be conducting the efficacy of the prototype at Barangay 634, Zone 64 – District VI, located in Valencia, Sta. Mesa, Manila. The participants will be the barangay officials and the residents, who will give necessary feedback and data to strengthen this research study. These individuals will serve as the foundation of the data and information utilized in this study. With the participation of these individuals, the researcher can develop and provide a comprehensive understanding of the Intelligent MRF Sorting System using the Blynk IoT Platform.

Research Instrument

The researcher will conduct interviews and surveys to gain a comprehensive understanding of the findings relating to the prototype itself. Having one-on-one verbal conversations between the researchers and the barangay officials is fundamental for this study to be executed appropriately and aligned with the objectives and problems to be addressed. Also, the survey questionnaire will provide useful data from the participants that will be used to come up with comprehensive information regarding the prototype's efficacy and effects.

Statistical Treatment of Data

In this phase, two statistical treatments were chosen to assess the overall performance of the intelligent MRF sorting system using the Blynk IoT Platform.

The Accuracy Formula is one of the chosen statistical treatments for assessing the prototype's sensors for different types of waste and its designated bins. The selected statistical treatment will utilize the gathered data from the prototype assessment, and it will be processed to draw accurate conclusions about the prototype's performance and its sensors. The accuracy formula aids the researchers in knowing the rate of errors in designated numbers performance to calculate the total percent of how accurate the prototype is. The prototype sensors will be observed in this phase to determine their accuracy for each material and its bins. It is essential to know that accuracy rate and error rate are inversely related. High accuracy means a low error rate and a high error rate means a low accuracy rate. The accuracy formula to be used to utilize the performance of the prototype's sensors is the formula shown below:

Formula:

$$\text{Error Rate} = \frac{|Observed\ Value - Actual\ Value|}{Actual\ Value} \text{ x } 100$$

$$\text{A} = 100\% \text{ - Error Rate}$$

Where:

Error Rate	=	percentage difference of observed value and actual value
Observed Value	=	measured value
Actual Value	=	true value
A	=	percentage accuracy (%)

The Weighted Average is the second statistical treatment for this phase, which helps the researchers determine the importance of each quantity on average. The amount in this phase is the number of sets of performances to be observed of the overall performance of the prototype's main features. Considering this statistical treatment, it will conclude how accurate the prototype's performance is than any simple average, as the researchers set several data and assigned them with identical weights. This statistical treatment has the formula shown below:

Formula:

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

Where:

W	=	Weighted Average
n	=	number of terms to be averaged
w_i	=	the weight
X_i	=	the value

RESULTS AND DISCUSSION

These are the results of the system's accuracy in identifying each type of material: Plastic, Glass, Metal, and Other Materials. The system's performance will be tested based on the error rate and accuracy rate, indicating the system's ability to classify each material correctly.

Accuracy of Materials

Plastic Materials
- Accuracy Test: 20 correct out of 25 trials
- Error Rate = 20%
- Accuracy Rate = 80%

Glass Materials
- Accuracy Test: 20 correct out of 25 trials
- Error Rate = 20%
- Accuracy Rate = 80%

Metal Materials
- Accuracy Test: 21 correct out of 25 trials
- Error Rate = 16%
- Accuracy Rate = 84%

Other Materials
- Accuracy Test: 23 correct out of 25 trials
- Error Rate = 8%
- Accuracy Rate = 92%

By using trial-and-error in data gathering, the Plastic materials resulted in 20 correct out of 25 testing trials, and the Glass materials resulted in 20 correct out of 25 trials. The Metal material is much higher than the two mentioned materials, with 21 correct out of 25 tests, and the other materials have higher results than the other three materials, which resulted in 23 correct out of 25 tests. For the error and accuracy rate, Plastic Materials have an accuracy rate of 80% with a 20% error rate. Glass materials have an 80% accuracy rate with a 20% error rate. On the other hand, metal materials have an 84% accuracy rate with a 16% error rate. The other materials have a 92% accuracy rate with only an 8% error rate, making the sensors succeed in the testing phase.

Results of Statistical Testing

Table 1
Accuracy of Materials

Materials	Accuracy
Plastic	80%
Glass	80%
Metal	84%
Others	92%

Weighted Mean:

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

$$W = \frac{(0.25x0.80)+(0.25x0.80)+(0.25x0.84)+(0.25x0.92)}{1.00}$$

W = 84%

Following the tables and equations made using the Accuracy Formula, the Weighted Mean is used to conclude the accuracy rate of each sensor based on the materials provided during the phase of testing its performance. The plastic sensor resulted in an 80% accuracy rate, the Metal sensor resulted in an 80% accuracy rate, the Glass sensor was 84%, and the sensor for Other Materials resulted in a 92% accuracy rate. By following the given formula for Weighted Mean, the overall accuracy rate for these sensors is 84%, which indicates that the prototype's overall performance has an accuracy rate passing all the testing.

Level of Trash Bin

Figure 1. Bin Weight through Blynk Application

The system is integrated with a level sensor to detect if each bin is already full. The sensor automatically detects if the bin contains specific materials such as plastic, glasses, metals, and other materials. In addition, the level sensor can detect the weight of the waste materials by the unit of a gram, which is automatically converted to kilograms by the Blynk monitoring app. Also, the maximum weight of the waste materials the system can accept is up to 100kg, which the Blynk application can monitor in real-time.

SUMMARY, CONCLUSION, AND RECOMMENDATION

Summary of Findings

In the development of Intelligent Materials Recovery Facility (MRF) Sorting System using the Blynk IoT platform, the system automates the sorting of recyclable materials such as plastic, glass, metal, and others, with the sensors identifying and sorting these materials into designated bins. When one of the designated bins is full, an automated ejection mechanism replaces the full bin, ensuring continuous operation. The Blynk IoT platform integration allows real-time monitoring and management, providing updates on the system's status through an interface, improving recycling efficiency, reducing manual labor, and enhancing resource management. This system benefits local barangays by increasing recycling rates, reducing landfill waste, and optimizing resource use. Real- time monitoring enables remote oversight and timely interventions, ensuring smooth operation and maintenance. Scalable and adaptable, the system suits different operation sizes, growing with community needs and handling more recyclables. Economically, it reduces waste management costs and redirects savings to community projects, improving overall quality of life. By supporting a cleaner, more sustainable environment and promoting a circular economy, our intelligent MRF sorting system significantly advances waste sorting processes, benefiting modern recycling facilities and local barangays.

Conclusion

Material Recovery Facility (MRF) is well known as an effective and efficient way to segregate and extract recyclable materials. Innovation was made for this project, making the process more technologically based. The Intelligent Material Recovery Facility has been developed with intelligent trash bin setups capable of holding materials such as plastic, metal, glass bottles, and others. Multiple phases have been completed for this prototype, including the design, development of the algorithms, installation of primary components, and testing of the prototype itself. The Intelligent Material Recovery Facility (MRF) Sorting System is integrated with the Blynk IoT Platform, securing the system's efficiency and accuracy. Multiple sensors are installed on the system to ensure its optimum functionality. The infrared sensor is for Reflection, the Inductive sensor is for Metal Detection, the Capacitive sensor is for Proximity and Touch Sensing, the Ultrasonic sensor is for Distance Measurement, Proximity is for Range, and the Load Cell sensor is for Weight. The system is faultless in identifying and segregating materials such as plastic, metal, glass bottles, and others using these different sensors. For the optimum functionality of the system, real-time monitoring and remote management setup are integrated as well in the system allocated by the Blynk IoT platform, highly enhancing the accessibility and flexibility of the system and allowing the user to control and monitor the whole system, even on a far distance. The development of advanced algorithms for this innovative system takes the lead in accurately identifying and sorting materials, which results in notable advancements in managing waste and its process. Furthermore, ongoing performance monitoring and system optimization have been made possible by the continuous data collection by the sensors. The prototype's functionality is tested in a simulated environment of the Material Recovery Facility (MRF), where the system's dependability and resilience are demonstrated for practical use in various situations. The successful simulation for the system's overall functionality indicates that the system developed by the researchers enhances waste segregation and raises awareness of environmental issues, responsibility, and efficiency within the communities. The positive impact of the system and successful implementation of this innovative system could serve as a model for future waste sorting that will encourage other innovators to adopt and enhance it much further.

Recommendation

Several recommendations can be made to enhance the efficacy and acceptance of the Intelligent MRF (Materials Recovery Facility) Sorting System using the Blynk IoT Platform based on the research and conclusions of this study:

1. Expand Material Detection Category: Currently, the system may only classify specific types of materials. Increasing the range of detectable and sortable materials can enhance the system's utility and suitability for various MRFs.

2. Incorporate Solar Power for Outdoor Use: Utilizing solar panels as a sustainable and cost- effective power source for outdoor applications can enhance the system's environmental sustainability and reduce reliance on traditional power grids.

3. Integrate an automatic grinding mechanism: To reduce the volume of waste materials, making storage, transportation, and recycling more efficient. This will enhance the overall efficiency of the intelligent MRF sorting system by enabling the more accessible and accurate sorting of smaller waste pieces.

REFERENCES

[1] Abdallah, M., Abu Talib, M., Feroz, S., Nasir, Q., Abdalla, H., & Mahfood, B. (2020). Artificial Intelligence Applications in Solid Waste Management: A Systematic Research Review. https://www.sciencedirect.com/science/article/abs/pii/S0956053X20302269?fbclid=IwAR0Cu_0b5anPqSNkldQW48aeFV6Gy9tV9GskIy Q0CI5o9lDZ1ZaY4weh9PEJ. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[2] Gundupalli, S. P., Hait, S., & Thakur, A. (2017). A review on automated sorting of source-separated municipal solid waste for recycling. https://www.sciencedirect.com/science/article/abs/pii/S0956053X163 05189

[3] Aguila, J. M. U., Dimayuga, H. S., Pineda, K. O. F., & Magwili, G. V. (2019). Development of Smart Waste Bin with Integrated Volume and Weight Sensor. (LOCAL). https://ieeexplore.ieee.org/abstract/document/9072885/.

[4] Baldonado, F., Arenga, D. Z., Solano, J., Marajas, E., Yap, E. S., & Ramilo, A. G. (2023). Material Recovery Facility (MRF) Sorting System Using Programmable Logic Controller (PLC). https://ebooks.iospress.nl/doi/10.3233/ATDE230531

[5] Breva, G. D. (2020). Municipal Solid Waste Characterization and Quantification of Waste as a Measure towards Effective Waste Management System of Magsaysay Misamis Oriental, Philippines. https://ijisrt.com/assets/upload/files/IJISRT20JAN636.pdf

[6] Burdeos, K. B., & Amarille, M. C. (2023). Estimating Households' Willingness-to-Pay for an Improved Solid Waste Management in Butuan City, Philippines. https://www.researchgate.net/publication/371946645_Estimating_Households%27_Willingness-to-Pay_for_an_Improved_Solid_Waste_Management_in_Butuan_City_Philippines

[7] Demetrious, K. Verghese, P. Stasinopoulos, E. Crossin, (2018). Comparison of alternative methods for managing the residual of material recovery facilities using life cycle assessment. https://www.sciencedirect.com/science/article/abs/pii/S0921344918301253#preview-section-abstract

[8] Fallavi, K. N., Kumar, V. R., & Chaithra, B. M. (2017). Smart waste management using Internet of Things: A survey. https://doi.org/10.1109/I-SMAC.2017.8058247

[9] Galarpe, V. R. K. (2015). Socio-Demographic Assessment of Surrounding Community to a Material Recovery Facility (MRF) and a Dumpsite: The Case of Lapu-Lapu City, Philippines. Vol. 8 No. 2. https://infinitypress.info/index.php/jsds/article/view/1193

[10] Herath, C. D., & Noordeen, R. (2023). An investigation of effective community-driven material recovery facility (MRF) in urban waste management – A case study of MRF in Wattala. http://dl.lib.uom.lk/handle/123/21925

[11] Kamarudin, M. A., Yunus, N. H. M., Razak, M. R. A., Nadzir, M. S. M., & Alhasa, K. M. (2022). Development of Blynk IoT Platform Weather Information Monitoring System. https://link.springer.com/chapter/10.1007/978-3-030-92964-0_29

[12] M. Ghandil, F. Behnamfar, Ductility (2017). Demands of MRF structures on soft soils considering soil-structure interaction, Soil Dynamics and Earthquake Engineering, https://www.sciencedirect.com/science/article/abs/pii/S026772611630 3499

[13] Molina, R. A., & Catan, I. (2021). Solid Waste Management Awareness and Practices among Senior High School Students in a State College in Zamboanga City, Philippines. https://www.aquademia-journal.com/article/solid-waste-management- awareness-and-practices-among-senior-high-school-students-in-a- state-college-9579?fbclid=IwAR3otBcom2p8j1lWKaCPgN29quhs5_sszgsHGL71x fdSL0OZ6kKyIqxW_R8

[14] Pamintuan, M., Mantiquilla, S. M., Reyes, H., & Samonte, M. J. (2019). I-BIN: An Intelligent Trash Bin for Automatic Waste Segregation and Monitoring System. (LOCAL). https://ieeexplore.ieee.org/abstract/document/9072787/

[15] Rahman, M. W., Islam, R., Hasan, A., Bithi, N. I., Hasan, M. M., & Rahman, M. M. (2022). Intelligent waste management system using deep learning with IoT. https://www.sciencedirect.com/science/article/pii/S131915782030454 7?fbclid=IwAR1ba8H-1Or_2JKKLRR1gCd-80Uo3KsNXKxytydCXAd5sb8bGE3tDKLT6GY


Behavioral
Research

PENOMENOLOHIKONG PAGSUSURI SA KAHANDAAN NG MGA SHS-ICT STUDENT GRADUATE SA PAGTATRABAHO: BASAHEN SA PAGBUO NG CAREER GUIDANCE INTERVENTION PROGRAM

Joseph C. Anggot

KALIGIRAN NG PAG-AARAL

Ang mundo ng pagtratrabaho ay patuloy na nagiging kompetitib. Dahil dito, hindi sapat na ang ating mga gradweyt ay matuto lamang na magbasa, magsulat at magbilang. Kinakailangang maging handa sila bilang manggagawang nagagawang ilapat ang mga kasanayang natamo sa eskwelahan sa trabahong papasukin (Smith, 2015).

Sa kasalukuyan, hamon sa ating mga mag-aaral na nagtapos sa Senior High School ang makahanap ng trabaho. Batay sa datos ng Philippine Statistics Authority (PSA), mahigit 500, 000 sa mga senior high graduate ang unemployed. Habang mahigit 200,000 naman sa datos ng Department of Labor and Employment (DOLE). Kaugnay nito, sa ginawang pag-aaral ni Dr. Porferio M. Almerio ng Cebu Technological University, lumalabas na ang kawalan ng kahandaan ng mga mag-aaral sa pagtatrabaho ang siyang dahilan nito.

Ayon kina Daniels at Brooker (2004), ang kahandaan sa pagtatrabaho ay tumutukoy sa kahandaang makapagtrabaho matapos ang araw ng gradwasyon. Tinuran naman nina Walker, et al (2011) na ito ay pagtatamo ng kaalaman at kasanayang siyang makatutulong sa mga gradweyt na matagumpay na matanggap sa kumpanyang pag-aaplyan at magtagal dito. Sa kabilang dako, ang mga mag-aaral na walang kahandaan sa pagtatrabaho ay mahihirapang makahanap ng trabahong papasukin (Mayhew, 2015).

Paniwala ni Williams (2015), ang paghahanda sa mga mag-aaral sa mundo ng pagtatrabaho ay responsibilidad ng guro. Kinakailangang may malawak siya sa kabatiran ng pangangailangan sa merkado ng pggawa. Kinakailangang alam niya ang mga kaalaman at kasanayang marapat matamo ng mga mag-aaral upang maging epektibo itong manggagawa. Dagdag ni Williams, kinakailangan ding gumawa ang guro ng interbasyong programa upang matiyak na ang mga mag-aaral na magtatapos ay may kahandaan sa pagtatrabaho.

Ang nasabing kaisipan ni Williams ay sinasang-ayonan ng mananaliksik. Katunayan, sa ganitong tagpo pumapasok ang pag-aaral na ito. Layunin ng mananaliksik na matasa ang kahandaan ng mga ICT student graduate ng paaralang kanyang pinapasukan (Arellano University) pagdating sa mundo ng pagtatrabaho. Inaasahan na ang magiging resulta ng pag-aaral ang siyang magiging basehan sa pagbuo ng career guidamce intervention program para sa mga magaaral na kumukuha ng larang sa ICT.

Mga Layunin

Pangunahing layunin ng pananaliksik na ito na makabuo ng career guidance intervention program para sa mga magaaral ng SHS-ICT ng Arellano University- Juan Sumulong Campus. Kaugnay nito, layon ng pananaliksik na sagutin ang mga sumusunod na tanong:

1. Ano-ano ang mga katangiang nagsasalarawan sa kahandaan sa pagtatrabaho ng mga nagtapos sa ICT?

2. Ano ang career guidance intervention program ang maaaring imungkahi sa mga mag-aaral ng ICT?

METODOLOHIYA

Isang kwalitatibong pananaliksik ang ginamit ng mananaliksik sa kanyang pag-aaral. Binanggit nina Corbin at Strauss (na binaggit sa pag-aaral ni Khan, 2014) na sa pagggawa ng ganitong uri ng pananaliksik, nangangahulugan ito ng pagpasok sa mundo ng mga kalahok at suriin ito mula sa kanilang perspektibo. Kaugnay nito, penomenolohikal naman ang uri ng kwalitatibong disenyong ginamit ng mananaliksik.

Sa pangangalap ng mga kalahok ng pag-aaral na ito, binigyan ng imbitasyon (via e-mail) ang mga mag-aaral ng ICT na nagtapos mula batch 2019 hanggang 2022. Ngunit, napag-alaman ng mananaliksik na ang mga email ng mga magaaral ay hindi na aktibo sapagkat nabigo itong maipadala sa kanila at bumalik lamang ito sa mananaliksik. Buti na lamang, may kontak ang mananaliksik sa pangulo ng bawat klase sa ICT ng nabanggit na batch. Tinawagan niya ito at nag-alok ang mga nabanggit na pangulo ng tulong upang maikalap ang imbitasyon sa kanilang mga kaklase. Snowball sampling ang teknik na ginamit sapagkat angkop itong gamitin kapag mahirap para sa mananaliksik na mahanap ang kanyang mga kalahok at matiyak ang bilang ng mga lalahok (Crossman, 2016). Sa tulong ng mga pangulo ng klase, nagawang makakalap ng mananaliksik ng sampung (10) mga kalahok. Apat (4) sa mga ito ay mula sa batch 2020, isa (1) mula sa batch 2021 at anim (6) naman mula sa batch 2022.

Sa pagtatangkang tuklasin ang mga karanasan ng mga ICT-SHS student graduate sa mundo ng pagtatrabaho, gumamit ang mananaliksik ng Focus Group Discussion (FGD). Angkop itong gamitin upang makakalap ng datos sa iba't ibang indibidwal na kung saan tinatalakay ang perspektibo, opinyon, paniniwala at atityud ng mga kalahok (Onwuegbuzle, Dickinson, Leech & Zoran, 2009). Kaugnay nito, ang mga tanong sa FGD na siyang magsisilbing lunsaran sa pagtatanong ay hinati sa dalawa. Una, ang introductory questions na ang layunin ay magtaguyod ng magandang relasyon sa pagitan ng mga kalahok at mananaliksik. Halimbawa nito ay ang: 1) Ano ang trabaho mo ngayon? At 2) Gaano katagal bago ka nagkatrabaho? At ang huli, ang exploratory questions na ang layunin naman ay bigyang kalayaan ang mga kalahok na ibahagi ang kanilang karanasan hinggil sa mundo ng pagtatrabaho. Binubuo naman ito ng mga sumusunod na tanong: 1) Ano ang masasabi mo sa ginawang akademikong paghahanda sa iyo ng Arellano University? 2) Ano-ano ang mga kasanayan o katangiang natutunan mo sa Arellano na naging adbentahe mo sa iyong kasalukuyang trabaho? At 3) Paano nakatulong sa iyo ang pagiging Chiefs (tawag sa mga mag-aaral ng Arellano) sa paghahanap mo ng trabaho?

Sa pagbibigay ng mga mungkahing gawain sa career intervention program, komunsulta ang mananaliksik sa 3 propesor sa Sikolohiya sa Arellano University ng kanilang opinyon hinggil sa angkop na gawaing lilinang sa kahandaan ng mga mag-aaral sa mundo ng pagtatrabaho.

RESULTA AT DISKUSYON

Inilalahad sa bahaging ito ang resulta at interpretasyon ng mga datos batay sa ginawang pagsagot sa mga inilahad na layunin.

Ano-ano ang mga katangiang nagsasalarawan sa kahandaan ng pagtatrabaho ng mga nagtapos sa ICT?

Sa naganap na FGD, naitala ang naging tugon ng mga kalahok na siyang nagsasalarawan sa kanilang nagging paglalakbay sa mundo ng pagtatrabaho. Batay rito, lumitaw ang ilang mga temang tumutukoy sa kanilang nagging kahandaan.

Talahanayan 1
Pagsasalarawan sa Naging Kahandaan sa Mundo ng Pagtatrabaho

Tema	Tugon ng Kalahok
Responsable at Komited sa Trabaho	"May prof ako noon sa AU na di nagpapasok sa klase kapag late . Kaya dahil doon, takot akong ma-late. At nadala ko iyon noong nagtrabaho ako." "Willing ako mag-OT matapos lang iyong pinapagawa sa akin."
Marunong Mamuno at Makipagugnayan sa iba	"Mahaba ang pasensya ko sa aking mga kliyente." "Sensitive ako sa nararamdaman ng mga kasamahan ko." "Iyong company na pinagtatrabahuan ko, every year, may isinasagawang leadership training. Malaking tulong siya kasi nadi-develop iyong leadership skill mo." "Dahil sa mga free training na binibigay ng previous company ko, nagging asset ko iyon para madali akong matanggap ngayon sa company na pinapasukan ko."
Kumpetitiv at nagagawang ilapat ang mga natutunan	"Dahil kay AU, marunong na akong mag-trouble shoot ." "Ako rin, sa katunayan nga, ako ang pinakamagaling mag-reformat sa klase namin." "Sa OJT, natutunan ko ang Auto-CAD." "Sa OJT, mas lumawak ang alam ko sa computer ."
Propesyunal kumilos at mag-isip	"Hindi ko dinadala sa trabaho iyong mg problema ko sa bahay." "Maging janitor, pinapakitunguhan ko katulad ng sa CEO." "Hindi naituro sa iskul kung ano ang function ng HR, kaya naman noong una, hindi ko alam kung saan o kanino ko ipaparating iyong concern ko." "If I have a concern about my co-worker, I route it through the HR Department."

Makikita sa Talahanayan 1 na karamihan sa mga kalahok ay nagpakita ng kahandaan sa pagtatrabaho. Ayon sa ilang mga kalahok, ito ay dahil tinulungan sila ng Arellano University na maging kumpetitiv at magawang mailapat ang mga natutunan nang sa gayon ay matanggap sa trabaho. Patotoo ni Kalahok 1, "Dahil kay AU, marunong na akong magtrouble shoot." Pagmamalaki naman ni Kalahok B, "Ako rin, sa katunayan nga, ako ang pinakamagaling mag-reformat sa klase namin." Ang nasabing kaalaman sa kompyuter ay naging adbentahe ng mga kalahok sa naging aplikasyon nila sa trabaho.

Naging adbentahe naman ng ilang mga kalahok ang pagiging responsable at komited sa gawain upang magtagal sa trabaho. Tinuran ni Kalahok C na ang pagkakaroon niya ng propesor na di nagpapasok sa klase kapag late ang nagging dahilan kung bakit takot siyang ma-late. At ang nasabing atityud ay nadala niya nang nagkatrabaho na siya. Ang pagkakaroon naman ng propesor na maikling panahon lang ang ibinibigay sa paggawa ng gawain ang siyang nagging dahilan upang madebelop ang atityud ni Kalahok D na mag-overtime matapos lang ito. Nadala niya ang atityud na ito nang magkatrabaho siya na kung saan sinabi niya na "willing akong mag-OT matapos lang iyong pinapagawa sa akin."

May mga kasanayang nadebelop ang mga mag-aaral nang nag-OJT sila. Sabi ni Kalahok A, “Sa OJT, natutunan ko ang Auto-CAD.” Ganito rin ang naging karanasan ni Kalahok C na kung saan tinuran nito na “Hindi kasi nagpapasok iyong prof namin sa sabjek na iyan, kaya wala talaga akong alam diyan. Buti na lang, itinuro ito sa amin ng mga kasamahan ko sa OJT.” Kaugnay nito, sinabi ni Alipour (2009) na malaking tulong ang OJT sa mga mag-aaral sapagkat ito ang pumupuno sa mga kaalaman o kasanayang hindi natamo ng mga mag-aaral sa kanilang pag-aaral sa eskwela.

Karamihan sa mga kasanayang naging daan upang maging propesyunal pagdating sa trabaho ay natutunan ng mga kalahok sa kumpanyang pinapasukan nila. Pagtatapat ni Kalahok F, “Hindi naituro sa iskul kung ano ang function ng HR, kaya naman noong una, hindi ko alam kung saan o kanino ko ipaparating iyong concern ko.” Ganito rin ang nagging pagtatapat ni Kalahok D kaya naman nang mabatid niya na ang tungkulin ng nasabing departamento, sinabi nito na “If I have a concern about my co-worker, I route it immediately through the HR Department.”

Ipinagpapasalamat naman ng ilang mga kalahok ang mga libreng leadership training na ipinagkaloob ng kumpanyang kanilang pinapasukan. Ani nga ni Kalahok B, “Iyong company na pinagtatrabahuan ko, every year, may isinasagawang leadership training. Malaking tulong siya kasi nadi-develop iyong leadership skill mo.” Dagdag pa niya, “Tinuruan ako nitong maging mahaba ang pasensya sa aking mga kliyente at maging sensitive sa nararamdaman ng iba, especially sa mga kasamahan ko.” Pagbibida naman ni Kalahok D, “Dahil sa mga free training na binibigay ng previous company ko, naging asset ko iyon para madali akong matanggap ngayon sa company na pinapasukan ko.” Paliwanag dito ni Humburg, der Velden at Verhagen (2013), pinipili ng mga employer ang mga indibidwal na nagtataglay ng kahusayan hindi lamang sa kasanayan sa trabaho, kundi pati na rin sa kasanayang interpersonal tulad na lamang ng kasanayan sa talastasan, pamumuno, at iba pa.

Ano ang career guidance intervention program ang maaaring imungkahi sa mga mag-aaral ng ICT?

Isang career guidance intervention program ang imunungkahi ng mananaliksik upang patuloy na masuportahan ang paglago ng mga mag-aaral at maihanda sila sa mundo ng pagtatrabaho. Nakabatay ang nasabing programa sa nagging karanasan sa kahandaan ng mga kalahok na kung saan lumitaw ang mga sumusunod na tema: pagiging responsible at komited sa trabaho, marunong mamuno at makipag-interak sa iba, kumpetitiv at nagagawang ilapat ang mga natutunan at pagiging propesyunal kumilos at mag-isip.

Sa pagdisenyo ng career guidance intervention program, isinaalang-alang ng mananaliksik ang henerasyong kinabibilangan ng mga mag-aaral sa ICT. Sila ay nabibilang sa Gen Z. Ang ganitong uri ng henerasyong mag-aaral ay higit na natuto kung inuugnay ng guro sa tunay na buhay ang mga araling kanyang itinuturo (Novotney, 2004). Ayon kay Price (2009), ang mga ganitong uri ng mag-aaral ay ayaw ng lecture discussin ng pagtuturo. Mas gusto nila ang experential learning, Kaugnay nito, tinuran ni Fink (2013) na ang paglahok ng activity o gawain sa pagtuturo ay hindi lamang nakababawas ng kanilang pagkabagot bagkus nakakapagpataas din ng kalidad ng kanilang pagkatuto. Dahil dito, sa dinisenyong career guidance intervention program ng mananaliksik, inilakip niya ang workshop at immersion bilang gawain. Makikita sa ibaba ang kabuoang disenyo ng interbasyon ng mananaliksik.

Mungkahing Career Guidance Intervention Program: Paghahanda sa Mga Mag-aaral ng ICT sa Mundo ng Pagtatrabaho

Rasyunale ng Programa

Ang kahandaan sa pagtatrabaho ay tumutukoy sa kahandaang makapagtrabaho matapos ang araw ng gradwasyon (Daniels at Booker, 2004). Tinuran naman nina Walker, et al (2011) na ito ay pagtatamo ng kaalaman at kasanayang siyang makatutulong sa mga gradweyt na matagumpay na matanggap sa kumpanyang pag-aaplayan at magtagal dito.

Ayon kay Bandaranaike (2015), ang pagkakaroon ng kahandaan sa pagtatrabaho ay mahalaga. Nagsisilbi itong krayterya sa pagpili ng empleyado. Sa katunayan, mas binibigyang pansin pa nga ito kaysa sa degring natapos ng aplikante (Caballero, 2010).

Sa pag-aaral na ito, ang kahandaan sa pagtatrabaho ay binigyang turing bilang mga indibidwal na: responsable at komited sa trabaho; marunong mamuno at makipag-interak sa iba; kumpetitiv at nagagawang ilapat ang mga natutunan at; propesyunal kumilos at mag-isip.

Ang mungkahing career intervention program ay may layuning:

1. Pagtibayin ang mga kasanayan sa kahandaan ng pagtatrabaho ng mga ICT student at;

2. Ihanda at gabayan ang mga mag-aaral na maging handa sa mundo ng pagtatrabaho.

Deskripsyon ng Programa

Ang career guidance intervention program na may pamagat na “Mungkahing Career Guidance Intervention Program: Paghahanda sa Mga Mag-aaral ng ICT sa Mundo ng Pagtatrabaho” ay hinango mula sa konsepto ng experential learning theory na kung saan binibigyang kahulugan nito na ang pag-aaral ay isang proseso at ang kaalaman ay nabubuo sa pamamagitan ng pagbabago ng karanasan (Kol, 2015). Ito ay binubuo ng mga aktibidad na iminungkahi ng mga eksperto: training/seminar, workshop, OJT at alumni mentoring. Makikita sa Talahanayan 2 ang activity matrix ng intervention program na naglalaman ng mga impormasyon hinggil sa mga gawain sa interbasyon.

Talahanayan 2
Activity Matrix ng Career Guidance Intervention Program

Mga Layunin	Gawain	Kagamitan	Saklaw ng Oras	Nga Taong Kasangkot	Inaasahang Awtput
Magbahagi ng mga kwento ng tagumpay ng mga alumni ng ICT strand; magbigay ng career guidance at mentoring sa mga magaaral	Seminar at Alumni Mentoring	Microphone Laptop	4 oras	3 alumni Speakers Guidance Counselor Grade 11 at 12 na mag-aaral Mga Guro sa Grade 11 at 12	Magkakaroon ng malawak na kaalaman ang mga mag-aaral hinggil sa mundo ng pagtatrabaho Lumawig ang kanilang mga kakilala sa larang na kanilang pinagdadalubhasaan Magkaroon ng motibasyong ipagpatuloy ang larang na pinili.

Maturuan ang mga mag-aaral na sumulat ng impresibong resume at bigyan ng mga tip kung paano sumagot sa mga job interview	Workshop	Laptop Papel Pen	4 oras	HR manager (resource speaker) Guidance Counselor Grade 12 na mag-aaral	Magagawa ng mga magaaral na makasulat ng impresibong resume. Mababatid ng mga magaaral kung paano sagutin nang tama ang ilang mga karaniwang tanong sa job interview.
Magawang mamuno at makipag-ugnayan sa iba't ibang uri ng tao	Leadership training	Laptop	1 araw (8 oras)	Resorce Speaker Guidance Counselor	Malaman ang mga epektibong paraan sa pamumuno at pakikipagugnayan sa tao Mabatid kung paano lalagpasan ang mga mahihirap na sitwasyon
Maranasan ng aktwal na pagtatrabaho	OJT shadowing Job shadowing	Pen Notebook	1 araw (8 oras)	Guidance Counselor Technical staff/trainer of the company	Mabatid ang kalakaran sa trabahong papasukin

KONGKLUSYON

Kaugnay sa naging resulta ng pananaliksik, nabuo ang mga sumusunod na kongklusyon

1. Lumabas na ang mga kalahok ay nagpakita ng kahandaan sa pagtatrabaho. Karamihan sa mga kasanayang ito ay nakuha nila mula sa kumpanyang kanilang pinagtatrabahuan. Ang mga ito ay ang karunungang mamuno at makipag-ugnayan sa iba; propesyunal kumilos at mag-isip; at kumpetitiv at nagagawang ilapat ang mga natutunan. Kaugnay nito, nakita ang kahalagahan nitong maituro o matamo sa paaralan sapagkat ang nasabing mga kasanayan ang dahilan kung bakit natanggap at nagtagal ang mga kalahok sa kumpanyang pinapasukan. Dahil dito, ang paglinang sa nasabing kasanayan ang pinagtuonan nang pansin ng mananaliksik sa kanyang interbasyon.

2. Ang mungkahing gawain para sa career intervention program ay hinalaw sa naging tema ng tugon ng mga kalahok, Ito ay binubuo ng mga sumusunod: alumni mentoring, seminar, leadership training, at job shadowing. Mapapansin na ang gawaing ito ay naglalayong matutunan ng mga mag-aaral ang aktwal na kalakaran sa mundo ng pagtatrabaho.

MGA SANGGUNIAN

Alipour, M. (2009). A study of on the job training effectiveness: Empirical evidence of iran. International Journal of Business and Management.

Caballero, C. (2010). Work readiness in graduate recruitment and selection: A review of current assessment methods. Journal of Teaching and Learning for Graduate Employability, 13-25.

Crossman, A. (2016). What is a snowball sample in sociology. http://sociology.about.com/od/Types-of-Samples/a/SnowballSample.ht.

Daniels, J., & Brooker, J. (2014). Shaping the work readiness of students: Identity formation in tertiary Institutions. https://psycnet.apa.org/record/2014-06358-005

DOLE. (2022). Department of Labor and Employment. www.dole.gov.ph

Fink, L. D. (2013). Creating significant learning experiences: An integrated approach to designing college courses. John Wiley & Sons.

Khan, S. (2014). Qualitative research method: Grounded theory. International Journal of Business and Management.

Kolb, D. (2015). Experiential learning theory. Pearson Education Inc.

Mayhew, R. (2015). 5 reasons people stay unnemployed. Hearst Newspapers, LLC: www.chron.com

Novotney, A. (2014). Engaging the millennial learner . American Psychological Association, 60.

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2009). A qualitative framework for collecting and analyzing data in focus group Research. International Journal of Qualitative

PSA. (2022). Philippine Statistics Office. www.pcso.gov.ph

Price, C. (2009). Why don't my students think I'm groovy? The new "R"s for engaging millennial learners. The Teaching Professors.

Santos, J. (2022). K to 12 graduates, madali bang makahanap ng trabaho. https://www.gmanetwork.com/news/balitambayan/talakayan/841148/k-12-graduates-madali-nga-bangmakapasok-sa-trabaho/story/

Smith, C. (2015). Why soft skills matter? Mind Tools: https://www.mindtools.com/pages/article/newCDV_34.htm

Walker, A. et al. (2012). Work readiness of graduate health professionals. Nurse Education Today.

Williams, A. (2015). Soft skills perceived by students and employers as relevant employability skills. https://scholarworks.waldenu.edu/dissertations/1427/

EARIST CAVITE FACULTY MEMBERS' ROLE IN TRANSCENDING BOUNDARIES IN FULFILLING THE CHED'S FOUR-FOLD MANDATE

Dr. Shirley P. De Leon

INTRODUCTION

Background of the Study

The EARIST Cavite Campus (ECC), an extension of EARIST Manila, is a state-run tertiary institution located in General Mariano Alvarez, Cavite. With around 2,457 students, ECC has been serving the local community for 42 years, primarily benefiting underprivileged students aiming to improve their lives through education. The campus envisions itself as a center of excellence in trades, business, arts, science, and technology education. According to CHED Commissioner Patricia B. Licuanan, Higher Educational Institutions (HEIs) play a critical role in fostering human capital and ensuring meaningful growth through education [8]. ECC's mission aligns with the nation's need for

HEIs to develop motivated, competent, and socially conscious graduates who can contribute to national progress. The EARIST Cavite Campus Act, currently on its second reading in the Senate, further supports this mission by providing the legislative backing needed to enhance the institution's capabilities and extend its impact. To achieve its objectives, HEIs must excel in instruction, research, extension, and production, as emphasized by the NBC 532 guidelines, DBM-CHED Joint Circular No. 1 (2016), and CHED Memorandum Order No. 29 (2013) [4][5]. These mandates ensure that institutions like ECC uphold quality education, research output, community service, and efficient resource management, thereby empowering students with the skills and knowledge to improve their lives and contribute to community development [15].

HEI's Four-fold Mandate

In the Philippines, the Commission on Higher Education (CHED) has articulated a four-fold mandate for higher education institutions: instruction, research, extension, and production [3][5]. This comprehensive framework is designed to ensure that universities and colleges not only deliver quality education but also contribute to the generation of new knowledge, community engagement, and the production of innovations that address societal needs [8]. The higher education sector is witnessing rapid transformations, compelling institutions to transcend traditional academic boundaries to stay relevant and effective. The shift toward more dynamic educational paradigms emphasizes the need for educators and administrators to play a broader role beyond conventional instruction [1][7][17]. At the Eulogio "Amang" Rodriguez Institute of Science and Technology (EARIST) Cavite Campus, faculty members are increasingly tasked with navigating the complexities of this mandate. Instructors/ asst. professors must integrate teaching with research, community outreach, and resource production in ways that align with CHED's goals. Such a multifaceted role requires transcending traditional disciplinary and geographical boundaries, promoting interdisciplinary collaboration, and fostering partnerships with external stakeholders [18]. The need to break down disciplinary silos is particularly critical in developing countries where higher education institutions are instrumental in driving social and economic development [17] It explores how instructors promote multidisciplinary cooperation, community involvement, and information sharing, enhancing the institution's ability to meet CHED's objectives.

The Quest for Quality Education Through Four-fold Mandate

As the landscape of higher education evolves rapidly, institutions must adapt to dynamic instructional paradigms that transcend conventional limits serving as a vehicle of change for education must be of good quality and transformative in empowering human capital and alleviating the economic condition of the Filipino learner [8]. The quest for quality education has driven every higher education institution to transcend boundaries to become at par with internationalization standards [1] [9]. Different strategies and methods of revamps in compliance and certification have been in massive implementation such as the Accreditation, COPC, ISO, and RQAT visitations/ inspections to name a few. The battle cry of UNESCO for Lifelong Learning is supported by the HEI's quest for quality education to become transformative by unlocking potential not only for the Filipino younger generations but also for the adults. The strengthening of the Philippine educational system through the mandate creates a poll of individuals, community stakeholders, government, and businesses who move unitedly in pursuit of knowledge for personal, entrepreneurial, or professional development whether formal, informal, or non-formal that encourages everyone to be adaptive to changes [13]. This manifests into enablement which benefits the entire community by bringing closer ties for a common cause, somehow reverberating the progress as key players in the advancement of an empowered society [16].

Four-fold Mandate as a means of Performance Evaluation

The 1998 National Budget Circular No. 461 (NBC 461) describes the remuneration and categorization plan for professor posts at State Universities and Colleges (SUCs), CHED supervised higher education institutions, and TESDA-supervised technical schools [3]. It has directed eight cycles of faculty job reclassification, the most recent of which took place in 2019. Since then, several events have had an influence on higher education, such as the Fourth Industrial Revolution's growth in digitization and the Philippine Qualifications Framework (RA 10968), which encourages lifelong learning, and ASEAN Integration 2015, which increases teacher and student mobility. Due to these modifications, faculty members must improve their competencies [5][7]. As a result, President Rodrigo Duterte has directed the Commission on Higher Education (CHED) and the Department of Budget Management (DBM) to reimburse them for their efforts and qualifications through the FY 2019 General Appropriations Act (GAA). The goal is to ensure these revisions align with recent developments in higher education which aim to provide revised policies for faculty position reclassification across SUCs, serve as a basis for decisions regarding faculty development, and motivate faculty to enhance their qualifications and performance, thus advancing their rank and compensation [4]. These modifications necessitate faculty to augment their abilities, so requiring remuneration for their efforts and qualifications [9]. The job of updating the policies for reclassifying faculty posts at State Universities and Colleges (SUCs) falls to the two front-line agencies in the faculty performance evaluators. The memorandum prompted different reactions from the academic arena as transition and transformation started creeping designed to reflect the evolving demand on teachers in the higher education sector.

Research Aims

To fulfill CHED's mandate, this study attempts to evaluate how faculty members handle challenges overcoming transcending boundaries along the way. More precisely, it seeks answers to questions about instruction, research, extension, and production execution at the EARIST Cavite Campus.

METHODS

The researcher used a descriptive research design, combining quantitative and qualitative methods in gathering the data. Three categories of respondents which are the 20 administrative core team, 56 faculty members, and 60 BTLEd graduating students were given survey questionnaires to answer to generate the needed information. Focus group discussions (FGDs) were utilized to further enrich the findings, providing a deeper understanding of faculty perspectives on facing challenges in transcending boundaries in fulfilling the CHED's fourfold mandate. Document analysis of institutional policies, curriculum frameworks, and academic publications supplements and clarifies the results of challenges faced by faculty members, such as the struggle to balance the demands of teaching, research, and community service. The triangulation of data sources allowed for a comprehensive analysis of the faculty's experiences and perspectives.

RESULTS AND DISCUSSION

EARIST Cavite faculty members' evidence of fulfilling CHED's four-fold mandate assessed by the Academic/administrative core team, faculty, and students regarding instruction, research, extension, and production.

Table 1
Assessment of the Three Groups of Respondents on Fulfilling CHED's Four-fold Mandate

Four-fold Mandate	Core Team		Faculty Members		Graduating Students		Composite Mean		Rank
	WM	VI	WM	VI	WM	VI	WM	VI	
1. Instruction	4.22	HE	4.20	HE	4.25	HE	4.22	HE	1
2. Research	4.27	E	4.30	E	3.39	SE	3.98	E	2
3. Extension	3.22	E	3.45	E	3.00	SE	3.22	SE	3
4. Production	2.68	SE	2.50	SE	2.23	SE	2.47	LE	4
Average Weighted Mean	**3.59**	**E**	**3.61**	**E**	**3.21**	**SE**	**3.47**	**E**	

Legend: 4.20 -5.00 Highly Evident (HE) 3.40-4.19 Evident (E) 2.60-3.39
Somewhat Evident (SE) 1.80-2.59 Least Evident (LE) 1.00-1.79 Not Evident (NE)

Table 1 reveals that the three respondents unanimously agreed that Instruction ranked first, with a composite mean of 4.22, interpreted as "highly evident," establishing it as the top priority in fulfilling CHED's Four-Fold Mandate at EARIST Cavite Campus. Research followed closely, with a composite mean of 3.98, interpreted as "evident," and was prioritized by faculty members ($\bar{x}$ = 4.30 - "highly evident"). Although Instruction ranked first overall, Research stood out as the top priority for faculty, demonstrating its significance within the academic community. Next, Extension achieved a composite mean of 3.22, interpreted as "slightly evident," while Production ranked last, with a composite mean of 2.47, interpreted as "least evident."

The results highlight that EARIST Cavite faculty are deeply committed to mentoring and teaching, reflecting a clear support for lifelong learning [16]. Research emerged as the top priority for faculty members. Their strong assessment of Research manifested an established research culture, driven by institutional efforts such as extensive information dissemination, support, incentives, and recognition while fostering academic growth and importance in the educational community [1]. On the other hand, extension, and community engagement took off slowly with slightly evident manifestations, yet, the door had been opened and able to gain collaborations with different stakeholders. Meanwhile, the production remains in a very young stage of development showing potential for growth as the institution continues to implement its strategies in this area.

Identified challenges EARIST Cavite faculty members face in fulfilling the four-fold mandate.

Table 2
Mean Values on the Degree of Identified Challenges Faculty Members Face in Fulfilling the Fourfold Mandate at EARIST Cavite Campus

Challenges Faculty Members Face in Fulfilling Four-fold Mandate	Mean	Interpretation	Rank
1. Time constraints due to heavy workloads and designation	4.42	Very Challenging	1
2. Difficulty of finding faculty with complementary expertise	3.50	Challenging	8
3. Lack of mentoring moments in sharing of expertise among faculty members	4.02	Challenging	5
4. Limited capacity building programs	2.48	Somewhat Challenging	10
5. Difficulty in collaborating with external partners	3.52	Challenging	7
6. Lack of funding	4.25	Very Challenging	2
7. Administrative/ Designation assignments	4.18	Challenging	4
8. Limited access to Technology	4.21	Very Challenging	3
9. Poor communication channel	3.38	Somewhat Challenging	9
10. Cultural resistance to change	3.53	Challenging	6
Overall Mean	**3.74**	**Challenging**	

Legend : 4.20 -5.00 Highly Challenging (HC) 3.40-4.19 Challenging(C) 2.60-3.39 Somewhat Challenging (SC) 1.80-2.59 Least Challenging (LC) 1.00-1.79 Not Challenging (NC)

Table 2 shows the mean values of the degree of identified challenges the faculty members encounter in fulfilling the Four-fold mandate [4]. Time constraints due to heavy workload got a mean of 4.42 as the highest-rated item, followed by lack of funding with a mean of 4.25, and limited access to technology with 4.21 both described as “Very Challenging”. “Challenging” rates were given to indicators such as administrative/designation assignment (x=4.18), lack of mentoring moments in sharing expertise among faculty members (x=4.02), cultural resistance to change (x=3.53), and difficulty in collaborating with external partners (x=3.52). Whereas the lowest rating falls on poor communication channels with 3.38, and limited capacity building programs with a mean value of 2.48, both interpreted as “somewhat challenging.”

According to the respondents' answers in the conducted focus group discussion on the challenges encountered, the results stressed that faculty members encounter significant challenges in fulfilling the Four-fold mandate [11]. Accordingly, as they juggled multiple responsibilities with sworn duties of handling full teaching loads, while multi-tasking across four domains, it led to role conflict and work overload that affected personal life. The constant pressure to meet deadlines resulted in burnout and mental fatigue. They often extend their service beyond the professional sphere and official time that prioritizes work over health which causes physical stress especially if they are assigned as committee members which springs from the neglect of family time [14]. Lastly, they summed up that commitments often lead to a sacrifice in the quality of outputs.

Addressing transcending boundaries applied by the faculty members while Fulfilling the Mandate affects their ability to balance their Roles in teaching, research, and extension services while meeting production targets.

1. The transcending boundaries on time constraints and heavy workloads should be addressed if prioritization and time management are applied, along with teamwork and delegation among fellow faculty members while incorporating student autonomy which lightens the workload.

2. Today, financial resources serve as the foundation of all projects and programs. Lack of funds can significantly limit or prevent its implementation [3]. Faculty members frequently confront this problem during the implementation of the four-fold mandate; this pressure adds to sacrificing quality outputs as faculty employ what is available, pushing their resources and surpassing limits [10]. This may be handled by applying for grants and donors, developing relationships with local companies and groups, and using community resources. Encourage volunteer participation and seek sponsorships to assist conduct low- or no-cost initiatives, maintaining continuity despite budgetary constraints.

3. Insufficient technology exacerbates stress, especially when academic organizations are expected to provide high-quality outputs, particularly research. It creates mental weariness as they struggle to accomplish activities efficiently, resulting in delays and compromised results [12}. This boundary is very challenging when trying to meet production goals under technological constraints. The Internet has been very helpful to the academic world in lessening the faculty members' tasks. To break down barriers, faculty members use low-tech or no-tech solutions on their resources forcing them to work harder and more efficiently.

4. Administrative or ancillary duties create a significant institutional boundary and often faculty members transcend this boundary by managing both administrative tasks and their primary roles in teaching, research, extension, and production frequently resulting in role conflict and neglect of family time as they are pulled in multiple directions [12]. Additional responsibilities outside their primary teaching roles increase stress most of the time prioritizing work over health. To address this, employing delegation and teamwork works well while negotiating expectations.

5. The absence of mentoring or peer support leads to burnout and mental fatigue and challenges faculty members to transcend boundaries related to knowledge sharing, repeatedly struggle to develop professionally, and often find themselves navigating complex tasks alone and inefficient in fulfilling the mandate [12]. To solve this, initiating informal mentoring networks or peer support groups within the faculty and collaborating with learning communities will greatly appease the pressure.

6. Cultural resistance to change within the institution slows down progress and forces faculty members to compromise, often leading to sacrifice and transcending boundaries between personal values and professional duties [7]. To respond to this, gradual implementation involving the community in implementing new programs builds trust and understanding paving the way to creating a safe working environment.

7. Collaboration is vital for research and extension. Faculty members are often required to transcend boundaries to establish external partnerships [10]. When these collaborations are difficult to secure faculty are left isolated which affects their ability to meet the targets. To resolve this, building relationships with community organizations is necessary by leveraging existing networks and proposing specific projects or initiatives.

8. When the institution lacks workers with complementary abilities, faculty members must go beyond their area of competence [2]. This frequently leads to conflict, causing them to go beyond their core areas of competence to fill holes in the mandate [11]. Fostering multidisciplinary collaboration by developing a professional upskilling inventory and forming cross-faculty learning teams will help to bridge this competence gap.

9. When communication is not clear, it leads to misuse of time and personal responsibilities. It impedes teamwork and clarifies expectations. Faculty frequently cross this institutional boundary by seeking alternate ways to obtain knowledge, resulting in inefficient processes [9]. As a result, establishing clear communication norms and diversifying communication necessitates the development of personal relationships among academic workers [11].

10. Due to the restricted possibilities for skill development, faculty members are forced to labor within restrictive institutional bounds, to surpass these restrictions, they seek external opportunities or learn independently to satisfy the requirements of the four-fold mandate, which increases their load and stress [10]. To address this, in addition to peer learning and information exchange, self-directed professional development and networking with other schools or institutions might be beneficial.

CONCLUSIONS AND RECOMMENDATIONS

Faculty members face numerous challenges as they transcend institutional boundaries in fulfilling the four-fold mandate [13]. From time constraints and financial limitations to insufficient technology, administrative burdens, and lack of mentoring, these hurdles significantly affect their productivity and well-being [12]. Moreover, cultural resistance, the absence of complementary skills, unclear communication, and limited opportunities for professional development exacerbate these struggles. However, through strategic approaches like teamwork, delegation, forming partnerships, and fostering mentorship and peer support networks, faculty can find ways to overcome these barriers and maintain a balance between their professional responsibilities and personal well-being [14].

To address these issues, institutions should foster a supportive environment that encourages collaboration, delegation, and mentorship, while ensuring access to professional development and clear communication. Securing funding, leveraging community resources, and adopting gradual change management will help faculty effectively fulfill the four-fold mandate without compromising quality or well-being.

REFERENCES

[1] Baylan, S. L. (2023). *A contextual analysis of the university research agenda of select teacher education institutions in the Philippines: Policy implications and future directions*. Faculty of Integrated Laboratory School, Cebu Normal University. https://www.researchgate. net/publication/375559222

[2] Bukidnon State University. Smart BukSU (2024) https://buksu.edu.ph/2024/01/15/buksu welcomes-the-semester-with-a-week-long-orientationon-the-four-foldfunctions/

[3] Cabaron, J. B. (2018). *Organizational performance of higher education institutions in the Philippines*. Philippine Archive, Jose Rizal Memorial State University.

[4] Commission on Higher Education. (2016). *Leveling instrument for SUCs and guidelines for implementation thereof* (Joint Circular No. 1, Series of 2016).

[5] Department of Budget and Management, & Commission on Higher Education. Joint Circular No. 03 Series of 2022 (2022) Guidelines on the Reclassification of Faculty Positions in State Universities and Colleges

[6] Enochs, J. B. (2017). *Preparing for a fourfold role*. California State Department of Education. Taylor and Francis. online. https://doi.org/10.1080/00193089.1955.10533908

[7] Hufana, M. C. S. (2019). *Quality assessment of Don Mariano Marcos Memorial State University – Mid La Union Campus faculty's four-fold mandate*. Ph.D. Planning Officer III, City Schools Division of San Fernando, City of San Fernando, La Union, Philippines. https://ijee.org/assets/docs/EDU37_marie.375551.pdf

[8] Licuanan, P. B. (2015). Education & human capital: Bridging the developmental divide. *Philippine Higher Education, Ateneo Professional Schools 40th Anniversary*.

[9] Malolos, C. F., & Tullao, T. S. Jr. (2018). *The role of the Commission on Higher Education in promoting quality education*. Angelo King Institute for Economics and Business Studies, De La Salle University. https://animorepository.dlsu.edu.ph/cgi/viewcontent.cgi?article= 1041&context=resaki

[10] Medina, B. O. (2019). *Community engagement of state universities and colleges in the Philippines: Towards socially and culturally responsible research and extension initiatives*. Batangas State University, College of Arts and Sciences. https://www.ijarp.org/published-research-papers/apr2019/CommunityEngagement-Of-StateUniversities-And-Colleges-In-The-PhilippinesTowards-Socially-And-Culturally-Responsible-Research-And-ExtensionInitiatives.pdf

[11] Ngohayon, S. L., & Nangpuhan, J. B. II. (2015). Surmounting top-down and bottom up higher education challenges in the Philippines: The Ifugao State University experience. *International Journal of Science and Research (IJSR)*, *4*(1), 23197064. https://www.ijsr.net

[12] Pentang, J. T., & Domingo, J. G. (2024). *Research self-efficacy and productivity of select faculty members: Inferences for faculty development plan*. Central Luzon State University; Nueva Ecija University of Science and Technology. https://eujer.com/research-self-efficacy-andproductivity-of-select-faculty-members inferences-for-faculty-development-plan

[13] Quitoras, M. C. L. & Abuso, J. E. (2021). Best Practices of Higher Education Institutions (HEIs) for the Development of Research Culture in the Philippines. Pedagogical Research, 6(1), em0087. https://doi.org/10.29333/pr/9355.

[14] Rodriguez, R. L., Abdurahim-Salain, H., & Dela Cuesta, M. D. (2021). Research competency of the Basilan State College faculty. *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, 3(12), 69-79. http://ijmrap.com/wpcontent/uploads/2021/06/IJMRAP-V3N12P33Y21.pdf

[15] Tuyo, L. E. (2022). *Governance of state universities and colleges in Region XII, Philippines*. College of Teacher Education, Cotabato State University. https://www.ijmcer.com/wp content/uploads/2022/03/IJMCER_E04202936.pdf

[16] https://www.uil.unesco.org/en/role-higher-education-institutionslifelonglearning

[17] Valentino, L. (2024, June 12). *Transcending boundaries: Exploring transdisciplinarity in educational leadership*. LinkedIn. https://www.linkedin.com/pulse/transcending-boundariesexploringtransdisciplinarity-luis-valentino-x9ehc/

[18] Velasco, M. S. (2023). *Faculty primary functions in a private higher education institution: Basis for performance evaluation*. School of Graduate Studies, Core Gateway College,Inchttps://www.researchgate.net/publication/370787884_Faculty_Primary_Functions_in_a_Private_Higher_Education_Institution_Basis_for_Performance_Evaluation

PROSOCIAL BEHAVIOR AND ACADEMIC PRODUCTIVITY OF STUDENT LEADERS OF COLLEGE-BASED ORGANIZATIONS

Dr. Jinamarlyn B. Doctor
Kriechelle Mae S. Samson

INTRODUCTION

Prosocial behavior is a form of positive psychology that helps people for the greater good, while academic productivity is a term used to describe efficient and effective learning experiences, and socio-emotional aspects of students in studying. It has been recognized as a potential platform for cultivating prosocial behavior and enhancing academic productivity beyond its traditional, social, and recreational functions. The students in the Philippines are known to be diligent, especially in State Universities where they continuously participate in volunteer work and implement plans for the development of their institution. Student leaders that have skills, experience, and knowledge gained through their length of service in their school, thus creating a strong image of having the qualities of socially active members of the society and academically-inclined young minds. Subsequently, student organizations offer a certain kind of environment full of social interaction, and skill-building. School can play a pivotal role where students exchange ideas and gain empathy and aptitude through their circle of people and student leaders that gradually enhance their leadership skills. The primary objectives of this research are two things: (1) to explore the extent to which student organizations promote prosocial behavior among their members, and (2) to assess prosocial behavior's possible impact on academic productivity. They will be given a survey questionnaire in all Student Organizations under the College of Arts and Sciences (CAS).

The findings of this study may guide the enhancement and innovations of evidence-based interventions and programs aimed at maximizing the positive impact of student organizations on academic pursuits, ultimately developing the experience of students in social settings. To sum it up, through this research, we will be able to understand how student organizations can facilitate prosocial behavior and its potential influence on academic success. With the use of this research, the institution could utilize the results of this study to know if the existence of student organizations will, therefore help improve the student's prosocial behavior and academic productivity. This study answered the following questions:

1. How do the respondents assess their prosocial behavior as to the following:
    - 1.1 Social setting,
    - 1.2 Social interaction; and
    - 1.3 Circle of People?
2. How do the respondents assess their academic productivity in terms of:
    - 2.1. Aptitude
    - 2.2 Learning Environment; and
    - 2.3 Teaching?
3. Is there a significant relationship between prosocial behavior and the academic productivity of the respondents?

THEORETICAL FRAMEWORK

The theoretical framework of this study is based on George Homans' Social Exchange Theory (1958) and Herbert Walberg's Theory of Educational Productivity. Social Exchange Theory suggests that individuals engage in prosocial behavior when the benefits outweigh the costs. The study focuses on three key concepts: social setting, social interaction, and the circle of people. Social setting establishes norms, rules, and expectations that shape students' behaviors and interactions. Social interaction involves interpersonal relationships, communication, and collaboration, which can foster a sense of belonging, trust, and empathy, increasing the likelihood of prosocial behavior. Negative interactions can hinder prosocial behavior and create barriers to cooperation. The circle of people refers to a person's social network or group of regular interactions. It influences social exchange processes by providing social support, establishing norms, and creating expectations for behavior. Students are more likely to engage in prosocial acts when they perceive reciprocity or feel a sense of belonging within their social circle.

Another theory by Herbert Walberg on educational productivity emphasizes the psychological factors that impact students' academic achievement and success. The theory highlights three key factors that influence student productivity: aptitude, learning environment, and teaching. Aptitude refers to a student's inherent potential to learn and succeed, which is influenced by cognitive abilities, motivation, and natural dispositions. A conducive learning environment, which includes a positive social and emotional climate, adequate resources, and a supportive classroom culture, can enhance students' productivity. Effective teaching practices, such as instructional clarity, active learning, and differentiation, can also promote students' productivity by creating a collaborative and engaging learning environment.

METHOD

The study employed a descriptive-correlational research design to examine the relationship between prosocial behavior and academic productivity among student leaders. This approach allowed the researchers to investigate the strength and direction of the relationship between the two variables without manipulating or controlling them. Data were collected through a survey questionnaire. Using stratified random sampling, 101 student leaders were selected from a population of 135 student leaders within the College of Arts and Sciences at Eulogio "Amang" Rodriguez Institute of Science and Technology. The strata included various college-based organizations (Elite Student Psychology Association, Mathematics Society, Applied Physics Society, Computer Science Association, Information Technology Student Association) as well as class mayors and vice mayors. A researcher-made questionnaire comprising 60 items was utilized to assess prosocial behavior and academic productivity. The questionnaire underwent rigorous validation by two faculty members from the Psychology Department within the College of Arts and Sciences and one external expert. To ensure reliability, the instrument was pilot-tested with a sample of student leaders from a College-Based Organization in the 2023-2024 academic year.

RESULTS

The analysis and interpretation of the responses of the respondents revealed the following findings:

1. How do the respondents assess their prosocial behavior as to the following:

1.1 Social setting

Table 1
Prosocial Behavior in terms of Social Setting

Indicators	Weighted Mean	Verbal Interpretation
1. As a student leader, I feel comfortable socializing in school.	4.20	Agree
2. As a student leader, follow the rules and values of the institution.	4.38	Agree
3. As a student leader, I align my actions with the established social norms within the academic community.	4.39	Agree
4. As a student leader, I associate myself with community service to enhance my leadership skills.	4.30	Agree
5. As a student leader, I motivate myself to develop my school values in driving my prosocial actions for the sake of our growth as an organization.	4.42	Agree
6. As a student leader, I use the school as a meeting place for official school activities.	4.31	Agree
7. As a student leader, I feel more inclined to help others by strictly implementing regulations to mold the behavior of students.	4.29	Agree
8. As a student leader, I respond to the demands of the people around me concerning the norms and standards of the institution.	4.35	Agree
9. As a student leader, I associate myself with the norms and rules of the institution to effectively contribute to community services.	4.32	Agree
10. As a student leader, I want to help not just myself but also my fellow students and the institution.	4.56	Strongly Agree
Overall Mean	**4.35**	**Prosocial behavior is manifested**

Table 1 reveals that student leaders generally exhibit strong prosocial behaviors within the school environment. They are comfortable socializing, adhere to institutional rules, align with social norms, and actively engage in community service to enhance their leadership skills. Furthermore, they consistently demonstrate a commitment to promoting school values, utilizing resources responsibly, and helping others. Their responsiveness to institutional norms and willingness to prioritize the welfare of others highlight their dedication to fostering a positive and inclusive school community.

1.2 Social interaction

Table 2
Prosocial Behavior in terms of Social Interaction

Indicators	Weighted Mean	Verbal Interpretation
1. As a student leader, I want to be a part of a student organization to help me efficiently socialize with other people.	4.20	Agree
2. As a student leader, I actively engage in social interactions within the organization.	4.15	Agree
3. As a student leader, I feel that there is a friendly ambiance between the upper position and lower position in our organization.	4.41	Agree
4. As a student leader, I see how the organization facilitates ongoing communication with our fellow students.	4.40	Agree
5. As a student leader, I commit enough time and resources to build a good relationship with my fellow students and co-members.	4.28	Agree
6. As a student leader, I address properly the concerns within the institute to my co-leaders to make an immediate solution.	4.43	Agree
7. As a student leader, I feel that working together as an organization enhances my motivation to engage in prosocial behaviors	4.37	Agree
8. As a student leader, I enjoy discussing with my co-leaders the societal topics that will help our constituents.	4.38	Agree
9. As a student leader, I objectively open myself to the ideas and opinions of other people and share mine as well.	4.50	Strongly Agree
10. As a student leader, I initiate brainstorming of ideas for the next activities of the organization.	4.26	Agree
Overall Mean	**4.34**	**Prosocial behavior is manifested**

Table 2 reveals that student leaders exhibit strong prosocial behavior in their organizational interactions. They actively engage in organizational activities and social interactions, fostering a friendly and collaborative environment. They prioritize building relationships, demonstrate problem-solving skills, and are motivated by collaborative efforts. They also engage in discussions on societal issues and remain open to diverse perspectives, actively contributing to the planning and organization of activities. Overall, their prosocial behavior contributes to a supportive and inclusive organizational environment.

1.3 Circle of people

Table 3
Prosocial Behavior in terms of Circle of People

Indicators	Weighted Mean	Verbal Interpretation
1. As a student leader, I feel what others feel.	4.38	Agree
2. As a student leader, I offer comfort to those who feel sad.	4.18	Agree
3. As a student leader, I am empathetic to those who seek and need my assistance.	4.40	Agree
4. As a student leader, I associate myself with sharing good opportunities with my co-members to develop their growth.	4.42	Agree
5. As a student leader, I am influenced by the helpful behavior of my constituents.	4.32	Agree
6. As a student leader, I understand when my co-members are uncomfortable, even if they do not say it directly.	4.38	Agree
7. As a student leader, I like to participate in fun activities with my co-members to strengthen our bond within the organization.	4.26	Agree
8. As a student leader, I find myself heedful to the emotional needs of my co-members.	4.22	Agree
9. As a student leader, I help fellow student leaders with tasks, even if they do not ask.	4.17	Agree
10. As a student leader, I feel respected when my co-members and fellow students do not invade my personal space.	4.58	Strongly Agree
Overall Mean	**4.33**	**Prosocial behavior is manifested**

Student leaders demonstrate strong prosocial behavior in their social circles. They exhibit empathy, actively contributing to their peers' growth and development. For example, they share opportunities (WM=4.42) and are influenced by their peers' helpful behavior (WM=4.32). They also prioritize emotional support, understanding when others are uncomfortable (WM=4.38), and finding themselves heedful to their peers' emotional needs (WM=4.22). Student leaders participate in bonding activities (WM=4.26), offer help without hesitation (WM=4.17), and value personal boundaries (WM=4.58). Overall, the data shows a strong manifestation of prosocial behavior among student leaders, with an overall mean of 4.33. This highlights their commitment to fostering supportive, empathetic, and inclusive relationships within their social circles.

2. How do the respondents assess their academic productivity in terms of:

2.1 Aptitude

Table 4
Academic Productivity in terms of Aptitude

Indicators	Weighted Mean	Verbal Interpretation
1. As a student leader, I pay attention and listen to my professors during lectures.	4.35	Often
2. As a student leader, I make sure that I am ready for every subject.	4.20	Often
3. As a student leader, I do an advanced reading or get familiarized with my course outline by reading our syllabus and module.	3.80	Often
4. As a student leader, I exert time and effort when I do difficult assignments and activities.	4.35	Often
5. As a student leader, I study the lessons I missed.	4.07	Often
6. As a student leader, I make sure that my extracurricular activities do not badly affect my studies.	4.44	Often
7. As a student leader, I make sure that I do my pending school activities first before anything else.	4.26	Often
8. As a student, I develop learning strategies to be able to cope and match the pace of my classmates.	4.30	Often
9. As a student leader, I further study the lessons I find interesting and useful for my leadership career and personal growth.	4.30	Often
10. As a student leader, I participate in class discussions by sharing my ideas to contribute to a more comprehensive understanding and perspective of the topic.	4.17	Often
Overall Mean	**4.23**	**Academic productivity is frequently evident**

Table 4 shows that student leaders are committed to academic engagement, with high levels of attentiveness and preparedness during lectures. They also exhibit proactive learning habits, such as advanced reading and familiarizing themselves with course materials. Additionally, they display a strong work ethic when it comes to challenging assignments and activities, and prioritize catching up on missed lessons and balancing extracurricular activities with their academic commitments. Student leaders also prioritize completing pending school activities and developing learning strategies to cope with the pace of their classmates. Furthermore, they engage in further study of interesting and relevant lessons for their leadership career and personal growth, demonstrating a holistic approach to learning beyond the classroom. Overall, the data suggests that student leaders frequently exhibit behaviors and strategies conducive to academic productivity, with an overall mean of 4.23. This underscores their dedication to academic productivity and success, reflecting their commitment to both their leadership roles and their academic pursuits.

2.2 Learning Environment

Table 5
Academic Productivity in terms of Learning Environment

Indicators	Weighted Mean	Verbal Interpretation
1. As a student leader, I offer aid to my co-students in using available learning equipment provided by our institution (digital projector, television, whiteboard, music system, etc.)	4.09	Often
2. As a student leader, I have the motivation to share my thoughts with my classmates inside our classroom.	4.26	Often
3. As a student leader, I feel that the institution supports the diversity of students to enable a good and healthy learning environment.	3.96	Often
4. As a student leader, I make sure that the room assignments are efficient as a learning environment.	4.14	Often
5. As a student leader, I feel that the faculty members and institution give attention and time to serve good quality education.	3.95	Often
6. As a student leader, I strategize in engaging with people to maintain a neat and comfortable learning environment.	4.17	Often
7. As a student leader, I spend my free time with my classmates while doing our assignments in class.	3.91	Often
8. As a student, I maintain focus on learning despite distractions.	4.15	Often
9. As a student leader, I find myself sensitive to what my classmates may feel or how they will react to a specific learning strategy.	4.11	Often
10. As a student leader, I contribute effectively to maintaining a healthy learning environment for all students.	4.30	Often
Overall Mean	**4.10**	**Academic productivity is frequently evident**

Table 5 reveals that student leaders are instrumental in fostering academic productivity within the learning environment. Their engagement and contributions manifest in several key areas, including proactive assistance with peers, utilizing available learning equipment, and fostering a collaborative environment (WM=4.26), effective management of logistical aspects, such as efficient room assignments, to enhance the learning environment (WM=4.14), prioritization of high-quality education, appreciation for resources, and commitment to creating conducive learning conditions (WM=3.95 and 4.17), sensitive approach to creating inclusive and effective learning experiences, demonstrating resilience in the face of distractions (WM=4.11 and 4.15), and valuable contributions to maintaining a healthy and supportive learning environment, characterized by camaraderie and collaboration (WM=3.91). In general, student leaders demonstrate a strong commitment to enhancing the educational experience for themselves and their peers, with an overall mean score of 4.10. Their proactive efforts to create a positive and supportive learning environment underscore their critical role in fostering academic success and personal growth.

2.3 Teaching

Table 6
Academic Productivity in terms of Teaching

Indicators	Weighted Mean	Verbal Interpretation
1. As a student leader, I welcome and respect cultural diversity in the classroom.	4.52	Always
2. As a student leader, I plan activities to enhance students' learning experiences and engage their minds.	4.21	Often
3. As a student leader, I offer aid to my co-members and fellow students to attain our academic goals.	4.30	Often
4. As a student leader, I make sure to reinforce a sense of responsibility and collaboration among students by leading them appropriately.	4.34	Often
5. As a student leader, I listen to the opinions and perspectives of my fellow students and co-members about important matters concerning their academic achievements.	4.46	Often
6. As a student leader, I work with my co-members to create plans for implementing effective teaching practices like group study, seminars, or webinars to help students understand discussions.	4.24	Often
7. As a student leader, I use creativity to learn and share my knowledge effectively with my classmates.	4.40	Often
8. As a student, I find myself motivated to learn more when I receive good acknowledgment from my professors and classmates.	4.42	Often
9. As a student leader, I can keep up with our instructor's teaching pace.	4.23	Often
10. As a student leader, I devise effective teaching plans in reporting, leading to an engaging learning experience for my classmates.	4.19	Often
Overall Mean	**4.33**	**Academic productivity is frequently evident**

Table 6 highlights the role of student leaders in enhancing academic productivity through teaching practices. Key findings include student leaders prioritizing inclusivity and respect for diversity, fostering a welcoming learning environment (WM=4.52), planning activities to enrich students' learning experiences, demonstrate commitment to active learning, and provide frequent assistance to peers (WM=4.21-4.31, student leaders listen to peers' opinions, work collaboratively, and utilize innovative approaches to teaching and learning (WM=4.40-4.46), they demonstrate motivation to learn, keep up with the instructor's pace, and devise effective teaching plans (WM=4.23-4.19). Overall, the data shows that student leaders frequently engage in behaviors that contribute to academic productivity in teaching, with an overall mean of 4.33. This underscores their active role in fostering a supportive and enriching learning environment.

3. Is there a significant relationship between the Prosocial Behavior and Academic Productivity of the respondents?

Table 7
Test of Relationship between Prosocial Behavior and Academic Productivity as to Aptitude

Variables	r-value	Strength of Relationahip	p-value	Decision	Interpretation
Social Setting	0.618	Strong Positive Correlation	Almost 0	Reject Ho	Significant
Social Interaction	0.632	Strong Positive Correlation	Almost 0	Reject Ho	Significant
Circle of People	0.617	Strong Positive Correlation	Almost 0	Reject Ho	Significant

Note: *Procedure: Pearson Product Moment Correlation Coefficient. If the computed p-value is less than the level of significance, then reject Ho. Otherwise, failed to reject.*

Table 7 shows the relationship between prosocial behavior and academic productivity in terms of aptitude. The results indicate a strong positive correlation between prosocial behavior in social settings (r=0.618, p-value almost 0), s strong positive correlation between prosocial behavior in social interactions (r=0.632, p-value almost 0), a strong positive correlation between prosocial behavior within the circle of people (r=0.617, p-value almost 0). In all three cases, the results suggest a significant positive relationship between prosocial behavior and academic productivity, indicating that prosocial behavior is positively correlated with academic performance.

Table 8
Test of Relationship between Prosocial Behavior and Academic Productivity as to Learning Environment

Variables	r-value	Strength of Relationahip	p-value	Decision	Interpretation
Social Setting	0.694	Strong Positive Correlation	Almost 0	Reject Ho	Significant
Social Interaction	0.687	Strong Positive Correlation	Almost 0	Reject Ho	Significant
Circle of People	0.748	Strong Positive Correlation	Almost 0	Reject Ho	Significant

Note: *Procedure: Pearson Product Moment Correlation Coefficient. If the computed p-value is less than the level of significance, then reject Ho. Otherwise, failed to reject.*

Table 8 shows the relationship between prosocial behavior and academic productivity in the learning environment. The results indicate a strong positive correlation between prosocial behavior in social settings (r=0.694, p-value almost 0), a strong positive correlation between prosocial behavior in social interactions (r=0.687, p-value almost 0), a strong positive correlation between prosocial behavior within the circle of people (r=0.748, p-value almost 0). All three correlations are significant, indicating that prosocial behavior is strongly and positively related to academic productivity in the learning environment.

Table 9
Test of Relationship between Prosocial Behavior and Academic Productivity as to Teaching

Variables	r-value	Strength of Relationahip	p-value	Decision	Interpretation
Social Setting	0.654	Strong Positive Correlation	Almost 0	Reject Ho	Significant
Social Interaction	0.735	Strong Positive Correlation	Almost 0	Reject Ho	Significant
Circle of People	0.788	Strong Positive Correlation	Almost 0	Reject Ho	Significant

Note: *Procedure: Pearson Product Moment Correlation Coefficient. If the computed p-value is less than the level of significance, then reject Ho. Otherwise, failed to reject.*

Table 9 shows the relationship between prosocial behavior and academic productivity in teaching. The results indicate a strong positive correlation between prosocial behavior in social settings (r=0.654, p-value almost 0), a strong positive correlation between prosocial behavior in social interactions (r=0.735, p-value almost 0), a strong positive correlation between prosocial behavior within the circle of people (r=0.788, p-value almost 0). All three correlations are significant, indicating that prosocial behavior is strongly and positively related to academic productivity in teaching.

DISCUSSION

The following is the discussion of the results of the study:

Student leaders exhibit prosocial behavior, prioritizing the welfare of their peers and institution. This is supported by Quain et al (2016), which highlights the importance of volunteering and social skills in promoting a peaceful and harmonious community. Prosocial behavior involves cooperation with others to achieve a common goal, and developing this skill can foster a sense of self-satisfaction and contribute to a positive learning environment. The respondents' prosocial behavior in social settings is characterized by empathy, respect, and kindness. They feel respected when their co-members and fellow students do not invade their personal space, and they value thoughtfulness and kindness. Paroqinog (2018) stated that kindness can have a positive impact on academic performance and engagement, creating an environment that promotes a sense of belonging and mental security. Overall, the study emphasizes the importance of fostering a culture of kindness, empathy, and cooperation among student leaders, which can lead to positive social connections and a positive learning environment. By consolidating thoughtfulness interventions into educational practices, schools can promote academic success, overall development, and well-being among students (Datu, 2022)

Student leaders' academic productivity is evident in their ability to balance extracurricular activities with their studies. Brouwer and Engels (2020) suggest that students' prosocial attitudes and academic achievement play a crucial role in forming connections and seeking help. Student leaders contribute to maintaining a healthy learning environment, actively involved in creating and maintaining a positive atmosphere. The study by Thielmann et al. (2020) found that students who learn in a prosocial environment tend to be more prosocial over time. The academic performance of student leaders is influenced by their exposure to this environment, which is

associated with academic productivity. Reyes et al. (2021) highlighted the importance of peer tutoring, constructive criticism, and collaborative learning in enhancing prosocial behavior and academic productivity. Overall, the discussion suggests that student leaders' academic productivity is linked to their prosocial attitudes, academic achievement, and involvement in collaborative learning. By fostering a positive learning environment and engaging with peers, student leaders can improve their own academic experiences and achieve academic goals.

The results show a strong positive correlation between prosocial behavior and academic productivity in terms of aptitude, social interaction, and engagement. This is consistent with Khan et al (2023) suggesting that academic productivity is linked to student engagement and active participation, which includes aptitude. The findings indicate that prosocial behavior is essential for enhancing academic productivity, as it enables students to progress and achieve high academic achievements. The results also support the idea that a favorable learning environment encourages students to display prosocial behavior, which in turn enhances academic productivity (Neef, 2023). The significant p-values and strong correlation coefficients highlight the importance of prosocial behavior in fostering academic productivity within the teaching domain. In summary, the study demonstrates a strong positive correlation between prosocial behavior and academic productivity across various aspects of the learning environment, emphasizing the significance of prosocial behavior in fostering academic productivity in teaching (Khuram et al, 2023).

CONCLUSIONS

Based on the results of the study, the following conclusions were drawn as follow:

The CAS student leaders of EARIST Manila meet the expectations of the role when it comes to social setting, social interaction, and circle of people. Student leaders are viewed as effective and efficient individuals who excel and meet their role expectations as student leaders who continuously serve and do something to benefit or help their fellow students. They exhibit prosocial behavior.

The CAS student leaders of EARIST Manila meet the expectations regarding aptitude, learning environment, and teaching. Student leaders are frequently viewed as academically productive and high-performing students who achieve and meet their role expectations as student leaders in a healthy learning environment. They exhibit academic productivity.

The results highlighted that the CAS student leaders of EARIST Manila had significantly shown that there is a strong positive correlation between prosocial behavior and academic productivity.

REFERENCES

Brouwer & Engels. (2020). *The role of prosocial attitudes and academic achievement in peer networks in higher education.* European Journal of Psychology of Education. https://sci-hub.hkvisa.net/10.1007/s10212-020-00526-w

Datu, J. a. D., Mateo, N. J., & Natale, S. (2022). *The Mental Health Benefits of Kindness-Oriented Schools: School Kindness is Associated with Increased Belongingness and Well-Being in Filipino High School Students*. Child Psychiatry & Human Development, 54(4), 1075–1084. https://doi.org/10.1007/s10578-021-01299-z

Khan et al. (2023). *The effect of Students' Cognitive and Emotional Engagement on Student's academic Success and Academic Productivity.*https://ojs.jssr.org.pk/index.php/jssr/article/view/141/132

Khuram et al. (2023). *Impact of Supportive Supervisor on Doctoral Students' Research Productivity: The Mediating Roles of Academic Engagement and Academic Psychological Capital.* https://doi.org/10.1177/21582440231185554

Neef, C. (2023). *Analyzing the Associations between Motivation and Academic Performance via the Mediator Variables of Specific Mathematic Cognitive Learning Strategies in Different Subject Domains of Higher Education.* https://eric.ed.gov/?q=academic%20performance%20and%20social%20behavior&ff1=subHigher%20Education&ff2=subCollege%20Students&id=EJ1377101&fbclid=IwAR29GdACANMqhrliHCcKaf_blwH47nF1_dEYrC7IbUKZgpTozHLhNzS6yPY

Paroginog, F. et al. (2018b). *Social Skills and Academic Performance among Grade 10 Students of the University of Bohol – University High School. Academe*, 12(1), 1–31. https://doi.org/10.15631/aubgsps.v12i1.87

Quain et al. (2016). *Pro-social Behavior amongst Students of Tertiary Institutions: An Explorative and a Quantitative approach.* Journal of Education and Practice. https://files.eric.ed.gov/fulltext/EJ1095830.pdf

Reyes et al. (2022). *Academic Motivation and Self-regulated Learning in predicting academic achievement of Letran Freshmen.*https://ejournals.ph/article.php?id=17204&fbclid=IwAR3O-NX6u_gc1lcyLbFq7ND2oyQm4iAbj9MeTkwrPHLwJAo0F5IRsYTrUWA

Thielmann et al. (2020). Personality and prosocial behavior: A theoretical framework and meta-analysis. Psychological Bulletin, 146(1), 30–90. https://doi.org/10.1037/bul00002

CLASSROOM DYNAMICS AND SCHOOL CLIMATE: THEIR IMPACT ON STUDENT ENGAGEMENT IN THE COLLEGE OF BUSINESS AND PUBLIC ADMINISTRATION

Ma. Theresa G. Maddagan
Rommel DG. Aquino
Dr. Jhon Ven Saint L. Pasahol

INTRODUCTION

In higher education, the quality of the learning environment profoundly impacts student outcomes. Educational institutions act as second homes for students, fostering interactions among peers, faculty, and administrators that enhance both academic success and personal growth. These environments go beyond simply delivering academic content; they are vital for cultivating essential skills such as critical thinking, leadership, and interpersonal relationships. In business and public administration education, active participation and engagement are crucial for shaping future leaders, entrepreneurs, and public administrators. Thus, a supportive and dynamic classroom environment is integral to how students learn, collaborate, and engage with their academic responsibilities.

Creating a positive school climate is particularly vital in professional programs like business and public administration. The nature of interactions within the classroom—between instructors and students, as well as among peers—greatly influences the overall academic experience. Classroom dynamics, characterized by communication and relationships, are foundational in promoting a collaborative atmosphere that fosters both intellectual and emotional growth. In the College of Business and Public Administration (CBPA), such an environment is essential not only for improving academic performance but also for supporting the holistic development of students. A welcoming, inclusive, and well-managed classroom aligns with the college's mission to prepare students for impactful roles in business and public service.

Despite the acknowledged significance of positive classroom dynamics and a healthy school climate, gaps remain in understanding how these factors affect student engagement, particularly in business education contexts. While existing literature addresses classroom dynamics in general education, specialized fields like business and public administration have received insufficient attention. Moreover, although considerable research has explored student engagement, the intricate relationships between classroom dynamics and school climate as contributors to engagement remain underexamined. This gap underscores the need for targeted investigation of these elements within the CBPA.

The impetus for this study stems from the ongoing challenges faced by educational institutions, especially business and public administration courses, in maintaining student engagement. Research consistently shows that disengagement can lead to higher dropout rates, decreased academic performance, and negative institutional perceptions. Poor classroom dynamics and an unfavorable school climate can exacerbate issues such as faculty burnout and strained relationships between administrators and students. This study aims to bridge these gaps by examining the perceptions of students, faculty, and administrators regarding school climate and its influence on student engagement. It will also investigate whether these perceptions of classroom dynamics differ among various stakeholders.

The objective of this research is to assess the relationships between classroom dynamics, school climate, and student engagement within the CBPA. Specifically, the study seeks to identify key factors influencing student engagement and analyze how perceptions of classroom dynamics differ among students, faculty, and administrators. Furthermore, it aims to

propose intervention strategies to enhance classroom dynamics and foster a more positive school climate, ultimately promoting a more engaged and productive student body. Through these investigations, the findings will offer valuable insights for improving educational practices within business and public administration education, benefiting both academic institutions and their students.

METHODOLOGY

This study employed purposive sampling to identify respondent's representative of the population within the College of Business and Public Administration (CBPA) at Eulogio "Amang" Rodriguez Institute of Science and Technology (Manila Campus). This non-probability sampling technique was selected for its ability to strategically target participants based on characteristics relevant to the research objectives.

The study's sample comprised 500 CBPA students, 15 faculty members (including both full-time and part-time instructors), and 5 administrators. This diverse pool of respondents was intentionally chosen to ensure a comprehensive perspective on the impact of classroom dynamics and school climate on student engagement. Students were selected based on their current enrollment in the program, while faculty and administrators were chosen for their active roles in teaching and shaping the educational environment. The inclusion of these groups is crucial, as they are directly engaged with the classroom dynamics and school climate that may influence student engagement.

Data collection was conducted using a structured survey method, incorporating questionnaires designed to gather both quantitative and qualitative data. The survey focused on key aspects of classroom dynamics, such as teaching methods and teacher-student interactions, as well as elements of school climate, including institutional support, physical environment, and peer relationships. The student questionnaires aimed to measure their levels of engagement in the program, while faculty questionnaires explored their perspectives on how classroom dynamics and school climate affect student behavior and motivation.

The purposive sampling technique ensured that the study gathered pertinent insights from individuals most familiar with the academic environment under investigation. By concentrating on this specific population, the research aimed to provide a nuanced understanding of how classroom dynamics and school climate shape student engagement within the context of entrepreneurship education.

RESULTS AND DISCUSSION

This study yielded several significant findings that reinforce the research objectives and initial hypotheses regarding classroom dynamics and school climate, and their impact on student engagement. The key findings are summarized below:

1. The level of classroom dynamics as assessed by students and full-time and part-time faculty members in terms of:

1.1 School Climate

1.1.1 Teacher and Student Relationship

The findings indicate that while teachers maintain positive relationships with students, characterized by care, respect, and empathy, they often fall short in providing personalized attention that recognizes individual strengths, needs,

and learning styles. These positive relationships are crucial, as they significantly influence students' motivation and performance. According to Scales et al. (2020), students' academic outcomes are indirectly affected by motivation, which is closely linked to their relationships with teachers. Aledago (2022) further highlights that effective classroom techniques contribute to students' overall health and social connections. This underscores the need for teachers to not only foster supportive relationships but also to implement effective classroom management strategies that cater to students' diverse needs.

1.1.2 Classroom Atmosphere

The analysis reveals that classrooms are well-maintained and organized, featuring adequate space and visual aids that promote efficient learning. However, the lack of peer interaction and collaborative opportunities has diminished the sense of community among students. Collaborative learning activities are essential, as they significantly enhance academic achievement and personal development. Jaminal (2019) emphasizes the importance of sufficient infrastructure for promoting student learning, while Singh et al. (2020) notes the myriad benefits of collaborative learning, such as increased understanding of complex concepts. Thus, enhancing collaborative learning experiences is vital for fostering student engagement and performance.

1.1.3 Inclusivity and Diversity

The study found positive outcomes regarding equity and the incorporation of diverse perspectives, but there remains a need to cultivate a greater sense of belonging among students. Continued professional development in multicultural education is essential to address emerging challenges and ensure long-term inclusivity. Pamaos (2022) argues that a positive classroom environment, where students feel they belong, is critical for improving learning outcomes and reducing the risk of negative behaviors.

1.2 Student Engagement

1.2.1 Active Participation

Students displayed enthusiasm for participating in class activities; however, there was a noticeable lack of responsibility for their own learning and opportunities to apply knowledge practically. To address this, educators should assign relevant homework, facilitate individual research, and present real-world scenarios. Tolero, Tabile, and Achacoso (2021) suggest that implementing a reward system can effectively enhance student involvement, while Rone et al. (2023) emphasize the importance of empowering students in their educational journeys. Educators' enthusiasm and engaging teaching styles are crucial in promoting active class participation.

1.2.2 Interest and Relevance of Content

While students expressed curiosity about the content, they often found it lacking in relevance to their lives and future goals. Ensuring that course material connects meaningfully to students' interests is vital for developing competent professionals. Tumapon (2023) discusses the need to integrate 21st-century skills—such as critical thinking, collaboration, and creativity—into instruction, fostering deep learning beyond rote memorization. Engaging

students in this manner enhances their educational experience and prepares them for success.

1.2.3 Collaborative Learning

Teachers effectively facilitated collaborative learning by establishing clear goals and providing necessary guidance, which significantly enhanced student commitment. However, there is a noted deficiency in students' respect and empathy during peer interactions. Omrod, Anderman, and Anderman (2019) assert that competent classroom management is essential for fostering an environment conducive to student engagement. Wu (2023) highlights the need for meticulous planning in collaborative learning strategies to address inherent challenges and promote respectful interactions among students.

2. The significant difference in the classroom dynamics as assessed by respondents.

2.1 School Climate

The analysis reveals the computed F-values for the dimensions of Classroom Dynamics: Teacher-Student Relationship (0.12053), Classroom Atmosphere (0.38982), and Inclusivity and Diversity (0.00055). Both the F-values for Teacher-Student Relationship and Classroom Atmosphere are below the critical value of 3.89 (with 2 and 12 degrees of freedom at the 0.05 level of significance), indicating a significant difference in perceptions among the three respondent groups—students, faculty, and administrators. However, while the F-value for Inclusivity and Diversity is also below the critical value, it does not suggest a significant difference.

Thus, we reject the null hypothesis for Teacher-Student Relationship and Classroom Atmosphere but accept it for Inclusivity and Diversity. These findings indicate that while perspectives on Teacher-Student Relationships and Classroom Atmosphere differ significantly across the groups, there is a consensus regarding Inclusivity and Diversity. This has practical implications for developing targeted interventions aimed at improving classroom dynamics. By recognizing these differing perspectives, educational leaders can craft more effective strategies to enhance relationships and foster a positive atmosphere while promoting inclusivity. This aligns with the work of Omrod, Anderman, and Anderman (2020), who emphasize the importance of cultivating a sense of belonging and community in educational settings. They advocate for creating a collaborative learning environment where both teachers and students actively engage in knowledge creation.

2.2 Student Engagement

The computed F-values for dimensions of Student Engagement include Active Participation (0.02764), Interest and Relevance of Content (0.02096), and Collaborative Learning (0.38821). The F-values for Active Participation and Interest and Relevance of Content are below the critical value of 3.89, suggesting no significant difference in these areas among the three respondent groups. In contrast, Collaborative Learning, despite its F-value also being below the critical value, shows a significant difference.

Consequently, we accept the null hypothesis for Active Participation and Interest and Relevance of Content, while rejecting it for Collaborative Learning. These results indicate a consensus among students, faculty, and administrators regarding Active

Participation and Interest and Relevance of Content yet reveal significant variability in perceptions of Collaborative Learning. Understanding these differences can guide school leaders in designing targeted interventions to enhance collaborative learning experiences. As Wu (2023) notes, barriers such as low motivation, excessive cognitive load, and inadequate teacher support can hinder collaborative learning. Strategies such as team incentive systems and fostering metacognitive skills can enhance the effectiveness of collaborative learning. Team rewards promote cooperation and motivation among members, while metacognitive strategies help students develop effective learning habits through planning, monitoring comprehension, and evaluating performance. This dual approach not only enhances academic outcomes but also improves overall student satisfaction and engagement.

3. Problems Encountered by respondents.

The findings reveal that the respondents faced several external distractions, including electronic devices, social media, and personal issues, which significantly hindered their full participation in classroom activities. These distractions reduced their ability to focus and engage meaningfully in their learning environment. On the other hand, respondents also encountered a moderate level of disengagement due to the perceived lack of relevance in the curriculum. Specifically, students felt that some classroom content was disconnected from their personal interests, career goals, or real-world experiences, which further diminished their motivation to actively participate in class.

These challenges are consistent with the observations of Chetan Kumar, G. K et al. (2021), who emphasized that offline learning methods, such as seminars, are often preferred by academics due to the rich, firsthand experience they provide. Offline learning environments allow students greater opportunities to network with peers and faculty, promoting deeper comprehension of subjects. Additionally, without the need for electronic devices, offline learning reduces the potential for distractions, thus facilitating better classroom participation and engagement.

These findings suggest that while technological tools are essential for modern education, they can also introduce challenges if not managed effectively. Furthermore, aligning course content with students' interests and real-world applications may enhance engagement by making learning more meaningful and relatable to their future careers. By addressing these issues, educators can create a more conducive classroom dynamic and positive school climate that fosters higher levels of student engagement.

4. Proposed Intervention Program

To address the identified issues at the CBPA, particularly concerning student engagement, faculty practices, administrative support, and the overall school climate, a targeted intervention program has been developed. The proposed **Inclusive and Adaptive Learning Program (IALP)** is designed to enhance classroom dynamics and foster a positive school climate by promoting interactive learning and personalized support tailored to students' needs. This program aims to create an inclusive and flexible learning environment where students feel a sense of belonging, are engaged, and can thrive academically.

At the heart of the program are interactive learning seminars and workshops that actively engage students in collaborative activities. These workshops bridge the gap between classroom learning and real-world applications, encouraging students to share ideas and participate in discussions. This approach not only enhances the relevance of the subjects taught but also

strengthens the sense of community within the classroom, making students feel more connected to their peers and the school environment. In addition, IALP provides personalized and flexible learning support, recognizing the diverse needs and learning styles of students. By offering tailored support, the program minimizes external distractions and maximizes focus, productivity, and engagement, helping students feel respected and valued within an inclusive learning atmosphere.

A key component of IALP is its focus on real-world application. By integrating real-life scenarios into the curriculum, the program enables students to apply their knowledge and skills in practical contexts, making their learning more relevant and engaging. This fosters independence and problem-solving abilities, as students are encouraged to take ownership of their educational journey. Moreover, the program incorporates ongoing assessment and adaptation to ensure its effectiveness. Regular feedback from both students and faculty will guide necessary adjustments, allowing the program to evolve and remain responsive to the needs of the student body.

The implementation of IALP is expected to have a significant positive impact on classroom dynamics and student engagement. By fostering a more interactive and inclusive learning environment, students are likely to feel more respected, empowered, and connected, which will enhance both their academic performance and overall well-being. Furthermore, the improvement in the school climate—marked by collaboration, mutual respect, and active participation—will lead to greater student satisfaction and engagement across the CBPA.

CONCLUSION

Based on the findings of this study, the following conclusions have been drawn:

1. The research underscores the significant role that a positive classroom environment and school climate play in fostering student engagement. Strong teacher-student relationships, active student participation, and the promotion of diversity and inclusivity were found to be key contributors to a stimulating learning environment. The high level of student engagement, demonstrated through active involvement, enthusiasm for course content, and effective group collaboration, suggests that a supportive classroom atmosphere is pivotal in enhancing student learning experiences.

2. Although perceptions of inclusivity and diversity did not vary significantly among students, faculty, and administrators, there were notable differences in how these groups viewed the teacher-student relationship and classroom dynamics. While collaborative learning showed a significant divergence in perceptions, there was no substantial difference in how students, faculty, and administrators rated the relevance of course content, student interest, and active participation. This points to a shared understanding of certain engagement factors, but varying perspectives on classroom interaction and collaboration.

3. The study highlights six key challenges within classroom dynamics that negatively impact student engagement: distractions during class, ineffective teacher-student communication, negative social pressures, lack of enthusiasm from both students and faculty, passive learning methods, and an overwhelming workload. These factors hinder optimal student engagement and suggest areas for improvement in creating a more conducive and dynamic learning environment.

RECOMMENDATION

In alignment with the study's findings and conclusions, the following recommendations are proposed to enhance classroom dynamics and school climate, thus improving student engagement:

1. **Enhance Classroom Environment and Inclusivity.** To improve the overall school climate, it is recommended to maintain a well-organized, stimulating classroom environment that promotes inclusivity and diversity. This can be achieved through regular professional development programs for educators, enhancing student engagement initiatives, and continuously updating the curriculum to reflect diverse perspectives. Additionally, incorporating a range of instructional methodologies, offering students greater autonomy and choice in their learning processes, and strengthening collaborative learning with clear objectives and robust support will foster a more engaging and inclusive classroom experience.

2. **Strengthen Collaborative Efforts among Educators, Students, and Administrators.** To build stronger teacher-student relationships and create a welcoming classroom environment, it is recommended to implement cooperative projects that involve all stakeholders—educators, students, and administrators. These initiatives should aim to reinforce inclusivity across all aspects of education. Enhancing collaborative learning techniques through shared understanding and consistent practices will ensure their effectiveness. Retaining the strategies of *Active Participation, Interest, and Relevance of Content* will be critical, while addressing variances in perceptions of collaborative learning through targeted interventions is essential.

3. **Address Classroom Dynamics to Boost Engagement.** To address the six key challenges impacting classroom dynamics, it is recommended to enhance teacher-student interaction by providing regular feedback and cultivating an encouraging classroom environment. Creating a positive classroom culture to counter negative social pressures and increase student motivation through real-world connections is vital. Additionally, balancing the academic workload to ensure relevance, minimizing distractions by setting clear guidelines and delivering engaging lessons, and encouraging active learning through interactive teaching methods will improve classroom engagement. Furthermore, implementing policies to limit gadget use during class can help students remain focused and actively participate, leading to better learning outcomes.

REFERENCES

Aledago, R. T. (2022). *AIDE Interdisciplinary Research Journal*. Retrieved from https://ejournals.ph/article.php?id=18146

Chetan Kumar, G. K., Ranggapa, K. B., & Suchitra, S. (2021). *Munich Personal RePEc Archive*. Retrieved from https://mpra.ub.uni-muenchen.de/110320/

Jaminal, B. D. (2019). *SMCC Higher Education Research Journal*. Retrieved from https://ejournals.ph/article.php?id=14324&fbclid=IwAR2BW3a3c5qEtqASqlIT27x3I3yq-rs3IahwwTqD9qhDgmQEhZgBK781MZA

Omrod, J. E., Anderman, E. M., & Anderman, L. (2019). *Educational psychology: Developing learners*. Pearson.

Pamaos, J. (2022). *Psychology and Education: A Multidisciplinary Journal*. Retrieved from https://ejournals.ph/article.php?id=20979

Rone, N., Guao, N. A., Jariol, M. Jr., Acedillo, N., Balinton, K., & Francisco, J. (2023). *Psychology and Education: A Multidisciplinary Journal*. Retrieved from https://ejournals.ph/article.php?id=21231

Scales, P. C., Van Boekel, M., Pekel, K., Syvertsen, A. K., & Roehlkepartain, E. C. (2020). *Psychology in the schools*. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/pits.22350

Singh, A., Ago, B. J., Benosa, D., Cerillo, T., Laguna, D., & Ugto, A. (2020). *Ascendens Asia Singapore – Bestlink College of the Philippines Journal of Multidisciplinary Research*. Retrieved from https://ojs.aaresearchindex.com/index.php/aa%20sgbcpjmra/article/view/1491

Tolero, J., Tabile, D., & Achacoso, J. (2021). *International Journal of Multidisciplinary: Applied Business and Education Research*. Retrieved from https://ejournals.ph/article.php?id=16965

Tumapon, T. T. (2023). Collaborative learning. *The Manila Times*. Retrieved from https://www.manilatimes.net/2023/01/12/campus-press/collaborative-learning/1873850

Wu, Y. (2023). Explore the effectiveness factors and improvement strategies of collaborative learning. *Lecture Notes in Education Psychology and Public Media, 21*(1), 266-272. https://doi.org/10.54254/2753-7048/21/20230168

College Research Project Heads

Ar. John Vincent R. Lopez
CAFA

Dr. Roel P. Balayan
CAS

Dr. Emerson G. Cabudol
CBPA

Mr. Juan Leonardo B. Britanico
CCJE

Dr. Jefferson A. Costales
CCS

Dr. Ailene R. Tuazon
CED

Prof. Meriam L. Tria
CEN

Dr. Jeffrey B. Villena
CHTM

Prof. Joseph Angelo C. Tanuecoz
CIT

Dr. Josephine S. Tuvilla
ECC

Dr. Rogelio T. Mamaradlo
PRESIDENT

Dr. Allan Q. Quismundo
Executive Vice President

Dr. Eric C. Mendoza
Vice President for Academic Affairs

RESEARCH SERVICES STAFF

Dr. Marlene M. Monterona
DIRECTOR

Mrs. Melchorita P. Alvior
EDUCATION PROGRAM SPECIALIST II
In-charge, Journal Reproduction

Engr. Jerome M. Saltorio
EDUCATION PROGRAM SPECIALIST I
In-charge, DOST and IPO Phil Projects

Mr. Richard V. Evangelista
EDUCATION RESEARCH ASSISTANT I
In-charge, Journal Layout and Publication

Mr. Edgardo R. Sison
In-charge, Web Design / Development

Mr. Joseph Calandria
Research Staff

Mr. Marvin V. Lopez
Research Staff

EARIST Research Journal
Volume XXIV, No. 36 ISSN 0119-5212
JULY– DECEMBER 2024

Publication Board

Republic of the Philippines

EULOGIO "AMANG" RODRIGUEZ INSTITUTE OF SCIENCE AND TECHNOLOGY

Nagtahan, Sampaloc Manila

The EARIST Innovation and Technology Support Office (EARIST-ITSO) is one of the franchise patent libraries of the Intellectual Property Office, Philippines (IPO-Phil). Its main objective is to advocate the protection of intellectual property on the academe sector. Its strategy is to have a demystified, democratized, and development-oriented patent system, easy to understand by technical people and laymen, to remove the fear of disclosing their intellectual property and eventually registering them for their own protection.

A demystified patent system is evidenced by the fact that majority of the knowledge generators, researchers, and R and D proponents in the country know how to access global scientific and technology information through the patent databases, and when they wish to protect their innovations, they will know how to obtain patents.

A democratized patent system means that patents is an interdisciplinary concern involving business, researchers, engineering, scientists, faculty, students, government, lawyers and other professions, who will know about and use the patent information, engage in patenting activities and participate in technology commercialization.

A development-oriented patent system implies that the patent system is fashioned as an effective tool to bring progress and prosperity, purposely tailored-fit to the particular needs of, and readily accessible by those who want to use patent information and obtain patents.

Services Offered:

- Conduct Seminars and Trainings
- Patent Database Search
- Patent Drafting
- Assistance for Commercialization of Technology

Contact Nos. (02) 8243 9467 / 8243 9460 / 8243 9466 / 8243 9468 / 8243 9437 Loc. 117

TECHNOLOGY INNOVATION AND SUPPORT OFFICE