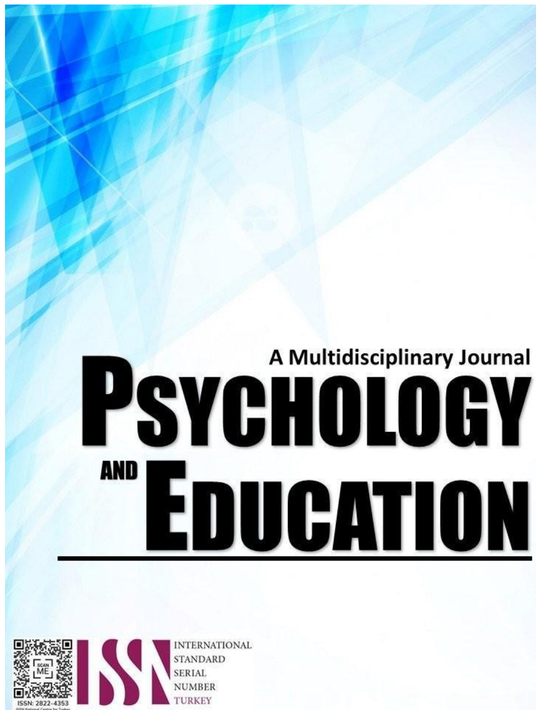
LEVERAGING MOBILE TECHNOLOGY APPLICATIONS TO ENHANCE CIRCUIT TRAINING IN MECHATRONICS: A PROPOSED LEARNING GUIDE



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Research Article

Leveraging Mobile Technology Applications To Enhance Circuit Training In Mechatronics: A Proposed Learning Guide

Nerlie R. Dimapilis,* Edilberto Z. Andal
For affiliations and correspondence, see the last page.

Abstract

This study examines the effectiveness of utilizing mobile technology applications—specifically, the FluidSIM mobile app—to enhance circuit training in Mechatronics education among Grade 11 students at General Mariano Alvarez Technical High School. Recognizing the challenges in providing adequate computer resources for technical and vocational subjects, this study explores how smartphones can serve as accessible tools for simulation-based learning in Pneumatics and Electro-pneumatics. Grounded in Mobile Learning Theory and Human-Computer Interaction (HCI), the research employs a quasi- experimental design with pre-tests and post-tests to evaluate learning outcomes. Forty-one students participated, and results revealed a statistically significant improvement in their post-test scores after using the FluidSIM app. The findings affirm the application's effect on increasing engagement, accessibility, and mastery of technical skills. The study concludes that mobile technology offers a practical and scalable solution to enhance Mechatronics training and recommends its broader adoption in technical-vocational curricula when appropriately integrated.

Keywords: *Leveraging Mobile Technology, FluidSIM, Mechatronics, Pneumatics, Electro-pneumatics*

Introduction

Concurrent with the advancement of technology in our nation, there is also progress in the use of contemporary teaching methodologies. Numerous strategies are being developed to simplify teaching methodology, particularly in technical disciplines. These advancements facilitate students' learning and empower them with access to modern educational devices, such as personal computers and cell phones.

Modern educational resources will significantly aid in efficiently transmitting information to students. Several internet platforms are available to assist teachers in developing classes and activities for students.

Insufficient computer resources hinder various activities, particularly in the field of Mechatronics, due to a shortage of computers relative to the number of students. According to DepEd ICT Director Ferdinand Pitagan, the student-to-computer ratio is 1:9, while the teacher-to-computer ratio is 1:30. This means that the number of computers cannot support the needs of both students and teachers.

According to the proposed Electronic Gadget-Free Schools Act (Senate Bill No. 2706), the Department of Education (DepEd) is required to announce guidelines regarding the prohibition of using cellphones and other electronic devices, unless they are used in lessons that specifically require mobile devices. This is stated in SEC. 7, which notes that mobile devices or electronic gadgets shall not be used within school premises during class hours, except in the following cases: Learning-related exceptions, such as classroom presentations or class-based learning activities that require the use of such technologies, or for learners who need reasonable adjustments to a learning program due to a learning disability or difficulty.

Within the field of Mechatronics, specific topics, such as Pneumatics and Electro-pneumatics, require a computer to carry out the associated tasks. However, if the computer the students utilize is inadequate, it will take them longer to complete a task.

This study aims to explore the significance of integrating digital technology, such as cell phones or smartphones, in enhancing the teaching and learning processes of instructors and learners.

Through a comprehensive analysis of existing literature and empirical evidence, this paper aims to assist educators in prioritizing the integration of digital technology in the classroom, specifically through the use of cell phones or smartphones, to cater to students' learning needs.

The primary objective of the research on Leveraging Mobile Technology Applications is to enhance the teaching and learning of circuit training in Mechatronics. Additionally, it addresses the issue of schools lacking the resources to provide computers for their students.

This study will focus on students from General Mariano Alvarez Technical High School. Grade eleven students will undergo sample collection. Students must be actively enrolled in the Mechatronics specialization. This study examines the effect of digital technology, specifically cell phones or smartphones, on students' academic performance and learning outcomes.

Research Questions

The study sought to determine leveraging mobile technology applications to enhance circuit training in Mechatronics. To answer the above-cited problem, an answer to the following will be sought:

1. What is the profile of the respondents as to:

1.1 age; and
1.2 gender?

2. What are the pretest scores of the respondents before the fluidsim mobile technology applications in the enhanced circuit training mechatronics in terms of:
   2.1 pneumatics; and
   2.2 electro-pneumatics?
3. What are the post-test scores of the respondents after using the fluidsim mobile technology applications in the enhanced circuit training mechatronics in terms of
   3.1 pneumatics; and
   3.2 electro-pneumatics?
4. Is there significant differences between the pre-test and post-scores of the respondents before and after using the fluidsim mobile application in the enhanced circuit training mechatronics in terms of:
   4.1 pneumatics; and
   4.2 electro-pneumatics?

Methodology

Research Design

This research employed a quantitative methodology. Quantitative research methods (King et al., 2021) are systematic approaches used to collect and analyze numerical data to draw objective conclusions and make statistical inferences. This method generates numerical data by administering questionnaires through Google Forms to students who serve as study participants. Furthermore, this quantitative approach yields methodical, deliberate, and organized study. This research method, known as quantitative research, is extensively utilized in many research studies. It involves gathering data, quantifying it, and verifying its accuracy using surveys and interviews with relevant individuals. This study mainly employs statistical research methods (Lindl et al., 2020) to get quantitative data from research projects. This quantitative research strategy yields exact and realistic information, enhancing the trustworthiness and validity of the study as it produces numerical outcomes.

This study employed a quasi-experimental design utilizing pre-tests and post-tests to assess the variance in student learning results between students using mobile technology applications. The quasi-experimental design is very similar to the experimental design but does not use an indefinite group of prospective research participants. Its purpose is to evaluate the effect of the experiment. However, it is limited to only controlling those involved in the research, as there is no specific selection of participants.

Respondents

The respondents of the study "Leveraging Mobile Technology Applications to Enhance Circuit Training in Mechatronics: A Proposed Learning Guide" were selected based on their direct involvement in the Mechatronics specialization. They were categorized as follows: Population: Grade 11 students currently enrolled in Mechatronics Servicing at General Mariano Alvarez Technical High School; Rationale: These students are the primary beneficiaries of the proposed mobile applications for their specialization. Their suggestions and experiences informed the adoption of mobile technology in their field; Sample size: The representative sample consisted of approximately 41 students from grade 11 Mechatronics.

The respondents of the study are presented in Table 1:

Table 1. *Distribution of the Respondents*

School	*Population*	*Actual Respondents*
1. General Mariano Alvarez Technical High School – Senior High SchoolG11 Mechatronics students – Salud Algabre	20	20
2. General Mariano Alvarez Technical High School – Senior High SchoolG11 Mechatronics students – Nicolasa Virata	21	21
Total	41	41

Instrument

The researcher prepared a pre-test to assess the prior knowledge of Grade 11 Mechatronics students studying pneumatics and electro-pneumatics without using a mobile application, as well as a post-test to evaluate the knowledge gained by these students after utilizing the mobile application. The content of both tests is based on the lesson about pneumatic and electro-pneumatic circuits, with each test containing 20 questions related to these topics. The validation process, which critically involved a 5-point Likert scale, relied on the results from the respondents.

After conceptualizing and formulating the pre-test and post-test, the researcher presented them to the panel members for necessary corrections, revisions, and suggestions for improvement. Approval for the final copy of the instrument was requested from the panel members.

Upon approval, the research instrument was validated by four (4) experts. It involved one (1) language teacher, one (1) TVL-Mechatronics teacher, one (1) master teacher in TVL, and one (1) head teacher in Mathematics. It was validated as to its coherence and relevance to the problems of the study. After the validation of the research instrument, the researcher advanced to pilot-testing among fifteen (15) Grade 11 students who were not included as the respondents of the study. It is to ensure that the contents are constructed within the mental ability of the respondents. The validated research instrument was presented again to the Oral Examination Committee for their approval in the administration of the said instrument.

Procedure

The researcher followed specific steps to achieve the study's objectives. Research instruments prepared by the researcher were utilized to gather the desired results. The researcher drafted a permission letter seeking approval from the Dean's Office of Laguna State Polytechnic University College of Teacher Education to conduct the study. This letter underwent validation by both internal and external validators. Upon receiving approval from the Oral Examination Committee, the researcher submitted a request letter to the Schools Division Superintendent (SDS) of Cavite Province to conduct the study. After a week, the research team from SDO-Cavite responded that the SDS had approved the request. This included a list of requirements that the researcher must fulfill to carry out the study. The researcher then forwarded a letter to the principal of General Mariano Alvarez Technical High School. The letter included attachments of the instruments, parental consent forms, assent forms from minors, and informed consent forms, as the respondents were students, most of whom were under 18 years old.

Afterward, with the consent of the SDS and the principal, the Mechatronics teacher at General Mariano Alvarez Technical High School was informed about the administration of the pre-test. After obtaining approval, the researcher presented the research instruments to external validators for further assessment. Following this, the participation of forty-one (41) students from General Mariano Alvarez Technical High School, specifically from Grade 11 sections Nicolasa Virata and Salud Algabre, was sought.

The researcher conducted a pre-test on Pneumatics in January 2025, using questionnaires to assess the students' prior knowledge. After analyzing the pre-test results, the researcher distributed copies of the learning guide for the FluidSIM Mobile Technology Application. Students used this application for circuit training because the limited number of available computers did not meet everyone's learning needs. The learning guide explains how to download, install, and use the application; this information can be found in Appendix H. After the students followed the learning guide to use the application, the researcher began teaching lessons on the Pneumatic circuit. While providing examples relevant to the lesson, the researcher also had the students use the application to enhance their understanding of the material and topic. Once all the lessons on Pneumatic Circuits were taught, activities were assigned to test whether the students understood the material. The instructions for the activities can also be found in the learning guide. The Pneumatic Circuit includes seven activities that students must complete using the FluidSIM mobile application. After all students completed the activities on the Pneumatic circuit, the post-test was administered in January 2025.

Following the discussion on pneumatics, a pre-test on electro-pneumatics was conducted in January 2025. After reviewing the students' results, lessons on electro-pneumatics began. Similar to pneumatics, students were encouraged to use the application, providing examples to create a circuit and deepen their understanding of the lesson. After successfully creating the electro-pneumatics circuit in the FluidSIM application, they wired in the mock-up to check whether it operated according to the required sequence. After the lessons are taught, students complete five activities. In these activities, they used the FluidSIM mobile application to test their understanding of the lesson and verify if the circuit they built is correct. Then, they wired it into the mock-up. After students completed all the activities, they were given a Post-test in February 2025.

The researcher collected all instruments and data for analysis. She summarized the data using various statistical tools, including Microsoft Excel formulas. The summarized data was sent to the adviser for cross-checking and to the statistician for statistical treatment. After the adviser and statistician validated the results, the researcher submitted them to the University's Statistics Center. She then waited for the validated results. Once received, she arranged the charts and tables, evaluating and interpreting them to gain a deeper understanding of the study's subject.

The researcher ensured the privacy and confidentiality of the student respondents' answers and data. The anticipated results from the gathered data were shared solely between the researcher and the thesis adviser. Additionally, the names of the student respondents were not required or disclosed in the study.

Data Analysis

The researcher employed several statistical tools to gather the data necessary to address the study's problem. This data ultimately facilitated the tabulation, analysis, summarization, interpretation, and presentation of the study's results.

In this study, the researcher employed frequency statistical treatment to determine the mean and standard deviation of the pre-test and post-test scores for both groups before and after using mobile technology. The researcher applied an independent t-test for pre-test analysis to compare the scores of the two groups and to see if there was any difference in their basic knowledge before using mobile technology in pneumatics and electro-pneumatics. The independent t-test was also utilized to compare the post-test scores of the two groups to assess the effectiveness of using mobile applications to promote learning in pneumatics and electro-pneumatics.

Results and Discussion

This chapter presents the study's results, analyzing the data gathered from the respondents through pre-test and post-test evaluations. It includes the respondents' profiles, their performance in Pneumatics and Electro-pneumatics before and after the implementation of the FluidSIM mobile technology application, and the statistical test of difference to determine the significance of the improvement observed.

Profile of the Respondents

Table 2. *Distribution of the respondents as to Age*

Age	*f*	*%*
16	17	41.5%
17	16	39.0%
18	5	12.2%
19	2	4.9%
22	1	2.4%
Total	41	100.0%

This table illustrates the age distribution of respondents. The majority of respondents were 16 years old, making up 17 or 41.5% of the total, closely followed by those who were 17 years old, accounting for 16 or 39.0%. The least represented group comprised respondents aged 22 years, which constituted only 1 or 2.4% of the population. This indicates that most respondents are in mid to late adolescence, a crucial developmental stage during which learning through interactive technology can be highly engaging and effective.

Table 3. *Distribution of the respondents as to Gemder*

Gender	*f*	*%*
Male	39	95.1%
Female	2	4.9%
Total	41	100.0%

The table presents the distribution of the student respondents by gender. The data shows that out of the 41 respondents, 39 or 95.1% identified as male, while only 2 or 4.9% identified as female. This reflects the male-dominated composition of students in the mechatronics course, which is typical in technical-vocational fields.

Pre-test Performance Before Using FluidSIM Mobile Technology

Pneumatics

Table 4. *Distribution of the Pretest Scores of the Respondents before the Fluidsim Mobile Technology Applications in the Enhanced Circuit Training Mechatronics in terms of Pneumatics*

Pneumatics pre-test Scores	*f*	*%*	*Interpretation*
17-20	-	-	Excellent
13-16	-	-	Very Good
9-12	1	0.6	Good
5-8	15	9.15	Fair
0-4	25	12.2	Needs Improvement

Legend: 17-20 (Excellent); 13-16(Very Good); 9-12 (Good); 5-8 (Fair); 0-4 (Needs Improvement)

This table displays the pre-test scores of students in pneumatics before using the FluidSIM mobile application. It indicates that the students' scores reflect their prior knowledge of the lesson. The table shows that 25 students, or 12.2%, received scores ranging from 0 to 4, which is interpreted as "Needs improvement." This indicates that the students do not yet possess sufficient knowledge of the lesson.

Fifteen students obtained scores ranging from 5 to 8, or 9.15%, and the verbal interpretation was "Fair." This indicates that they know a little more but not enough to claim they understand the lesson, as the pre-test may have been guessed.

Of the 41 students who took the pre-test, only one scored a 9 or 0.6%. With scores ranging from 9 to 12, the verbal interpretation was "Good," indicating that their scores show knowledge beyond the students' previous scores.

These results indicate a general need for improvement to a fair understanding of Pneumatics before integrating the FluidSIM mobile application, suggesting enhanced instructional methods are needed.

Electro-pneumatics

This table shows the pre-test scores of students in electro-pneumatics before using the FluidSIM mobile application. Students’ scores are lower in electro-pneumatics because it is more technical than pneumatics.

Table 5. *Distribution of the Pretest Scores of the Respondents before the Fluidsim Mobile Technology Applications in the Enhanced Circuit Training Mechatronics in terms of Electro-Pneumatics*

Electro-pneumatics pre-test scores	*f*	*%*	*Interpretation*
17-20	-	-	Excellent
13-16	-	-	Very Good
9-12	-	-	Good
5-8	8	6.53	Fair
0-4	33	16.1	Needs Improvement

Legend: 17-20 (Excellent); 13-16(Very Good); 9-12 (Good); 5-8 (Fair); 0-4 (Needs Improvement)

The results of the scores show that 33 students, or 16.1% of the population, received a score ranging from 0 to 4. These scores have a verbal interpretation of "Needs Improvement," which means that the students know little or nothing about the lesson and therefore need to undergo more in-depth study about electro-pneumatics.

It can also be noted that 8 students, or 6.53%, achieved higher scores ranging from 5 to 8, which were interpreted verbally as "Fair." The scores may be a little higher, but it's still not enough to say they really have knowledge in electro-pneumatics, so they still need to go through a more in-depth study of the lesson.

These findings confirm that students have limited knowledge and skills in Electro-pneumatics before using the FluidSIM mobile application.

Post-test Performance After Using FluidSIM Mobile Technology

Pneumatics

Table 6. *Distribution of the Post-test Scores of the Respondents after the Fluidsim Mobile Technology Applications in the Enhanced Circuit Training Mechatronics in terms of Pneumatics*

Pneumatic post-test Scores	*f*	*%*	*Interpretation*
17-20	41	25.03	Excellent
13-16	-	-	Very Good
9-12	-	-	Good
5-8	-	-	Fair
0-4	-	-	Needs Improvement

Legend: 17-20 (Excellent); 13-16(Very Good); 9-12 (Good); 5-8 (Fair); 0-4 (Needs Improvement)

This table illustrates the improvement in students' scores after utilizing the FluidSIM mobile application for pneumatic circuit training.

The table shows that the students' scores improved after using the FluidSIM mobile application. This improvement is attributed to their knowledge of pneumatics after the use of the FluidSIM mobile application, compared to their performance before being taught about the lesson.

The table shows that 41 students scored within the range of 17 to 20, accounting for 25.03% of the population with a verbal interpretation of "Excellent." This indicates that, based on their post-test scores, the use of the FluidSIM mobile application was effective for students.

This distribution indicates a marked improvement in students' understanding and performance in Pneumatics following the mobile technology-enhanced learning approach.

Electro-pneumatics

Table 7. *Distribution of the Post-test Scores of the Respondents after the Fluidsim Mobile Technology Applications in the Enhanced Circuit Training Mechatronics in terms of Electro-pneumatics*

Electro-pneumatics pre-test scores	*f*	*%*	*Interpretation*
17-20	41	25.03	Excellent
13-16	-	-	Very Good
9-12	-	-	Good
5-8	-	-	Fair
0-4	-	-	Needs Improvement

Legend: 17-20 (Excellent); 13-16(Very Good); 9-12 (Good); 5-8 (Fair); 0-4 (Needs Improvement)

Table 7 presents the improvement in students' performance after using the FluidSIM mobile application in electro-pneumatics circuit training.

The table indicates that the students' scores were high. All students received scores ranging from 17 to 20, representing 25.03% of the population. All scores obtained by students in the post-test were interpreted as "Excellent" verbally. This alone demonstrates that the use of the FluidSIM mobile application for their study of electro-pneumatic circuits was effective.

This pattern strongly indicates that the FluidSIM mobile technology application effectively improved student learning and mastery in Electro-pneumatics.

Significant Difference Between Pre-test and Post-test Scores

Pneumatics

Table 8. *Test of Significant Difference between the Pre-test and Post-scores of the respondents using the Fluidsim mobile application in the enhanced circuit training mechatronics in terms of Pneumatics*

Test	*Mean*	*SD*	*Mean Diff.*	*t*	*df*	*Sig. (2-tailed)*	*Interpretation*
Pre-test	3.98	2.23	-15.27	-38.793	40	0.000	Significant
Post-test	19.24	0.97					

Legend: Sig (2-tailed) ≤ .05 (Significant); Sig (2-tailed) ≥ .05 (Not significant)

The analysis of the respondents' pre-test and post-test scores, as shown in the provided table, reveals a significant improvement in scores from pneumatics circuit training following the use of the FluidSIM mobile application. The mean scores increased markedly from pretest to post-test, with a mean difference of -15.27. The t-value, -38.793, along with the corresponding p-values of 0.000, indicates that these improvements are statistically significant at the 0.05 level. This notable enhancement in the students' scores can be attributed to the use of the FluidSIM mobile application.

According to the study of Yuan et al (2025), consequently, the adoption of appropriate mobile applications at different stages of learning to enhance academic performance has emerged as a pressing issue.

Moreover, Aresta et al. (2015) found that pedagogical design and individual preferences are fundamental to the successful adoption of mobile applications. This aligns with using the FluidSIM mobile application for learning pneumatic circuit training.

Electro-Pneumatics

Table 9. *Test of Significant Difference between the Pre-test and Post-scores of the respondents using the Fluidsim mobile application in the enhanced circuit training mechatronics in terms of Electro-pneumatics*

Test	*Mean*	*SD*	*Mean Diff.*	*t*	*df*	*Sig. (2-tailed)*	*Interpretation*
Pre-test	2.95	1.86	-16.49	-56.382	40	0.000	Significant
Post-test	19.44	0.90					

Legend: Sig (2-tailed) ≤ .05 (Significant); Sig (2-tailed) ≥ .05 (Not significant)

The table presents the test for significant differences between pre-test and post-test scores in the electro-pneumatic circuit. The mean scores increased from the pre-test, which was 2.95, to the post-test, which was 19.44, resulting in a mean difference of -16.49. The t-value of -56.382, along with the corresponding p-value of 0.000, indicates that these improvements are statistically significant at the 0.05 level. This notable improvement in the students' scores can be attributed to the use of the FluidSIM mobile application. These findings imply that the use of FluidSIM mobile applications is effective in electro-pneumatic circuit training.

According to Yuan al (2025), once the appropriate mobile learning applications have been selected, learners are expected to actively engage with these tools to enhance their targeted skills. This demonstrated that by utilizing the FluidSIM mobile application, Grade 11 Mechatronics students were able to enhance their understanding of the lesson on electro-pneumatics, even though they were only using mobile devices. The absence of computers did not hinder their ability to acquire sufficient knowledge and skills in electro-pneumatics.

This study aimed to evaluate the effectiveness of the FluidSIM mobile technology application in enhancing circuit training in Mechatronics, with a specific focus on Pneumatics and Electro-pneumatics. The research involved 41 student respondents, whose profiles were described in terms of age and gender. Their knowledge and skills were assessed through pre-test and post-test scores, measured before and after integrating the mobile technology application.

The profile analysis showed that most respondents were 16 to 17 years old, and most were male, reflecting the standard demographics in technical-vocational education. Pre-test scores revealed that students generally performed poorly to moderately in both Pneumatics and Electro-pneumatics. After using the FluidSIM mobile application, post-test scores showed significant improvement, with many respondents achieving near-perfect or perfect scores.

Statistical analyses confirmed a significant difference between the pre-test and post-test scores in both subject areas, affirming the positive impact of the FluidSIM mobile technology on student learning outcomes.

Conclusions

Based on the findings of the study, the following conclusions are drawn:

The use of FluidSIM led to statistically significant improvements in students' performance, as evidenced by the results of the t-tests in both Pneumatics and Electro-pneumatics; therefore, the hypothesis is not sustained.

The effectiveness of mobile technology in circuit training can serve as a powerful tool for engaging learners, enhancing practical skills, and promoting academic success in Mechatronics; thus, the hypothesis is not sustained.

Considering the study's findings, the following recommendations are offered:

Integration of Simulation Tools: Schools offering Mechatronics and other technical courses should consider adopting simulation-based mobile applications like FluidSIM to supplement traditional classroom and laboratory instruction.

Professional Development: Teachers should be trained in using mobile technology applications and digital tools to maximize their potential in improving student learning outcomes, not only in Mechatronics but also in all subject areas.

Further Research: Future studies may explore the long-term impact of simulation technology on student performance or compare its effectiveness with other instructional methods across different strands or technical subjects.

Curriculum Enhancement: Educational institutions may consider revising their curriculum to include blended learning strategies incorporating mobile and digital tools in technical-vocational education.

Wider Implementation: This study's positive results support the potential for broader implementation of mobile technology in other areas of the K–12 curriculum, particularly in TVL-related courses.

References

Ababa, E., Joven, S., Santiago, J., Jomarie, Y., Mostajo, O., Pascual, S., Bucasas, J., Denver, J., Javillonar, D., Vera, S., Bocao, J., Francisco, C., & Francisco, C. (2021, January 29). The use of educational applications on the student's academic performance. International Journal of Multidisciplinary Studies. https://www.researchgate.net/publication/348930098_The_Use_of_Educational_Applications_on_the_Student's_Academic_Performance/citation/download

Ageing. Com (2023)What is Modern Technology and How is it Changing? Retrieved from https://aging.com/what-is-modern-technology-and-how-is-it-changing/

Ahmed, A., Arya, S., Gupta, V., Furukawa, H., & Khosla, A. (2021). 4D printing: Fundamentals, materials, applications and challenges. Polymer, 228, 123926. https://doi.org/10.1016/j.polymer.2021.123926

Aldi, Akbar, M., Hamdani, & Najib, N. (2024, November 15). Development of learning media for pneumatic control systems for separation and transportation of goods based on programmable logic controller (PLC). Jurnal Teknologi Elekterika, 21(2), 111–116. https://doi.org/10.31963/elekterika.v21i2.5105

Alencar, A., Z. Shimbo, J., Lenti, F., Balzani Marques, C., Zimbres, B., Rosa, M., Arruda, V., Castro, I., Fernandes Márcico Ribeiro, J., Varela, V., Alencar, I., Piontekowski, V., Ribeiro, V., M. C. Bustamante, M., Eyji Sano, E., & Barroso, M. (2020). Mapping Three Decades of Changes in the Brazilian Savanna Native Vegetation Using Landsat Data Processed in the Google Earth Engine Platform. Remote Sensing, 12(6), 924. https://doi.org/10.3390/rs12060924

AlFahad, F. N. (2009). Students' Attitudes and Perceptions towards the Effectiveness of Mobile Learning in King Saud University, Saudi Arabia. Turkish Online Journal of Educational Technology, 8(2) 111-119.

Ali, A., Rahim, H. A., Pasha, M. F., Dowsley, R., Masud, M., Ali, J., & Baz, M. (2021). Security, Privacy, and Reliability in Digital Healthcare Systems Using Blockchain. Electronics, 10(16), 2034. https://doi.org/10.3390/electronics10162034

AlMarwani, Manal. (2021). Acceptance and Use of Mobile Technologies in Learning and Teaching of EFL: An Economic Perspective. The EuroCALL Review, 28(2), 39-49. https://doi.org/10.4995/eurocall.2020.12388

Andujar, A., Salaberri-Ramiro, M. S., & Martínez, M. S. C. (2020). Integrating Flipped Foreign Language Learning through Mobile Devices: Technology Acceptance and Flipped Learning Experience. Sustainability, 12(3), 1110. https://doi.org/10.3390/su12031110

Bernacki ML, Greene JA, Crompton H. Mobile technology, learning, and achievement: advances in understanding and measuring the role of mobile technology in education. Contemp Educ Psychol 2020;60(1):101827–8. https:// doi.org/10.1016/j.cedpsych.2019.101827

Bleier, A., Goldfarb, A., & Tucker, C. (2020). Consumer privacy and the future of data-based innovation and marketing. International Journal of Research in Marketing, 37(3), 466–480. https://doi.org/10.1016/j.ijresmar.2020.03.006

Branch, A. J. (2020). Promoting ethnic identity development while teaching subject matter content: A model of ethnic identity exploration in education. Teaching and Teacher Education, 87, 102918. https://doi.org/10.1016/j.tate.2019.102918

Brew, M. (2024). What is Mobile Learning?: Definition, Benefits & Top Tips. Mobile Learning. https://www.edume.com/blog/mobile-learning#mobile-learning-definition

Campbell, C. (2018). Technology and the Curriculum: Summer 2018. https://pressbooks.pub. Retrieved 9 21, 2024, from https://pressbooks.pub/techandcurriculum/chapter/critical-issues-with-mobile-technologies/

Corbeil, J. R. & M. E. Valdes-Corbeil (2007). Are you Ready for Mobile Learning? Educause Quarterly, 30(2) 51-58.

Correani, A., De Massis, A., Frattini, F., Petruzzelli, A. M., & Natalicchio, A. (2020). Implementing a Digital Strategy: Learning from the Experience of Three Digital Transformation Projects. California Management Review, 62(4), 37–56. https://doi.org/10.1177/0008125620934864

Cui G, Wang S. Adopting cell phones in EFL teaching and learning. Adopting cellphones in EFL teaching and learning, 1. The University of Southern Mississippi; 2008. p. 69–80. https://doi.org/10.18785/jetde.0101.06. http://aquila.usm.edu/jetde/vol1/iss1/6.

D. Lindquist, T. Denning, M. Kelly, R. Malani, W. G. Griswold, and B. Simon, “Exploring the potential of mobile phones for active learning in the classroom,” in Proc. 38th SIGCSE Tech. Symp. Comput. Sci. Educ.- SIGCSE ’07, p. 384, 2007.

Da’u, A., Salim, N., Rabiu, I., & Osman, A. (2020). Recommendation system exploiting aspect-based opinion mining with deep learning method. Information Sciences, 512, 1279–1292. https://doi.org/10.1016/j.ins.2019.10.038

De Figueiredo, A., Simas, C., Karafillakis, E., Paterson, P., & Larson, H. J. (2020). Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: A large-scale retrospective temporal modelling study. The Lancet, 396(10255), 898–908. https://doi.org/10.1016/S0140-6736(20)31558-0

De Meester, A., Van Duyse, F., Aelterman, N., De Muynck, G.-J., & Haerens, L. (2020). An experimental, video-based investigation into the motivating impact of choice and positive feedback among students with different motor competence levels. Physical Education and Sport Pedagogy, 25(4), 361–378. https://doi.org/10.1080/17408989.2020.1725456

Demintseva, E. (2020). Educational infrastructure created in conditions of social exclusion: ‘Kyrgyz clubs’ for migrant children in Moscow. Central Asian Survey, 39(2), 220–235. https://doi.org/10.1080/02634937.2019.1697643

Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2020). The Global Findex Database 2017: Measuring Financial Inclusion and Opportunities to Expand Access to and Use of Financial Services*. The World Bank Economic Review, 34(Supplement_1), S2–S8. https://doi.org/10.1093/wber/lhz013

Design of a Pneumatics System Learning Material with AR Technology for Vocational Education Students. (2023). International Conference on Computers in Education. https://doi.org/10.58459/icce.2023.1430

Electropneumatic and PLC - Electropneumatic and PLC 1.1 Introduction Electro pneumatics is now commonly used in many areas of Industrial low cost. (n.d.) Retrieved from https://www.coursehero.com/fiel/22359 854/ Electropneumatic-and-PLC/

Feigin, V. L., Stark, B. A., Johnson, C. O., Roth, G. A., Bisignano, C., Abady, G. G., Abbasifard, M., Abbasi-Kangevari, M., Abd-Allah, F., Abedi, V., Abualhasan, A., Abu-Rmeileh, N. M., Abushouk, A. I., Adebayo, O. M., Agarwal, G., Agasthi, P., Ahinkorah, B. O., Ahmad, S., Ahmadi, S., … Murray, C. J. L. (2021). Global, regional, and national burden of stroke and its risk factors, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. The Lancet Neurology, 20(10), 795–820. https://doi.org/10.1016/S1474-4422(21)00252-0

Ferriz-Valero, A., Østerlie, O., García Martínez, S., & García-Jaén, M. (2020). Gamification in Physical Education: Evaluation of Impact on Motivation and Academic Performance within Higher Education. International Journal of Environmental Research and Public Health, 17(12), 4465. https://doi.org/10.3390/ijerph17124465

Festo. (n.d.). FluidSIM [Website]. Retrieved December 10, 2024, from https://www.festo.com/us/en/e/technical-education/digital-learning/virtual-simulation-and-modeling/fluidsim-id_1663056/

Goldie FJ. AMEE Guide No. 29: Evaluating educational programmes. Med Teach. 2006; 28: 210-24.

Hallberg, K., Cook, T. D., Steiner, P. M., & Clark, M. H. (2018). Pretest Measures of the Study Outcome and the Elimination of Selection Bias: Evidence from Three Within Study Comparisons. Prevention science : the official journal of the Society for Prevention Research, 19(3), 274–283. https://doi.org/10.1007/s11121-016-0732-6

Husnita, L., Rahayuni, A., Fusfitasari, Y., Siswanto, E., & Rintaningrum, R. (2023, 12 19). The Role of Mobile Technology in Improving Accessibility and Quality of Learning, 11, 259. 10.31958/jaf.v11i2.10548

Isna, R. (2019). Implementation of Festo Fluidsim Simulation to Improve Students' Skills in Electric Motor Installation Subjects in Class XI of SMK N 2 Banda Aceh (Doctoral dissertation, UIN ARRANIRY).

Jaloustre, A. (2022). Assistance éducative: Conditions pour le placement des enfants. Santé mentale et Droit, 22(4), 549–554. https://doi.org/10.1016/j.smed.2022.06.004

Javed, A. R., Faheem, R., Asim, M., Baker, T., & Beg, M. O. (2021). A smartphone sensors-based personalized human activity recognition system for sustainable smart cities. Sustainable Cities and Society, 71, 102970. https://doi.org/10.1016/j.scs.2021.102970

K. McKnight, K. O'Malley, R. Ruzic, M. K. Horsley, J. J. Franey, and K. Bassett, "Teaching in a digital age: How educators use technology to improve student learning," J. Res. Technol. Educ., vol. 48, no. 3, pp. 194–211, 2016.

Kanwar, G. J., Kumar, R., & Kumar, S. (2015). Designing and Fabrication of Electro-Pneumatic Trainer Kit. International Conference of Advance Research and Innovation, 59. Retrieved from https://www.ijari.org/assets/conf/icari2015-abstract.pdf

Kitanovski, A. (2020). Energy Applications of Magnetocaloric Materials. Advanced Energy Materials, 10(10), 1903741. https://doi.org/10.1002/aenm.201903741

Kizito R. Pretesting mathematical concepts with the mobile phone: implications for curriculum design. Int Rev Res Open Distrib Learn 2012;13(1):38–55. https://doi.org/10.19173/irrodl.v13i1.1065.

Kukulska-Hulme, A. (2007). Mobile Usability in Educational Contexts: What Have We Learnt? The International Review of Research in Open and Distance Learning, 8, 1-16. https://doi.org/10.19173/irrodl.v8i2.356

Kukulska-Hulme, A. (2009). Will Mobile Learning Change Language Learning? ReCALL, 21(2) 157–165. https://doi.org/10.1017/S0958344009000202

Kuyini, A. B., Desai, I. (Ishwar), & Sharma, U. (2020). Teachers' self-efficacy beliefs, attitudes and concerns about implementing inclusive education in Ghana. International Journal of Inclusive Education, 24(14), 1509–1526. https://doi.org/10.1080/13603116.2018.1544298

Liu, B., Ejaz, W., Gong, S., Kurbanov, M., Canakci, M., Anson, F., & Thayumanavan, S. (2020). Engineered Interactions with Mesoporous Silica Facilitate Intracellular Delivery of Proteins and Gene Editing. Nano Letters, 20(5), 4014–4021. https://doi.org/10.1021/acs.nanolett.0c01387

M. Mohanna, "Using knowledge engineering for modeling mobile learning systems," Universite´ Laval, Canada, 2015.

MacCallum, K., Day, S., Skelton, D., & Verhaart, M. (2017, 04 01). Mobile Affordances and Learning Theories in Supporting and Enhancing Learning. International Journal of Mobile and Blended Learning, 9, 61-73. 10.4018/IJMBL.2017040104

Persepsi Mahasiswa Mengenai Pembelajaran dalam Jaringan Selama Pandemi COVID-19 | Titian Ilmu: Jurnal Ilmiah Multi Sciences. https://journal.unuha.ac.id/index.php/JTI/article/view/779

Mahmood, A., & Wang, J.-L. (2021). A time and resource efficient machine learning assisted design of non-fullerene small molecule acceptors for P3HT-based organic solar cells and green solvent selection. Journal of Materials Chemistry A, 9(28), 15684–15695. https://doi.org/10.1039/D1TA04742F

Medeiros, A. D. D., Silva, L. J. D., Ribeiro, J. P. O., Ferreira, K. C., Rosas, J. T. F., Santos, A. A., & Silva, C. B. D. (2020). Machine Learning for Seed Quality Classification: An Advanced Approach Using Merger Data from FT-NIR Spectroscopy and X-ray Imaging. Sensors, 20(15), 4319. https://doi.org/10.3390/s20154319

MELINIAR, N. (2023). Innovation in Design and Design of Automatic Pneumatic Gripper Pick and Place System as a Handling and Sorting Tool for Biscuit Quality on Malkist Production Line.

Muñoz-Arteaga, J. (2017). Teaching experience of human-computer interaction at at autonomous university of aguascalientes. https://doi.org/10.1145/3123818.3123863

Panaitescu, M., Dumitrescu, G. B., & Scupi, A. (2013, September 28–30). Sustainable pneumatic transport systems of cereals [Conference presentation]. 2013 International Conference on Environment, Energy, Ecosystems and Development, Venice, Italy.

Pemberton, L., Winter, M., & Fallahkhair, S. (2010). Collaborative Mobile Knowledge Sharing for Language Learners. Journal of the Research Centre for Educational Technology, 6(1) 144-148.

Prensky M. What can you learn from a cell phone? Almost anything. Innovate: J Online Educ 2005;1(5):2. https://doi.org/10.4135/9781483387765.n23.

Pushpakumar, R., Karun, S., Rathika, S., Alawadi, A. H., Khamdamova, M., Venkatesh, S., & Rajalakshmi, B. (2023). Human-computer interaction: Enhancing user experience in interactive systems. E3S Web of Conferences, 399, Article 04037. https://doi.org/10.1051/e3sconf/202339904037

Rogers, Y., Connelly, K., Hazlewood, W., & Tedesco, L. (2010). Enhancing Learning: a Study of How Mobile Devices Can Facilitate Sensemaking. Personal and Ubiquitous Computing, 14(2) 111-124. https://doi.org/10.1007/s00779-009-0250-7

Sá, A. G. A., Moreno, Y. M. F., & Carciofi, B. A. M. (2020). Plant proteins as high-quality nutritional source for human diet. Trends in Food Science & Technology, 97, 170–184. https://doi.org/10.1016/j.tifs.2020.01.011

Sarker, A., Al-Garadi, M. A., Ge, Y., Nataraj, N., McGlone, L., Jones, C. M., & Sumner, S. A. (2022). Evidence of the emergence of illicit benzodiazepines from online drug forums. European Journal of Public Health, 32(6), 939–941. https://doi.org/10.1093/eurpub/ckac161

Sarker, M. N. I., Wu, M., Qian, C., Alam, G. M., & Li, D. (2019, June 11). Leveraging digital technology for better learning and education: A systematic literature review. International Journal of Information and Education.

Philippine Senate. (2024, June 4). Senate Bill No. 2706: Electronic Gadget-Free Schools Act. Senate of the Philippines, 19th Congress. https://web.senate.gov.ph/lis/bill_res.aspx?congress=19&q=SBN-2706

Sestino, A., Prete, M. I., Piper, L., & Guido, G. (2020). Internet of Things and Big Data as enablers for business digitalization strategies. Technovation, 98, 102173. https://doi.org/10.1016/j.technovation.2020.102173

Shahzad, A., Zhang, K., & Gherbi, A. (2020). Intuitive Development to Examine Collaborative IoT Supply Chain System Underlying Privacy and Security Levels and Perspective Powering through Proactive Blockchain. Sensors, 20(13), 3760. https://doi.org/10.3390/s20133760

Shivaraju, P. T., Manu, G., Vinaya, M., & Savkar, M. K. (2017). Evaluating the effectiveness of pre- and post-test model of learning in a medical school. National Journal of Physiology, Pharmacy and Pharmacology, 7(9), 947–951.

Singh, A. P., Gameti, N., & Gupta, S. (2024). Future trends in industrial hydraulics and pneumatics: Implications for operations and maintenance. Journal Title, 10, 15–25.

Snell L, Tallett S, Haist S et al. A review of the evaluation of clinical teaching: new perspectives and challenges. Med Educ. 2000; 34 (10): 862-70.

Taylor, D. (2005). End user preference of customisable features within a course management system. https://core.ac.uk/download/41537657.pdf

Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., Behling, S., Chambwe, N., Cintrón, D. L., Cooper, J. D., Dunster, G., Grummer, J. A., Hennessey, K., Hsiao, J., Iranon, N., Jones, L., Jordt, H., Keller, M., Lacey, M. E., Littlefield, C. E., … Freeman, S. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. Proceedings of the National Academy of Sciences, 117(12), 6476–6483. https://doi.org/10.1073/pnas.1916903117

Traxler, J. (2007). Defining, Discussing and Evaluating Mobile Learning: The Moving Finger Writes and Having Writ. The International Review of Research in Open and Distance Learning, 8(2) 1-12. https://doi.org/10.19173/irrodl.v8i2.346

Traxler, J. (2010). Sustaining Mobile Learning and its Institutions. International Journal of Mobile and Blended Learning, 2(4) 58-65. https://doi.org/10.4018/jmbl.2010100105

Tuleja, Peter. (2024). Educational procedures for training students in the field of pneumatic systems. Acta Mechatronica. 9. 39-42. 10.22306/am.v9i4.130.

Venkatesh, B., Nargundkar, R., Sayed, F. K., & Shahaida, P. (2006). Assessing Indian Students' Perceptions towards M-learning Some Initial Conclusions. International Journal of Mobile Marketing, 1(2) 75-79.

Wang BT. Designing mobile apps for English vocabulary learning. Int J Inf Educ Technol 2017;7(4):279–83. https://doi.org/10.18178/ijiet.2017.7.4.881

Yuan, R., Ab Jalil, H., & Omar, M. K. (2025). Adopting strategies of mobile technology for assisted learning performance in higher education in China. Computers and Education Open, 8, 100263. https://doi.org/10.1016/j.caeo.2025.100263

Zhao Xiuhua, Wang Qiumin. Application of FESTO Experiment System in Practical Teaching of Hydraulic and Pneumatic Transmission Course. MACHINE TOOL & HYDRAULICS, Vol.38(2010)No.22, p86-88.

Affiliations and Corresponding Information

Nerlie R. Dimapilis
General Mariano Alvarez Technical High School
Department of Education – Philippines

Edilberto Z. Andal, EdD
Laguna State Polytechnic University
San Pablo City Campus – Philippines