Research Article

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Development and Assessment of Instructional Material to Enhance Microsoft Excel Learning in a Pharmacology Laboratory

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Abstract: Microsoft Excel is a widely used tool for data management, analysis, and presentation in various fields, including healthcare and education. In the PHA 352 course, Pharmacology Laboratory for Pharmacy Students, at the College of Pharmacy, Rangsit University, students use Microsoft Excel to calculate and present experimental data. However, many students encounter difficulties with Microsoft Excel's basic and advanced scientific functions, highlighting the need for targeted training to meet course demands. This study aimed to develop instructional material for Microsoft Excel via the ADDIE model for the PHA 352 course. Students' perceptions of the material, as well as their understanding and skills in using Microsoft Excel, were evaluated. Pretest and posttest designs were used to measure competency levels, with a focus on essential Microsoft Excel functions for the course. Statistical significance between the scores was determined using a paired t-test or Wilcoxon signed-rank test at the 0.05 level. An online questionnaire was used to assess students' satisfaction with and perceived effectiveness of the material's content, exercises, and usability. Data were analyzed via descriptive statistics. The results from 160 third year pharmacy students revealed a significant improvement in posttest scores compared with pretest scores, demonstrating the effectiveness of the instructional material in enhancing Microsoft Excel skills. The findings indicate that students were highly satisfied, valuing how the material aligned with the course objectives and its practical uses. In conclusion, the instructional material for Microsoft Excel was effective in enhancing students' Microsoft Excel skills.

Keywords: Microsoft Excel, Instructional material, ADDIE, Student perceptions, Pharmacology laboratory

INTRODUCTION

One of the most crucial 21st-century skills is computing and information and communication technology (ICT) literacy. This skill encompasses computer and ICT proficiency; analysis, access, management, integration, evaluation, creation, and communication; and the ethical use of computers and ICT. For professionals aiming to succeed, especially pharmacists, these skills are essential. Proficiency in Microsoft Excel, a widely used spreadsheet program, is particularly important for pharmacists in managing and analyzing data to increase their work efficiency. Many areas of pharmacy use Microsoft Excel as a fundamental tool in various pharmacy-related activities, including calculating data, performing statistical analyses, and presenting information effectively (1, 2).

The course PHA 352, or the Pharmacology Laboratory for Pharmacy Students, is a core part of the curriculum at the College of Pharmacy, Rangsit University. As a mandatory 1-credit laboratory course for third-year pharmacy students, it explores a range of pharmacological studies, employing both in vivo and in vitro experimental techniques. The coursework covers topics such as drug actions, interactions, mechanisms of action, and toxicity tests. Within this course, students are required to use Microsoft Excel to calculate and present their experimental data. Excel is available to students through the university's subscription, allowing them to learn its basic functions in their first year. In contrast, while tools like GraphPad Prism and SPSS are also utilized for data management and analysis, their subscriptions are limited and not as accessible to students. Many students have not used these tools before. However, many students encounter difficulties with Microsoft Excel's basic and scientific functions, underscoring the need for a foundation in Microsoft Excel prior to tackling the demands of this course.

Instructional materials are fundamental in supporting students, as they work toward achieving their learning outcomes. Instructional materials can enhance the learning experience of students (3-5). They should be flexible, accessible anytime and anywhere, and exercise with feedback. The ADDIE model, a well-established method in instructional design, provided the foundational framework necessary to achieve the specified learning outcomes. The use of the ADDIE model, which encompasses analysis, design, development, implementation, and evaluation, is key in developing instructional materials that effectively meet educational standards and improve student outcomes (6).

Therefore, proficiency in the scientific functions of Microsoft Excel is essential in the pharmacology laboratory course. Instructional material should facilitate self-paced learning and enable students to apply their skills directly to the course. The ADDIE model will be employed for the development of the material. Consequently, this study aimed to develop instructional material based on the ADDIE model for teaching Microsoft Excel in the PHA 352 course. It also intended to evaluate students' perceptions of the instructional material and assess their understanding and skills in via Microsoft Excel.

METHODS

Study Design and Setting

This research was conducted from August–November 2024, and it was quasiexperimental research. The participants were pharmacy students who registered at the PHA 352 Pharmacology Laboratory for Pharmacy, the first semester of the 2024 academic year, College of Pharmacy, Rangsit University. The study protocol was approved by the ethics committee of the RSU Ethics Review Board (RSU-ERB) of Rangsit University, Thailand (reference DPE. No. RSUERB2024-026).

Subjects

The inclusion criteria are pharmacy students who are registered for the course Pharmacology Laboratory for Pharmacy Students (PHA 352) in the first semester of the academic year 2024. The exclusion criteria are pharmacy students who have withdrawn from the course Pharmacology Laboratory for Pharmacy Students (PHA 352) in the first semester of the academic year 2024.

Among the participants, 198 students met the inclusion criteria. We determined the sample size via Taro Yamane's formula, aiming for a 95% confidence level. The sample size was 132 students. These students were in their third year of the professional program.

Intervention

Microsoft Excel instructional material development

This instructional material was designed to teach students how to use Microsoft Excel for scientific analysis in the pharmacology laboratory. The learning outcomes of this instructional material are as follows:

Upon completion of this instructional material, students should be able to do the following:

1. Describe the fundamental principles of the Microsoft Excel program.

2. Use Microsoft Excel for basic calculations.

3. Use Microsoft Excel for statistical calculations.

4. Explain the principles of graph creation.

5. Use Microsoft Excel to create graphs for the pharmacology laboratory course.

This instructional material was created via Microsoft Excel because it allows students to become familiar with the program and complete exercises directly within it. The material was designed via the ADDIE approach, which is a widely favored instructional design framework among instructional designers and educational content developers. Compared with five key phases—analysis, design, development, implementation, and evaluation—the ADDIE model provides a structured and comprehensive method for developing instructional materials.

At the outset, the researcher analyzed the course, instructors, environment, course timeline, and readiness before designing the instructional material. During the design phase, the researcher specified the lesson learning outcomes, content, format of the instructional material, instructions for its use, learning activities, and how to integrate the instructional material into the course. The content of the instructional material is presented in Table 1 and Figure 1. A prototype version of the instructional material was then created and tested with a small group of pharmacy students to evaluate its quality and gather feedback for improvements. Feedback helped refine the instructional material, focusing on the design of the lesson, interactive functions within the material, and the content itself. In the implementation phase, the researcher prepared the instructional material along with supplementary resources, such as a user manual and information for integrating it into the course, before deploying it in the classroom. Finally, the effectiveness of the instructional material and student feedback were assessed at the end of the course, which utilized Microsoft Excel.

Table 1. The content of the Microsoft Excel instructional material

Order	Lessons	Information
1	Introduction to Microsoft Excel	Introduction to Microsoft Excel, navigating the Microsoft Excel interface, entering and formatting data
2	Basic calculations	Performing arithmetic operations (addition, subtraction, multiplication, division) and using formulas and functions
3	Statistical calculations	Using statistical functions and calculating mean and standard deviation
4	Charts	Introduction to charts and graphs, choosing the appropriate chart type
5	Creating column charts	Creating column charts for single and multiple datasets, customizing column chart appearance and adding chart element
6	Creating line charts	Creating line charts for single and multiple datasets, customizing line chart appearance and adding chart element
7	Creating XY charts	Creating XY charts for single and multiple datasets, identifying relationships between variables, transforming charts to semi-log scale and creating scatter plots with trendlines
8	Adding error bars	Adding error bars to charts and customizing error bar appearance

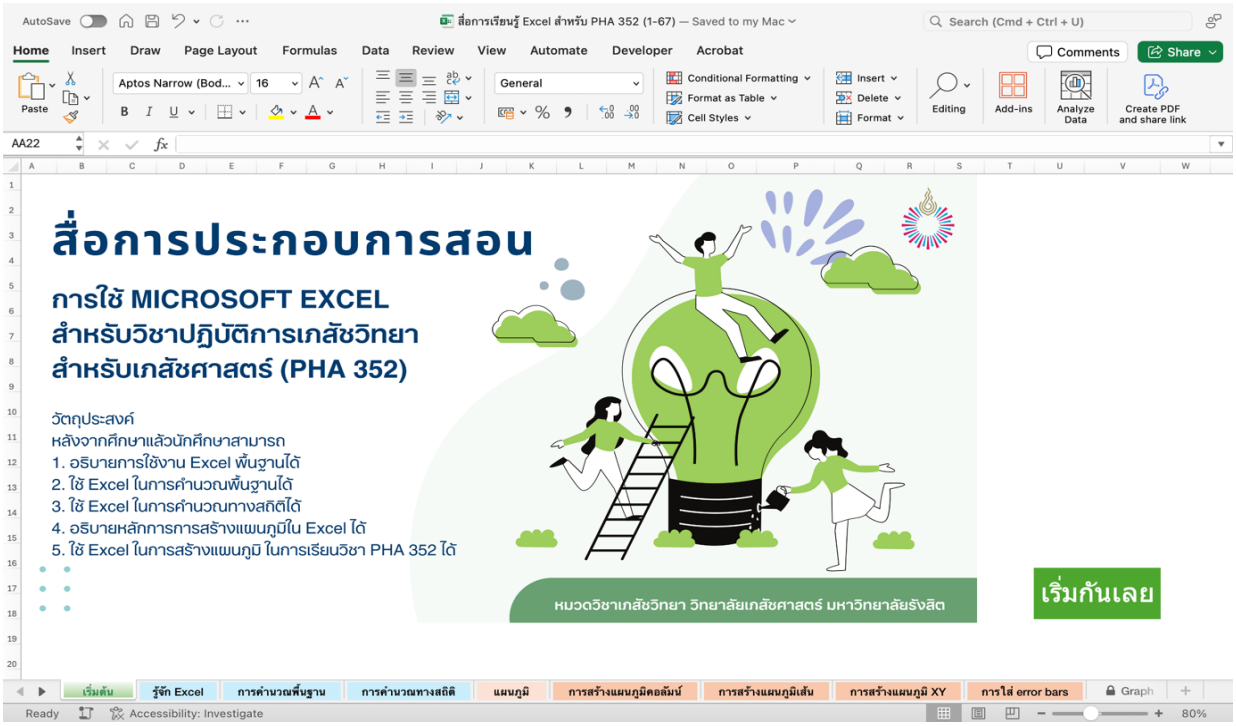

Figure 1. Microsoft Excel instructional material

Each Microsoft Excel lesson included interactive exercises within the instructional material to help students better understand the content, as shown in Figure 2. The instructional material was utilized by students throughout the course, spanning from August to November. Each lesson was designed to be completed within 15–30 minutes, including time for exercises and practice. Students were encouraged to revisit the material as needed for self-paced learning. On average, students spent approximately 2–4 hours using the instructional material and completing exercises over the course. During the course implementation, the Microsoft Excel lesson for each topic was introduced to students a few days before class through Microsoft Teams and in class. Each topic required different Microsoft Excel functions for result analysis. Since the students used Microsoft Excel to analyze real data for each topic, this enhanced their learning experience and provided practical applications.

Data Collection and Analysis

An online questionnaire was used as the research instrument. The questionnaire was anonymous, and the researcher ensured confidentiality. At the beginning of the course, students completed a 15-item pretest to evaluate their understanding and skills in using Microsoft Excel. The pretest and posttest were designed in alignment with the learning outcomes of this instructional material and were validated by expert assessments in the fields of Excel and education. Following the use of the instructional material throughout the course, students completed a 15-item posttest one week after the final Microsoft Excel session to assess their progress. A paired t-test or Wilcoxon signed-rank test was used to determine the statistical significance of the difference between the pretest and posttest scores at the 0.05 level.

During the posttest week, students' perceptions of the Microsoft Excel instructional material were surveyed. The survey was divided into three main sections. The first section collected general information through two questions. The second section, consisting of 20 questions on a 5-point Likert scale, assessed students' perceptions of the Microsoft Excel instructional material. This section was further divided into two subtopics: content and exercises, and the use of the instructional material. It also included a general question regarding overall satisfaction. The third section included open-ended suggestions from the students.

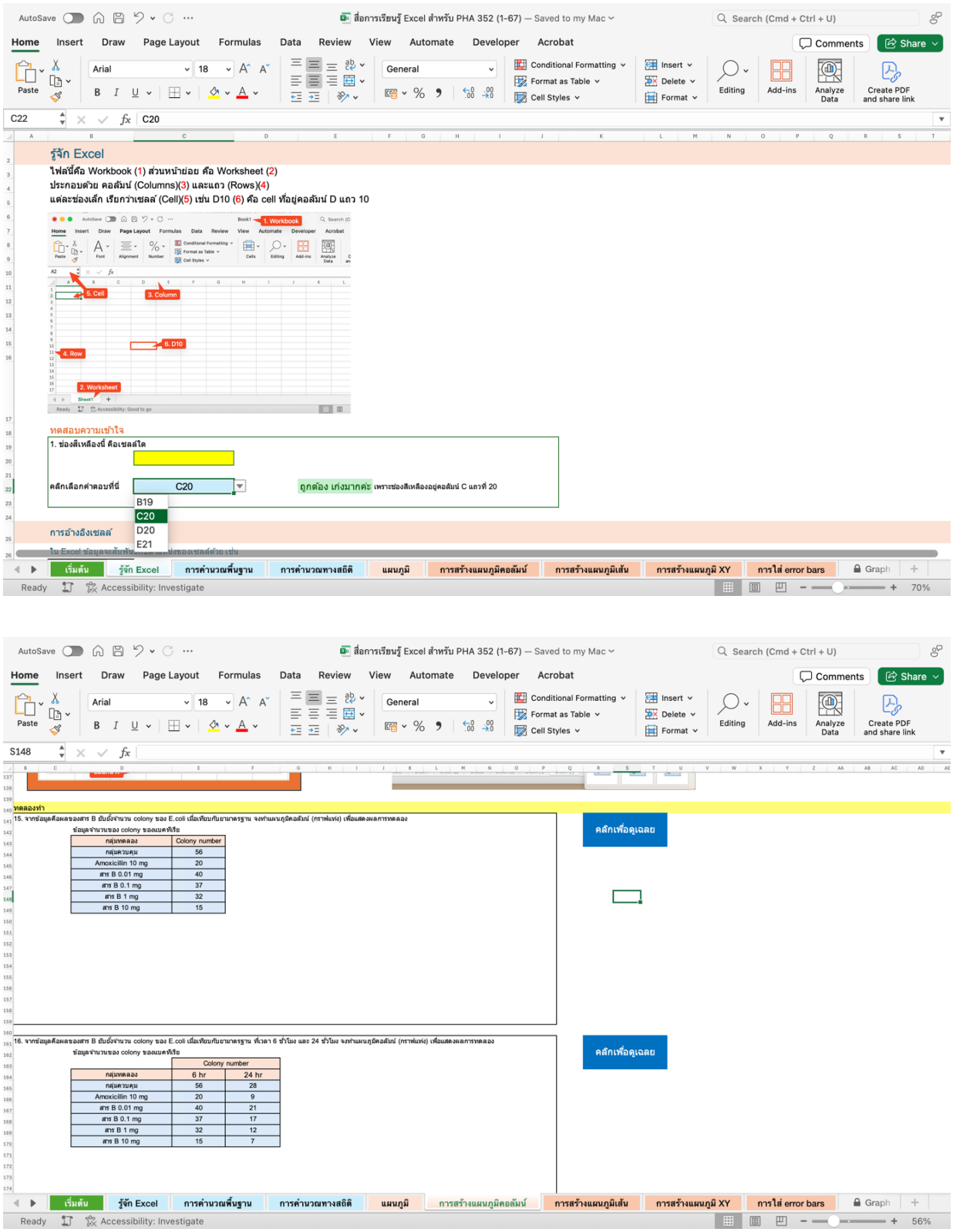

Figure 2. Examples of interactive exercises in the lesson

The items were rated on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). For each question, the average score was used to evaluate students' perceptions of the Microsoft Excel instructional material. The effectiveness of the content and exercises was categorized as ineffective (less than 3.00), average (3.00–4.00), or effective (greater than 4.00). Similarly, the effectiveness of instructional tool usage was classified as ineffective (less than 3.00), average (3.00–4.00), or effective (greater than 4.00). Data were analyzed via descriptive statistics and are presented as the means, standard deviations, and percentages.

Before being distributed to students, the questionnaire underwent a validity review by experts in the field of education, using the Index of Item Objective Congruence (IOC) for evaluation. The IOC values, which are based on the experts' assessments, ranged from 0.67–1.00, meeting accepted standards. Additionally, the reliability of the questionnaire was tested with 30 pharmacy students. With a Cronbach's alpha coefficient of 0.97, the instrument demonstrated high reliability and was considered suitable for data collection.

RESULTS

General Information

Data were collected from a group of 160 students, exceeding the required sample size calculated via Taro Yamane's formula for a 95% confidence level. Detailed information about the students is provided in Table 2.

Table 2. General information of the students (n = 160)

General information	Number (Percentage)
Admission Year	
2020	13 (8.12)
2021	41 (25.63)
2022	106 (66.25)
Major	
Industrial Pharmacy	89 (55.62)
Pharmaceutical Care	71 (44.38)
Total	160 (100)

The Pretest and Posttest Scores

The results of the pretest and posttest scores are presented in Table 3. The average pretest score was 5.45 ± 1.97, indicating limited initial understanding and skills in using Microsoft Excel among the students. After completing the course, the average posttest score increased to 10.34 ± 2.45, reflecting significant improvement. The posttest scores were significantly higher than the pretest scores ($p < 0.05$), as shown in Table 3.

Table 3. The pretest and posttest scores on understanding and skills in Microsoft Excel (n = 160)

Test	Average score ± S.D.
The pretest	5.45 ± 1.97
The posttest	10.34 ± 2.45*

* Significantly different from the pretest scores at $p< 0.05$

The Pretest and Posttest Scores: On-Track Students and Delayed Students

Table 4 shows the pretest and posttest scores for both on-track and delayed students. The posttest scores were significantly higher than the pretest scores for both groups. This outcome suggests that students in each group successfully achieved the desired outcomes.

Table 4. The pretest and posttest scores on understanding and skills in Microsoft Excel according to status: on-track students and delayed students

Test	Average score ± S.D.
On-Track Students (n=106)	
The pretest	5.69 ± 2.02
The posttest	10.99 ± 1.96*
Delayed Students (n=54)	
The pretest	4.76 ± 1.85
The posttest	9.07 ± 2.81*

* Significantly different from the pretest scores at $p< 0.05$

Table 5. Students' perceptions of the lesson content and exercises of the Microsoft Excel instructional material (n = 160)

Survey Items	Mean	SD
The content of the lesson aligns with the objectives of the instructional material.	4.78	0.45
The sequence of content makes it easy to understand.	4.70	0.57
The explanation of the content is easy to understand and clear.	4.71	0.53
The amount of content in each lesson is appropriate.	4.66	0.57
The exercises are consistent with the objectives of the instructional material.	4.75	0.48
The exercises have clear instructions/questions.	4.66	0.56
The number of exercises is appropriate.	4.68	0.54
The difficulty level of the exercises is suitable for the learners.	4.66	0.56
The exercises are relevant to the content in the lesson.	4.77	0.48
Each exercise topic helps students understand the lesson better.	4.72	0.54
The content and exercises are appropriate for using Microsoft Excel in the course PHA 352.	4.76	0.60
Average Mean Score	4.71	0.54

Students' Perceptions with Microsoft Excel Instructional Material

Table 5 presents the students' feedback on the lesson content and exercises of the Microsoft Excel instructional material. Overall, the responses were positive, with scores ranging from 4.66–4.78. Most students agreed that the lesson content and exercises aligned with the objectives of the instructional material, the exercises were relevant to the lesson content, and the content and exercises were appropriate for using Microsoft Excel in the PHA 352 course. This suggests that the quantity, difficulty level, sequence, clarity of the content and exercises, and overall usefulness of the material were well-suited for the course.

Table 6 presents the results of the survey on students' perceptions of using the instructional material. The highest-rated aspect was that the instructional material helped students effectively use Microsoft Excel in the PHA 352 course, with a score of 4.82. Other aspects, such as its engaging design, ease of use, accessibility, and interactive exercises, received scores ranging from 4.66–4.74. These results indicate positive student feedback regarding the instructional material.

Overall Satisfaction

Figure 3 reveals that 76% (121 students) and 22% (36 students) were very satisfied and satisfied with the Microsoft Excel instructional material, reflecting an average satisfaction score of 4.73 ± 0.51.

Table 6. Students' perceptions of using Microsoft Excel instructional material (n = 160)

Survey Items	Mean	SD
The instructional material is easy to use.	4.68	0.54
The instructional material makes the content of Microsoft Excel interesting.	4.66	0.58
Students can easily access the instructional material.	4.72	0.50
Interactive exercises increase interest in learning.	4.74	0.52
The format of the exercises in the instructional material increases interest in learning.	4.70	0.54
Students can review the content from the instructional material on their own.	4.71	0.52
The instructional material stimulates student learning of Microsoft Excel.	4.68	0.53
The instructional material enhances satisfaction with learning Microsoft Excel.	4.74	0.50
Using the instructional material helps students use Microsoft Excel in the course PHA 352.	4.82	0.40
Average Mean Score	4.72	0.52

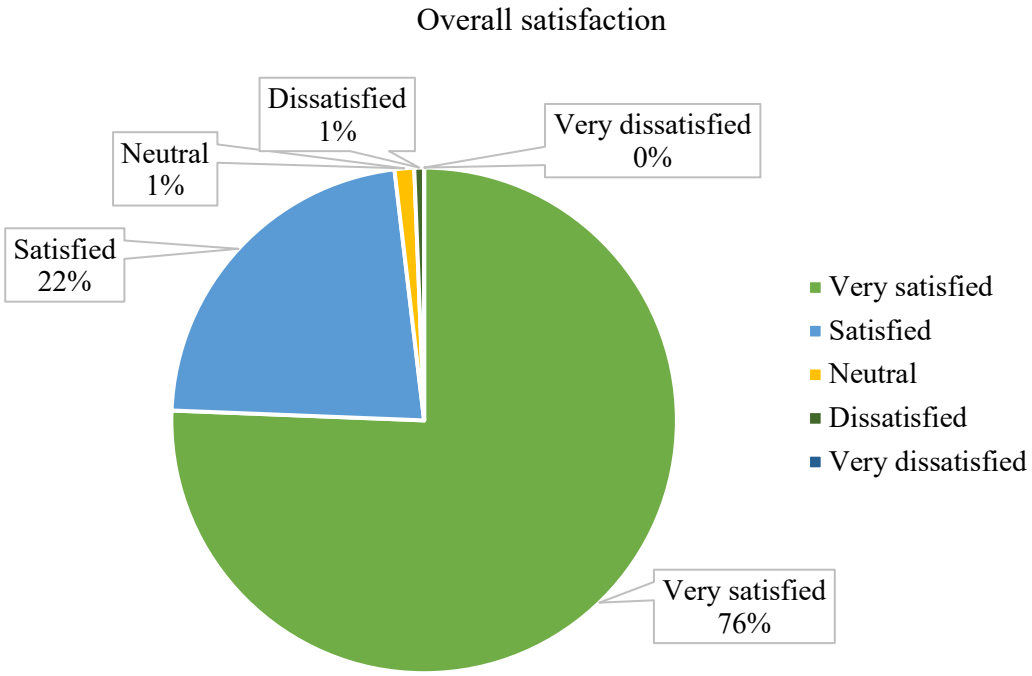

Figure 3. The percentage of students who responded to the overall satisfaction of the Microsoft Excel instructional material (n = 160).

Table 7. An example of a written student comment

Positive	Negative
The professor's teaching materials are easy to understand, and having the professor teach in the classroom helps to understand more. I think there should be ongoing Microsoft Excel training.	The Microsoft Excel file is difficult to use and can only be opened on a computer; sometimes the scrolling works, sometimes it does not.
The instructional material for teaching Microsoft Excel is highly beneficial for higher education. Thank you to the professor for the dedication and effort in preparing excellent and useful instructional material.	I would like Microsoft Excel materials that include more relevant data for learning.
I truly like it. I feel that the material the professor created is helpful. From being inexperienced with Microsoft Excel, I started to understand it. If there were one or two more tutorial sessions, I think it would be great. It would be nice if everyone could bring their own devices, and the professor could teach and let us practice together.	I would like there to be more instruction on how to do it on an iPad.
I truly like it. Initially, I never used it, but now I try to do it on my own gradually and have become much more proficient—it is very beneficial.	
The professor's instructional material is detailed and very beneficial to students.	
The instructional material greatly enhances understanding.	

Student Feedback

Feedback from the students, summarized in Table 6, revealed predominantly positive responses. Most students praised the clarity, ease of understanding, and effectiveness of the instructional material, noting that in-class teaching further supported their comprehension. The material was recognized as beneficial for higher education, with students acknowledging the professor's efforts and reporting significant improvements in their proficiency with Microsoft Excel. Some suggested adding more tutorial sessions or detailed content. However, a few students expressed concerns, such as difficulty using the Microsoft Excel file, compatibility issues with their computers, and inconsistent scrolling functionality. Others recommended making the data more relevant to the course content and offering instructions for using iPads, as well as the option to bring personal devices for hands-on practice.

DISCUSSION

Today, Microsoft Excel is recognized as a valuable tool for managing, analyzing, and presenting data. It is widely used in both professional healthcare settings and educational programs, particularly in research methods and analytics (7). For pharmacy students, learning and practicing Microsoft Excel is an essential part of their education, as this skill will prove highly beneficial in their future careers (2). Microsoft Excel is a flexible tool for managing and analyzing data, which is an essential aspect of digital literacy. Pharmacy students should become proficient in using these tools for data analysis to enhance their efficiency in tasks and decision-making processes in their future professional practice. (8).

Teaching Microsoft Excel for scientific analysis in class presents several challenges, primarily due to the limited duration of class sessions and the number of teaching hours allocated to the course. While students were introduced to basic Microsoft Excel skills in their first year, they had limited opportunities to apply these skills in subsequent courses. Consequently, some students have forgotten certain Microsoft Excel functions. To address this, the teaching approach should focus on helping students understand key principles and apply Microsoft Excel effectively during class activities. Real-world applications enhance students' understanding of Microsoft Excel's principles and provide them with practical skills that they can use in the future. The results revealed that the posttest scores were significantly higher than the pretest scores, indicating that this teaching method and the instructional material effectively improved students' understanding and application of Microsoft Excel functions in this course.

The instructional material encompassed essential Microsoft Excel principles and scientific functions for analyzing laboratory results. The lessons were designed to align with the weekly topics of the course, with an appropriate balance of content and exercises. According to the results, the interactive exercises in the instructional material significantly enhanced students' learning via Microsoft Excel. However, the examples in the lessons used general experimental data rather than pharmacological data to simplify and facilitate understanding. Some students suggested that the instructional material should incorporate more course-relevant data to better align with the learning objectives.

The results indicated that the students were generally satisfied with the Microsoft Excel instructional material. These findings align with those of a previous study in which Microsoft Excel was used as a teaching tool for basic statistics. In that study, a tutorial manual was developed to help students navigate statistical procedures in Microsoft Excel. The results showed that students valued the skills they gained, recognizing their relevance and applicability to future workplaces (9).

The device most commonly used by students in class is the iPad, while the instructional material is designed to be accessed through Microsoft Excel on a laptop. As a result, some students suggested using the iPad version of Microsoft Excel. Some students chose to study the instructional material on a laptop at home and then used Microsoft Excel for the iPad in class to analyze the results. However, Microsoft Excel for the iPad has limited functionality

compared with the laptop version, and certain aspects of its user interface differ as well. This led some students to seek guidance when using iPads in class. Despite these differences, the students were able to use Microsoft Excel for the iPad effectively because they had already grasped the fundamental principles of Microsoft Excel before they attended class. Additionally, the different versions of Excel, such as Office 365 and older versions, feature varied user interfaces. This variation can cause difficulties for some students when trying to use certain functions.

In conclusion, the Microsoft Excel instructional material developed for scientific analysis significantly improved students' ability to use the program for analyzing experimental data in the PHA 352 course. The students reported high levels of satisfaction and found that the instructional material was highly beneficial. However, the study highlighted several limitations, including the need to adapt the instructional material for various student devices and the absence of follow-up on students' Microsoft Excel skills after the course. Future studies could assess the long-term retention of Excel skills among students, exploring how these skills persist over time. Additionally, research could investigate the impact of students' prior experience with Microsoft Excel on their learning outcomes and proficiency development.

CONCLUSION

The research findings showed that the Microsoft Excel instructional material and teaching methods greatly enhanced students' understanding of Excel in the PHA 352 course. This was evidenced by improved test scores and high levels of student satisfaction. The majority of students found the material to be highly beneficial, demonstrating its effective support for teaching and learning throughout the course.

CONFLICTS OF INTEREST

None

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REFERENCES

1. Lee G, Caton E, Ding A. Evaluating digital competencies for pharmacists. Res Social Adm Pharm. 2023;19(5):753-7. https://doi.org/10.1016/j.sapharm.2023.01.012
2. Entringer Bottacin W, de Souza TT, Melchiors AC, Reis WCT. Preparing Pharmacists for the Digital Age: How Pharmacy Courses are Adapting to Challenges and Opportunities. Am J Pharm Educ. 2024;88(6):100700. https://doi.org/10.1016/j.ajpe.2024.100700
3. Matsuyama T, Machida K, Hamu A, Takagi K, Momi H, Higashimoto I, et al. Effects of instructional materials on the proper techniques of inhaler device use. Respir Investig. 2022;60(5):633-9. https://doi.org/10.1016/j.resinv.2022.04.010
4. Lee Y-H, Hsiao C, Ho C-H. The effects of various multimedia instructional materials on students' learning responses and outcomes: A comparative experimental study. Comput Hum Behav. 2014;40:119-32. https://doi.org/10.1016/j.chb.2014.07.041
5. Ruisoto Palomera P, Juanes Méndez JA, Prats Galino A. Enhancing neuroanatomy education using computer-based instructional material. Comput Hum Behav. 2014;31:446-52. https://doi.org/10.1016/j.chb.2013.03.005
6. Branch RM. Instructional Design: The ADDIE Approach. NY: Springer New York; 2009. https://doi.org/10.1007/978-0-387-09506-6

7. Johri N. Introduction to Healthcare Data and the Role of Excel®. New York: Springer Publishing Company. p. 1-10.
8. Alowais M, Rudd G, Besa V, Nazar H, Shah T, Tolley C. Digital literacy in undergraduate pharmacy education: a scoping review. J Am Med Inform Assoc. 2024;31(3):732-45. https://doi.org/10.1093/jamia/ocad223
9. Warner CB, Meehan AM. Microsoft Excel™ as a Tool for Teaching Basic Statistics. Teach Psychol. 2001;28(4):295-8. https://doi.org/10.1207/S15328023TOP2804_11