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Development of an Offline Computer-Based Assessment Tool in Statistics and Probability Utilizing MS PowerPoint and MS Excel

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Abstract

This capstone project aimed to develop an offline computer-based assessment (CBA) tool that uses a computer instead of a traditional paper test in evaluating student learning. This addresses the difficulties faced by teachers in administering quarterly assessments. Incorporating technology into student assessment can increase student interest because of the immediate feedback generated automatically and can help teachers improve their work performance. This capstone project employed a developmental approach and utilized a modified ADDIE (Analysis, Design, and Development) model to design the tool using Microsoft PowerPoint and Excel. Ten experts in mathematics, ICT, and assessment validated the face and content validity of the developed CBA tool. Based on the panel's evaluation, the developed offline CBA tool in Statistics and Probability has passed all the assigned criteria, such as functionality, usability, efficiency, technicality, and accessibility. Overall, the developed CBA tool is suitable for use to address assessment-related issues.

Keywords: *ADDIE model, assessment in learning, ICT integration, Microsoft office applications*

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1. Introduction

Assessment is integral to the teaching and learning process that determines whether the learner has learned what has been taught. It also provides teachers with immediate feedback, allowing them to modify their teaching approaches to the diverse learning styles of their students. There are various types of assessments used in the classrooms (Sarmiento et al., 2020; Gonzales & Callueng, 2014) but the public schools in the Philippines generally use the paper and pen tests (PPT), which several researchers argued the need for technology- based assessment techniques (Neumann et al., 2018; Danniels et al., 2020; Jurāne-Brēmane, 2023; Nye, 2022; Elmahdi et al., 2018). While majority of the studies showed no significant difference in the performance of the students in PPT and computer-aided tests (i.e. Bayazit & Aşkar, 2012; Darr, 2014; Grapin & Sayac, 2022; Laurie et al., 2015; Wang et al., 2008; Smolinsky et al., 2020; Akdemir & Oguz, 2008; DiCarlo et al., 2023; Moon, 2013) and some still prefer PPT (Wang et al., 2021; Wagner et al., 2022; Alabi et al., 2023), the PPT has three-fold tasks for teachers involving preparation, administration and post-evaluation of results. In fact, Jomuad et al. (2021) describe this as additional teachers' workload with a significant impact on their stress levels as well as on their performance. Similarly, Hundani and Toquero (2021) supposed that teachers' work-related paperwork contributes to their level of occupational stress.

Researchers and educators alike urge teachers to become innovative in assessing students' learning (Looney, 2009; Serdyukov, 2017; Zacharis, 2010) and one of the most effective strategies is to employ technology through computer-based assessment (CBA). A CBA is a method of evaluating student learning that uses a computer instead of a traditional paper test, also known as onscreen testing and e-testing. CBA has become essential to teaching and learning over the last two decades and is viewed as a solution for assessment implementation for learning and providing real-time feedback on students' performance (Burgmanis et al., 2023). It also reduces test durations while increasing students' motivation to take tests (AlAdl, 2020). While implementing computer-based tests can give teachers a new challenge in the digital era, they need to be creative to keep up with the advancement of science and technology. Aside from created opportunities to raise the status and accreditation of the school (Lesly, 2021), it follows the Department of Education (DepEd) order no. 78, s. 2010, on the computerization program to equip public schools with the necessary

technologies to improve the quality of education and address the challenges of the 21st century. Students nowadays prefer to use technological devices in every aspect of their daily activities (Cha et al., 2020; Pentang, 2021). Hence, the use of technology, particularly for assessment, is highly beneficial. It can help the country's educational system by allowing students to showcase their skills in ways that traditional methods would not allow (Das, 2019).

The use of CBA tool to assess students' performance increases teachers' productivity (Terzis & Economides, 2011) by reducing laborious tasks due to the automated results generated. In terms of the assessment administration, the main argument with the CBA is the availability of reliable internet connection (Sibberns, 2020; Csapó et al., 2012; Thurlow et al., 2010; Tomasik et al., 2018) specially in countries like the Philippines where the internet has been a constant challenge in online education (Asio et al., 2021; Gocotano et al., 2021; Barrot et al., 2021). Hence, offline CBA, a method of assessment that uses a computer without an internet connection, is highly recommended in the Philippines. If locally developed, an offline CBA is less expensive than an online CBA since it can be administered in school computer laboratories without a need for strong internet connection. Moreover, it can also reduce students' cheating chances since they cannot look for answers online and waste time when answering questions during the test (Alek, 2020). Through ICT, the content can be presented engagingly, capturing students' interest and perception through text, color, and visual displays (Mirsharapovna et al., 2022). Students and educators may benefit from such an approach regarding quality, efficiency, and quantity. Since many students use computers, tablets, and smartphones outside the classroom, utilizing these same devices for testing may help students connect what they learn in class and what happens in real-world situations.

Given the advantages of using CBA to the teachers through efficiency and ease (Nikou & Economides, 2019; Maqableh et al., 2015; Sirianni et al., 2017; Bloom et al., 2018; Ceka & O'Geen, 2019; Zheng & Bender, 2019; Sullivan, 2020; Efendi et al., 2021; Dembitzer et al., 2017; Terzis & Economides, 2011) and the immediate feedback given to the students (Shute & Rahimi, 2017; Debuse & Lawley, 2016), this capstone project developed an offline CBA tool in Statistics and Probability. In addition, to address the common issue on internet connectivity in the research locale, the CBA has been developed using easily

available built-in software Microsoft PowerPoint and Excel. This allows maximum benefit for teachers for the ease of use with minimum training required.

2. Methodology

2.1. Research design

This project used developmental research design to develop an offline CBA tool in Statistics and Probability. Based on Richey and Klein (2005), developmental research focuses on designing, producing, and assessing instructional materials and processes that can provide educators with valuable data. The instructional system design method was the modified ADDIE model, which only includes the analysis, design, and development processes. The implementation and evaluation stages were excluded from this project since the material needs to be validated by experts before implementation. According to Campbell (2014), ADDIE can be modified to meet almost any educational need or purpose. Given the dynamic nature of current education, this paradigm for instructional design is ideally equipped to address future issues associated with the design.

2.2. Participants

This project was evaluated by ten experts with the following criteria: Master's or Doctorate degree holder, an expert in teaching Mathematics, an experienced teacher in the field of Mathematics, an expert in ICT, and an Assessment expert. Purposive sampling was employed since the project requires specialized experts who can assist the study in achieving its objectives. This type of sampling is used to increase the study's rigor and the accuracy of the data and results by better matching the participants to the study's goals and objectives (Campbell et al., 2020). Purposive sampling helps the researcher to eliminate irrelevant feedback that is unnecessary in the study's context and it reduces the data collection margin of error (Obilor, 2023).

2.3. Instruments

As part of the analysis phase of the modified ADDIE model, the third and fourth quarterly assessment issues and concerns and other essential reports were used in developing the offline CBA tool. Teachers' experiences during the administration of assessments served

as the basis for developing the tool. Microsoft applications such as PowerPoint and Excel were used as the platforms for designing and developing the tool.

Moreover, the instrument used to validate the CBA tool was adapted from ISO 9126, an international standard for software quality. The validation form has the following criteria: functionality, usability, efficiency, technicality, and accessibility. Since the validation was limited to the CBA tool and not the assessment itself, the criteria only focus on software validation. Functionality refers to the usefulness and appropriateness for its intended use. Usability is a means of determining how easy it is to use. Efficiency is the ability to deliver desired and accurate outcomes with minimal resources. Technicality refers to the set of information and specifications regarding the utilization, and the accessibility is concerned with how easily the tool may be accessed or operated by anyone. Each criterion may be scored on a scale of 1 to 5, with 5 representing the highest rating. The validation rating sheet follows Pentang (2023) with the following: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree, and (5) strongly agree.

2.4. Data gathering procedures

The research used the modified ADDIE model development process. This method is the most appropriate since it offers an integrated approach that can be employed in developing the offline CBA tool.

Analysis phase. During this phase, it was found that evaluating student's learning involves various tasks, such as preparing test materials, administering tests, checking test papers, recording scores, and analyzing the test results. It is challenging for teachers because the various tasks require much time and effort. Similarly, during the conduct of the Regional-Mid-Year Assessment, there were necessary reports that teachers needed to submit following the administration of the assessment. Teachers struggle to keep up with the deadlines, especially during the 3rd and 4th quarter assessments, because of the other school forms and year-end activities needed. Additionally, students do not find traditional tests especially interesting or engaging based on the issues and concerns reported by the teachers specially in Statistics and Probability, a core subject in grade 11 senior high school.

During the fourth quarterly assessment at a particular school in Central Luzon, Philippines, 50 students underwent CBA for core subjects, and based on the report of

teachers who facilitated the CBA, one major problem is the internet connectivity since the platform used was Google Forms. Online CBA can be highly beneficial to schools, but since a strong internet connection is required, it is relatively expensive. Based on the analysis, innovative approaches to assessment are needed to help teachers prepare assessment-related reports, fulfill deadlines, and stimulate students' interest in assessments without using excessive resources.

Design phase. Using the data acquired during the analysis phase, the issues and concerns reported during the conduct of quarterly assessments were considered in designing the CBA tool, particularly for the preparation of assessment-related reports such as the grading sheets, Mean Percentage Scores (MPS), number of students who achieved or exceeded the minimum proficiency level and the most and least learned competencies. An offline CBA was designed considering the type of test and what platform to create the project, considering the functionality, usability, efficiency, technicality, and accessibility.

The tool was designed following the 50-item multiple-choice type of test and utilized the following software.

PowerPoint - a complete graphical presentation program with tools for word editing, outlining, sketching, and presentation management. This served as the central platform for creating the assessment tool; all the programming codes were done through this software.

PowerPoint macro-enabled Show – It enables users to integrate small programs known as macros into the slides. This is the medium through which test takers respond to the assessment.

Excel - a program used to arrange data, perform computations and perform data analysis. This stores all data about the assessment takers and is linked to the PowerPoint.

***Development phase*.** In this phase, the tool was created with help from comments and suggestions of ICT experts including techniques in designing the background design, adding navigation buttons for the tool's usability, and incorporating the following features and functionalities.

Offline setting. This tool does not require internet connectivity. This can also prevent students from cheating since this will be administered in computer labs, and students cannot open search engines to look for answers online.

Shuffling of choices. This feature can discourage students from copying their seatmates' answers.

Changing of answers. Students can change their answers if they accidentally click the wrong button.

An *Exit Assessment* button that leads to results if the test taker decides to terminate the exam early.

A *display of the taker's total score*, *number of missed questions*, and *percentage* after the assessment. The immediate results will attract students' interest and help teachers harvest scores and prepare grading sheets easily.

A button that *generates a certificate* if the test taker scored 60% or more.

An *Excel file* that stores all the student data, such as the student's name, section, score, percentage, and questions with corresponding labels (correct or wrong). This saves time for teachers to complete other tasks by making it simple for them to record and analyze test results and generate automated assessment-related reports on time.

Validation. Ten experts acted as the validation panel chosen based on their years of experience in teaching and their knowledge of Mathematics, ICT, and Assessments. They provided comments and suggestions to ensure the CBA tool is efficient and valuable.

2.5. Data analysis

To analyze the data in validating the CBA tool based on experts' ratings, the Content Validity Ratio (CVR) and the Content Validity Index (CVI) were employed. Ratings of "strongly agree" were considered. Given a panel of size of ten, a value greater than or equal to 0.62 is interpreted as valid (Lawshe, 1975). Tilden et al. (1990) suggested that a value must exceed 0.70 for the item to be considered valid. On the other hand, Lynn (1986) said that a value of 0.80 or more is preferred to be considered valid. Table 1 shows the formula to calculate the CVR and CVI used to analyze the experts' rating data.

Table 1

The formula for calculating the CVR and CVI

CVR values	**CVI values**
$\text{CVR} = \frac{Ne - \frac{N}{2}}{\frac{N}{2}}$ Where: *Ne* = the number of experts indicating "strongly agree" *N* = total number of experts	$\text{CVI} = \frac{\Sigma CVR}{n}$ Where: ΣCVR = total CVR scores *n* = total number of items

3. Findings and Discussions

3.1. Analysis phase

The data clearly show the experiences of the teachers on the laborious process of preparing assessment-related reports due to manual checking. Hence, an innovative approach is needed to assist teachers in assessing the students' learning, preparing quality assessment-related reports, and performing better. As Perryman and Calvert (2020) argue, teachers are disappointed with their jobs because they look to be made up of low-quality assignments that do not assist students. The biggest impediment to improving teacher performance is the high volume and low-quality workloads generated (Brady & Wilson, 2021). Teachers are experiencing high levels of stress and burnout due to the increased pressure from test-based accountability procedures (von der Embse et al., 2019). Ancho and Bongco (2019) stated that although it is good that teachers face challenges with a positive attitude, it would still be ideal to look for ways to complete the task without risking the teachers' physical well-being.

3.2. Design phase

The CBA tool used the 50-item multiple-choice type of test following the guidelines on test construction of the Department of Education. Multiple Choice Questions (MCQs) have been widely utilized as an educational assessment technique (Kumar et al., 2023). Kaipa (2021) revealed that students believe that MCQs will adequately assess their content knowledge and understanding.

Microsoft Office applications such as PowerPoint and Excel were used to design the offline CBA tool in Statistics and Probability. PowerPoint is a complete graphical presentation program with tools for word editing, outlining, sketching, and presentation management. Excel is a program used to arrange data and perform computations on it. It can perform data analysis and statistics computation. Because of the powerful tools available, such as PowerPoint Master Slide that is used for creating background designs, which allow users to create standards for the layout and visual appearance of every slide, and the built-in tools in PowerPoint, such as Visual Basic Application (VBA) and Macros, which are used to create programming codes to integrate interactive functions, PowerPoint and Excel are ideal platforms for designing assessment tools. As Abdulrahman et al. (2020) mentioned, using a suitable tool is crucial. Adopting multimedia in education demands a complete understanding of the technology and the components required to represent concepts or ideas accurately.

3.3. Development phase

3.3.1. The layout and features of the CBA tool using PowerPoint and Excel

Figure 1

Front-end view of the CBA tool

Figure 2

General Instructions for Assessment Takers

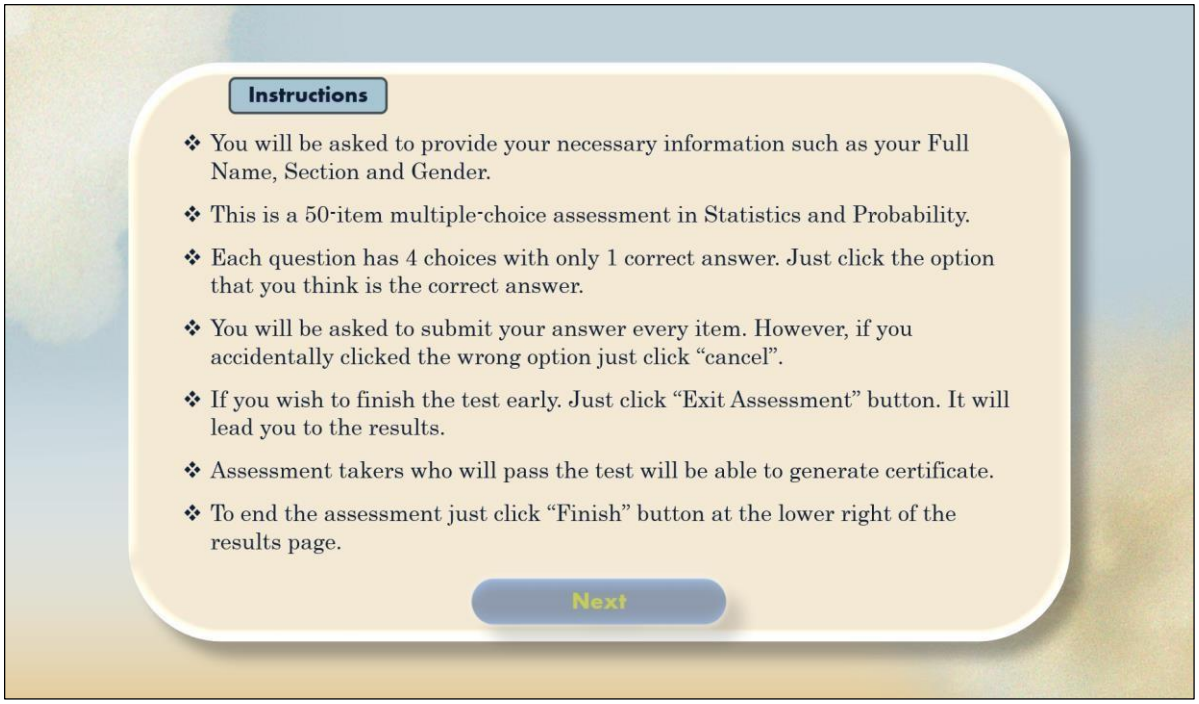
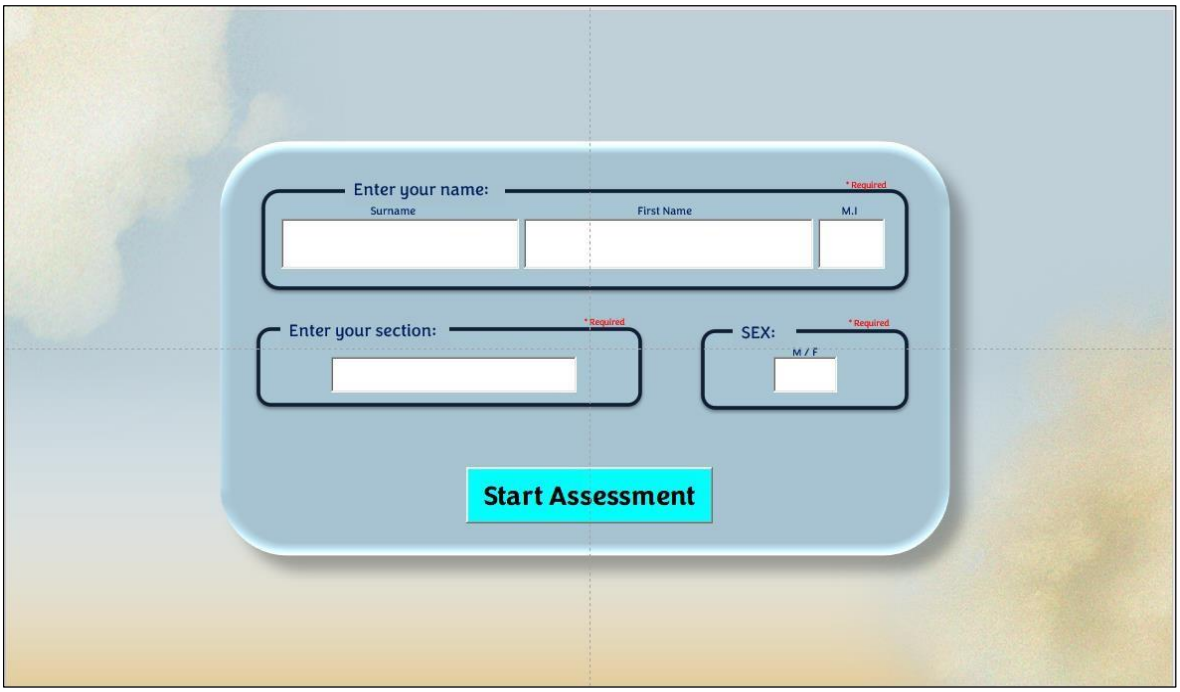


Figure 3

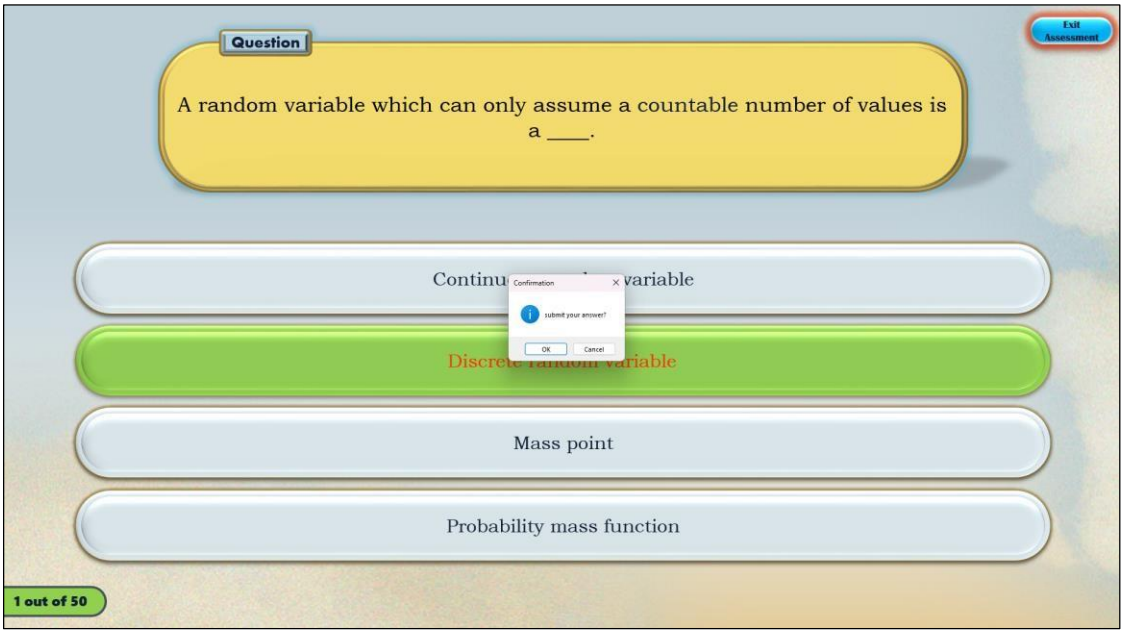
Data entry of necessary information for assessment takers



The tool does not require an internet connection. This can help prevent students from cheating. Because this will be administered through computer labs, teachers will have complete control and may restrict internet access so students cannot search for answers online.

Figure 4

Assessment question layout



Shuffling of choices. This feature can discourage students from copying their seatmates' answers.

Changing of answers. Students can change the answer if they accidentally click the wrong button. Teachers can easily give instructions to students because of the dialogue box that pops up whenever a user mistakenly clicks a wrong button.

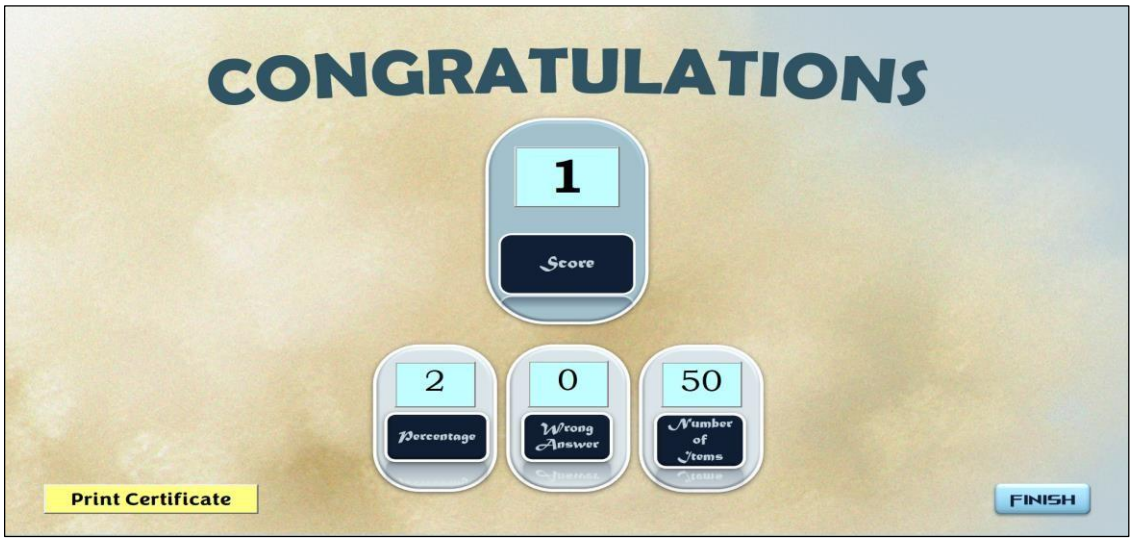
Exit assessment button. A button that leads to results if the test taker decides to terminate the exam early. Teachers can quickly provide directions to students since there are command buttons that are easy to understand.

Figure 5

View results layout

Figure 6

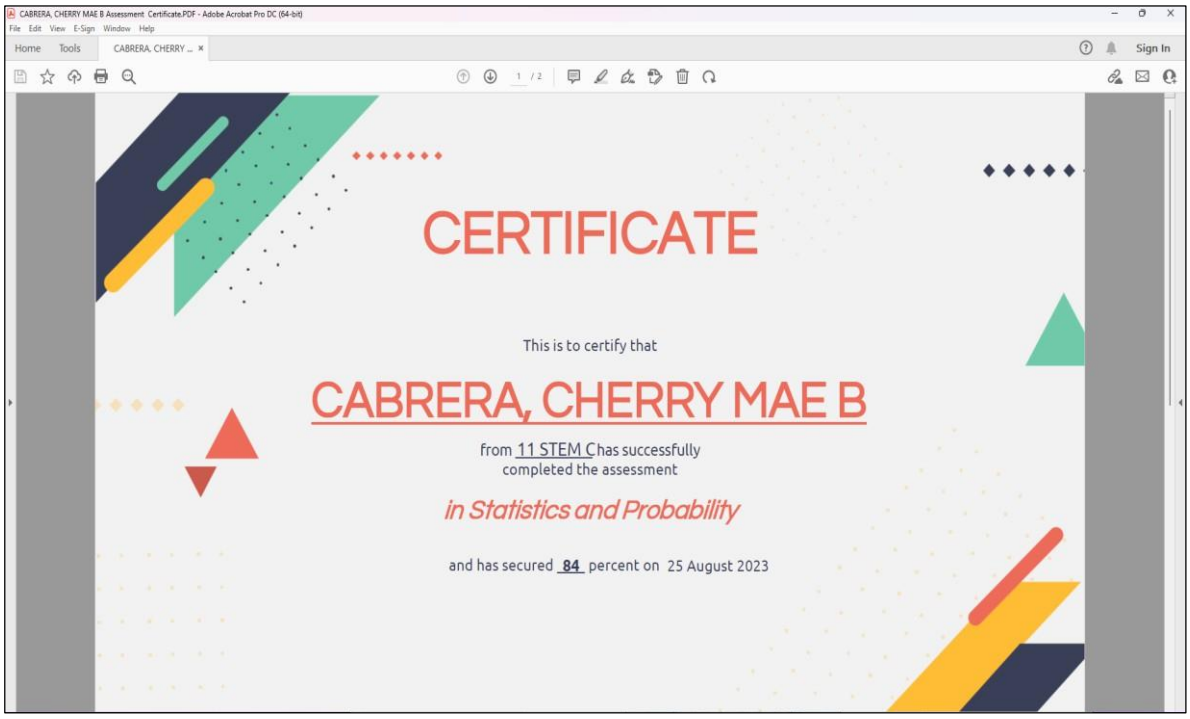
Results layout for assessment takers



It displays the taker's total score, number of missed questions, and percentage after the assessment. The immediate results will attract students' interest. Teachers can quickly harvest scores and prepare grading sheets on time.

Figure 7

Certificate of assessment passers layout



There is a button that generates a certificate if the test taker scored 60% or more.

Figure 8

Excel's data collection layout

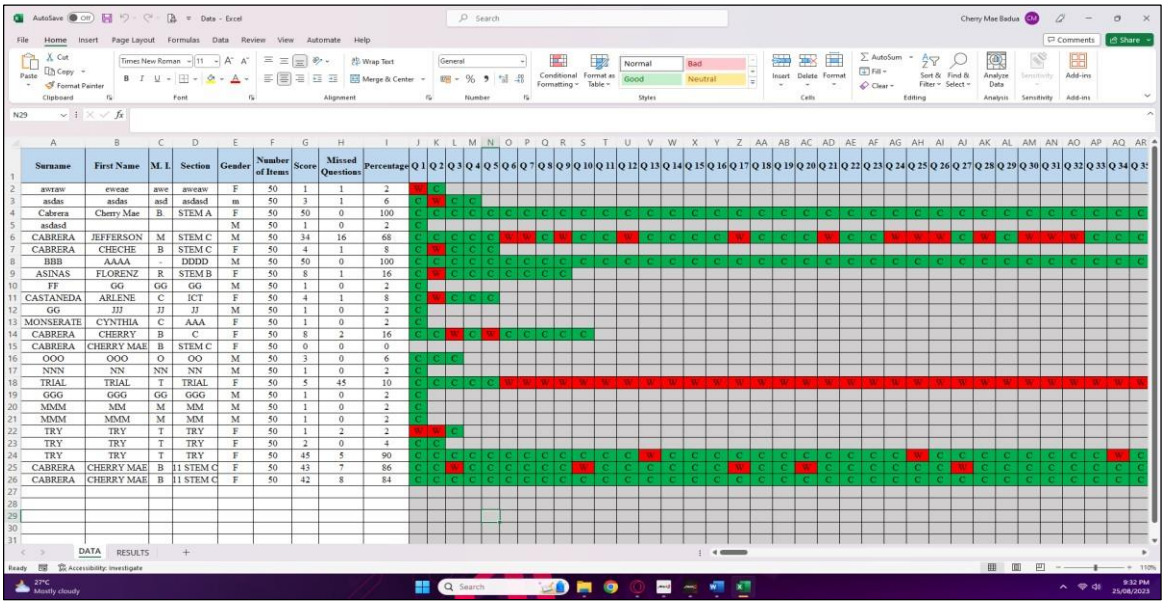
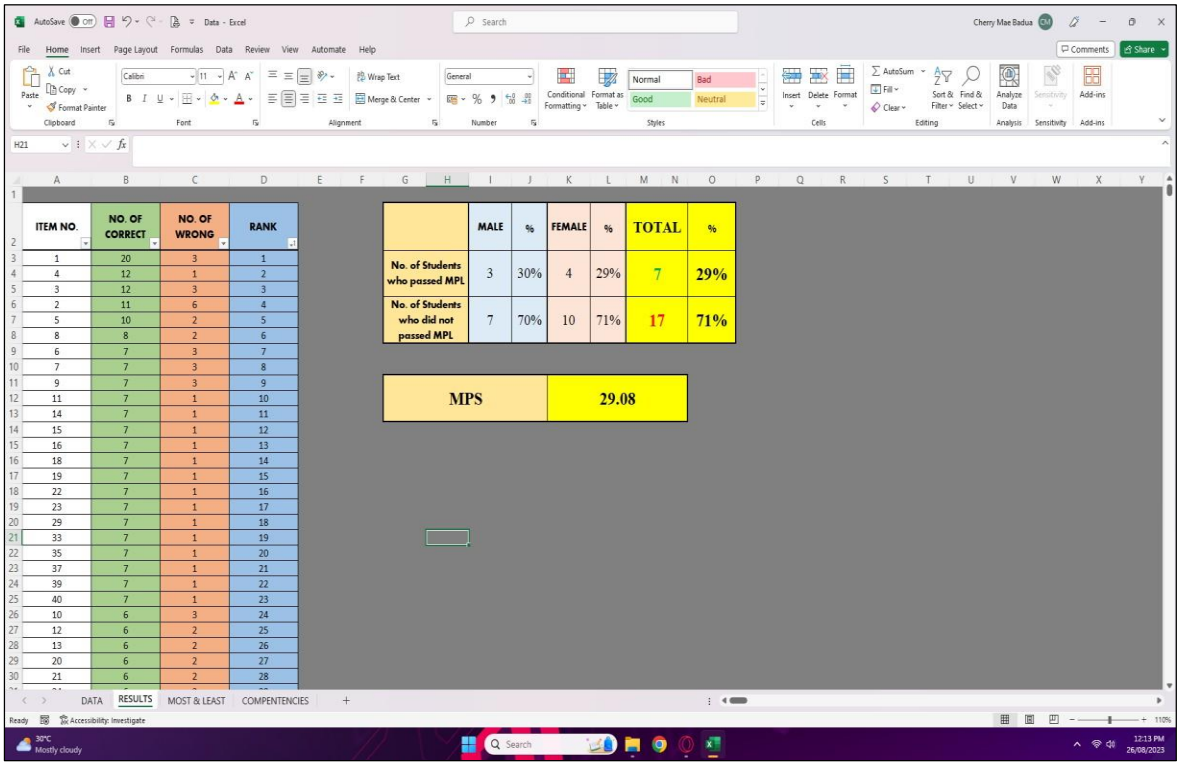


Figure 9

MPL and MPS results layout using Excel



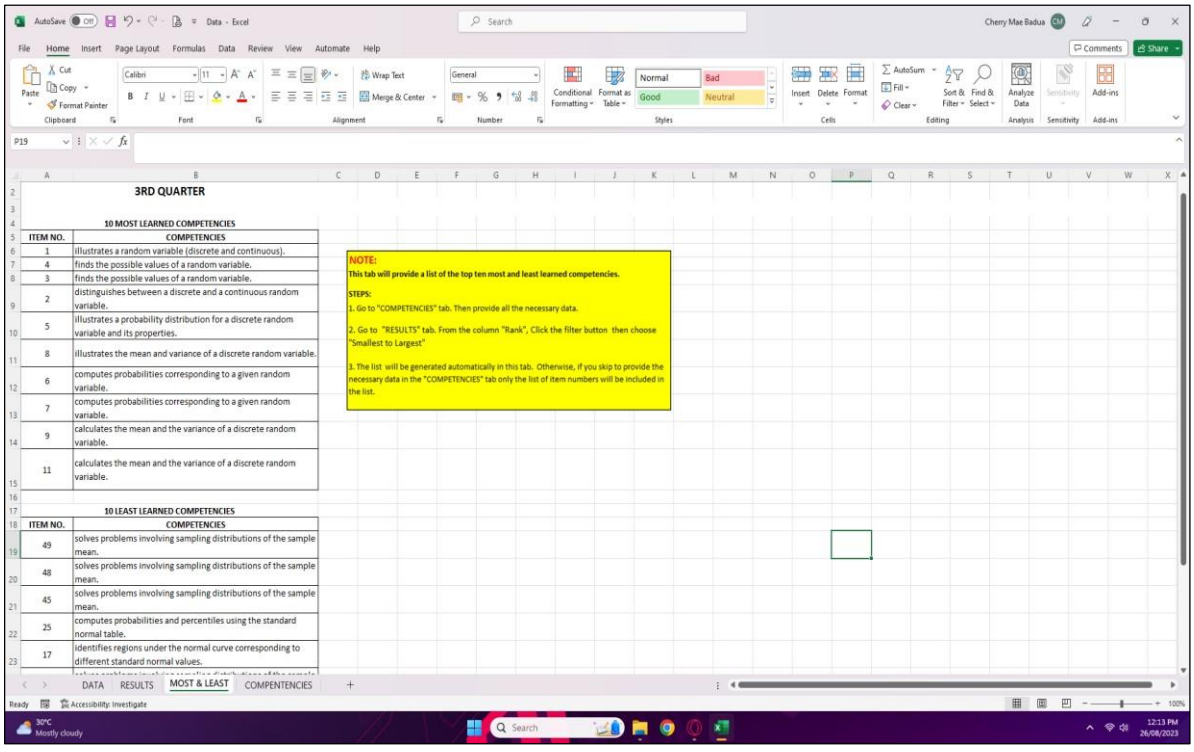
ITEM NO.	NO. OF CORRECT	NO. OF WRONG	RANK
1	20	3	1
4	12	1	2
3	12	3	3
2	11	6	4
5	10	2	5
8	8	2	6
6	7	3	7
7	7	3	8
9	7	3	9
11	7	1	10
14	7	1	11
15	7	1	12
16	7	1	13
18	7	1	14
19	7	1	15
22	7	1	16
23	7	1	17
29	7	1	18
33	7	1	19
35	7	1	20
37	7	1	21
39	7	1	22
40	7	1	23
10	6	3	24
12	6	2	25
13	6	2	26
20	6	2	27
21	6	2	28

	MALE	%	FEMALE	%	TOTAL	%
No. of Students who passed MPL	3	30%	4	29%	7	29%
No. of Students who did not passed MPL	7	70%	10	71%	17	71%

MPS	29.08

Figure 10

List of Most and Least Learned Competencies layout using Excel



3RD QUARTER

10 MOST LEARNED COMPETENCIES

ITEM NO.	COMPETENCIES
1	illustrates a random variable (discrete and continuous).
4	finds the possible values of a random variable.
3	finds the possible values of a random variable.
2	distinguishes between a discrete and a continuous random variable.
5	illustrates a probability distribution for a discrete random variable and its properties.
8	illustrates the mean and variance of a discrete random variable.
6	computes probabilities corresponding to a given random variable.
7	computes probabilities corresponding to a given random variable.
9	calculates the mean and the variance of a discrete random variable.
11	calculates the mean and the variance of a discrete random variable.

NOTE:
This tab will provide a list of the top ten most and least learned competencies.

STEPS:
1. Go to "COMPETENCIES" tab. Then provide all the necessary data.

2. Go to "RESULTS" tab. From the column "Rank", Click the filter button then choose "Smallest to Largest"

3. The list will be generated automatically in this tab. Otherwise, if you skip to provide the necessary data in the "COMPETENCIES" tab only the list of item numbers will be included in the list.

10 LEAST LEARNED COMPETENCIES

ITEM NO.	COMPETENCIES
49	solves problems involving sampling distributions of the sample mean.
48	solves problems involving sampling distributions of the sample mean.
45	solves problems involving sampling distributions of the sample mean.
25	computes probabilities and percentiles using the standard normal table.
17	identifies regions under the normal curve corresponding to different standard normal values.

There is an Excel file that stores all the data of the assessment takers, such as the name of the student, section, score, and percentage, and questions with corresponding labels (correct or wrong). This also includes the MPS result and the number of students correctly answering each item. This saves time for teachers to complete other tasks by making it simple for them to record and analyze test results and generate assessment-related reports on time.

3.3.2. Programming the codes using VBA and Macros

All the functionalities and features of the CBA tool were incorporated by allowing all the macros to run and using the VBA as a programming language. The codes are programmed by customizing the ribbon and adding the developer tool where all the codes are created. Each functionality was carefully programmed to make it easy for the user to navigate and understand each command button in the assessment tool.

Figure 11

Codes for collecting the test takers' information

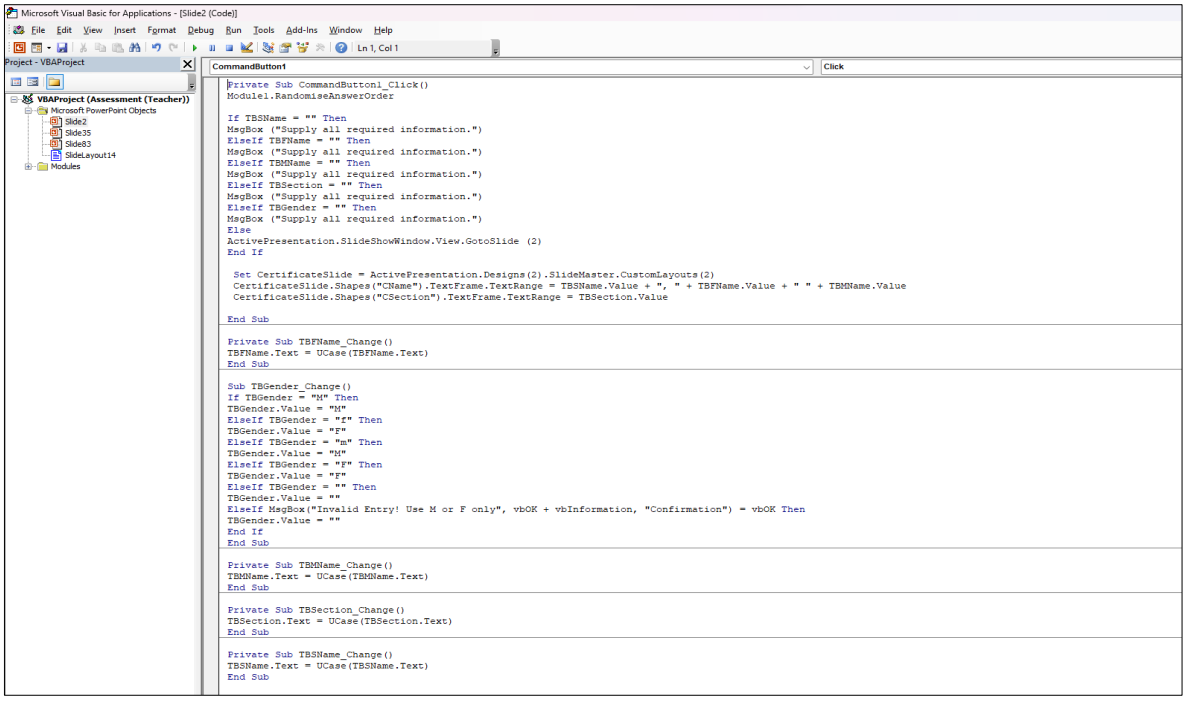


Figure 12

Codes for generating certificates for test takers

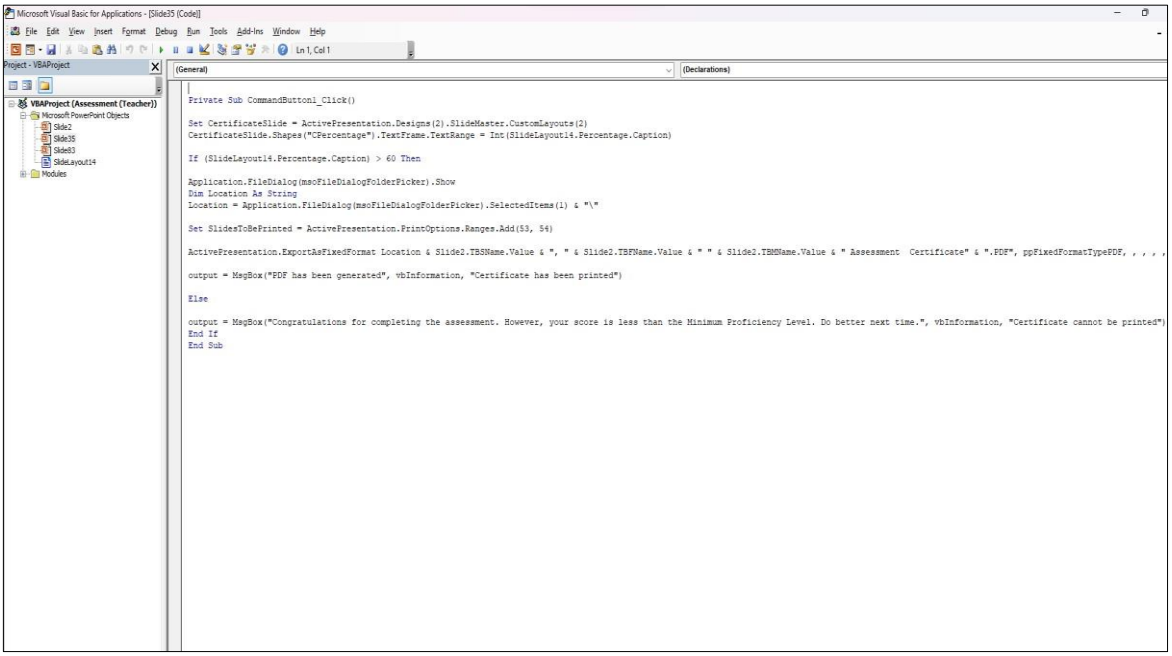


Figure 13

Codes for linking the results to the Excel file

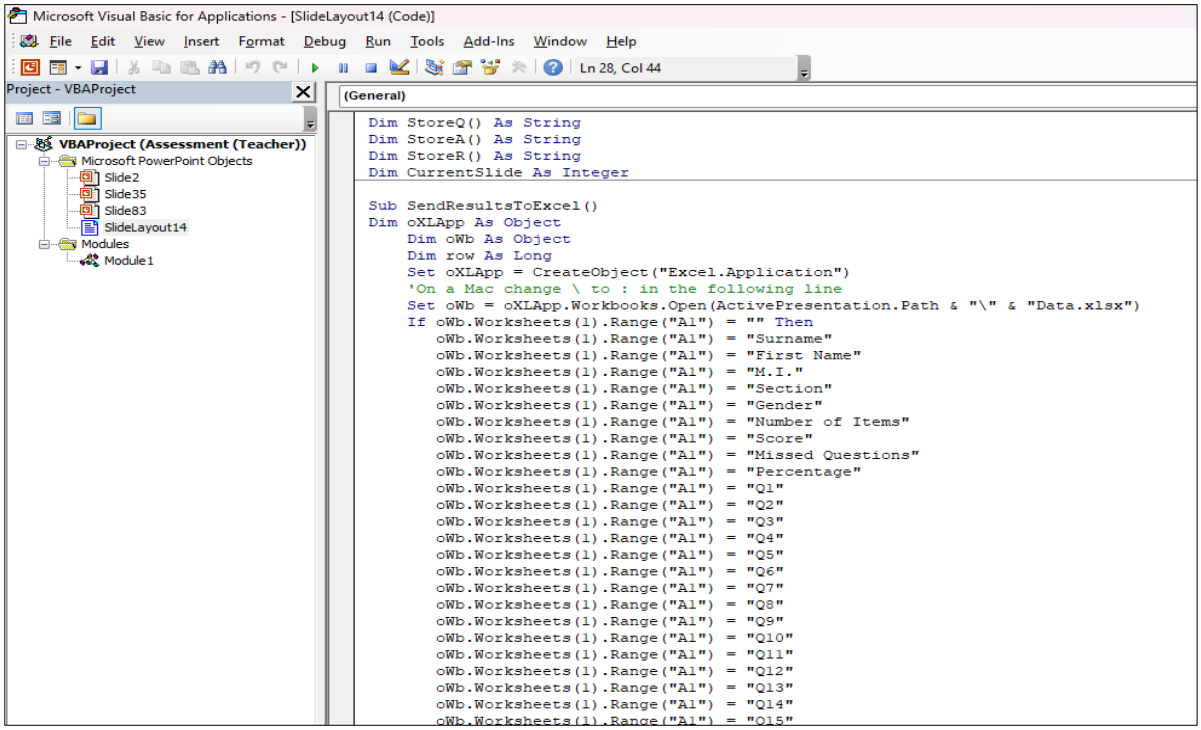


Figure 14

Codes for calculating the score of the test taker

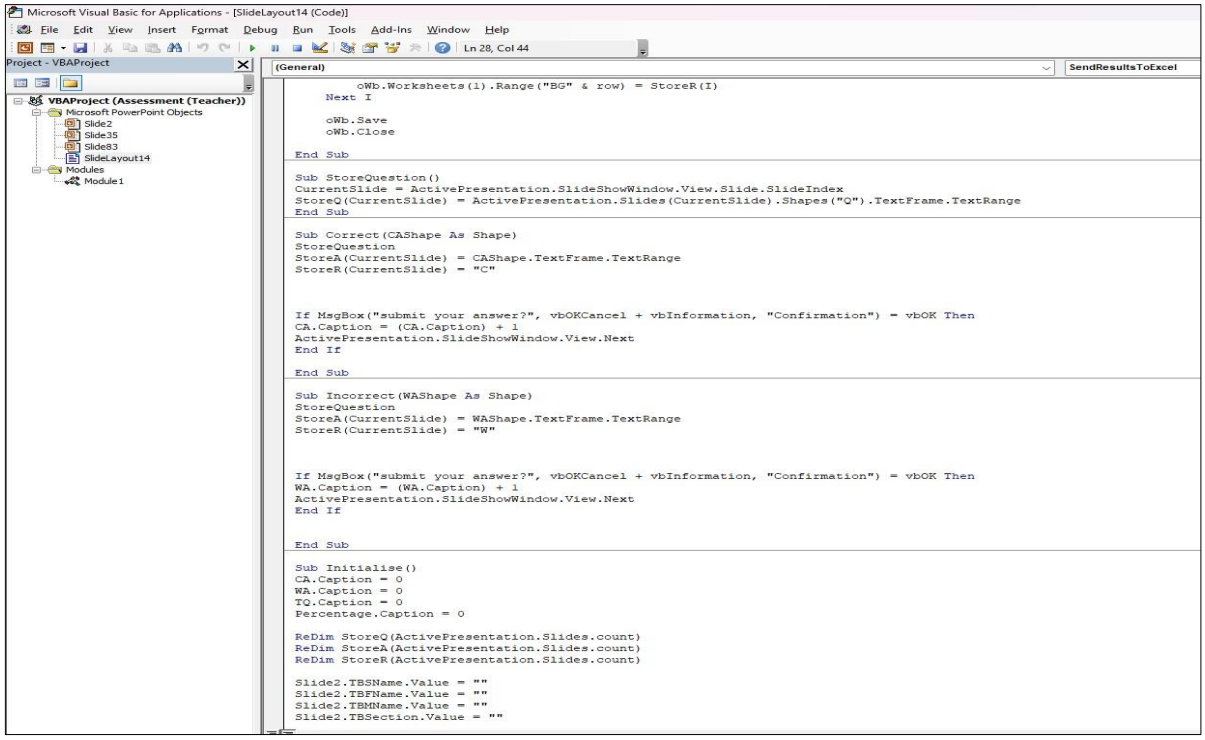


Figure 15

Codes for the shuffling of choices

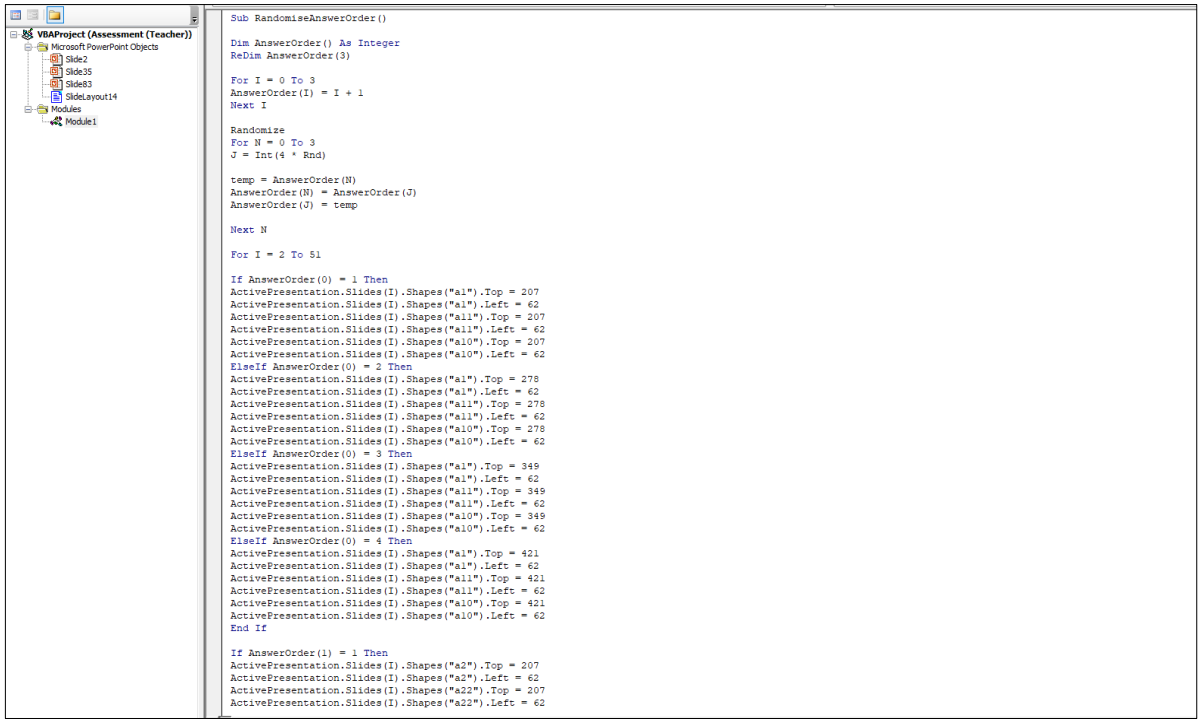
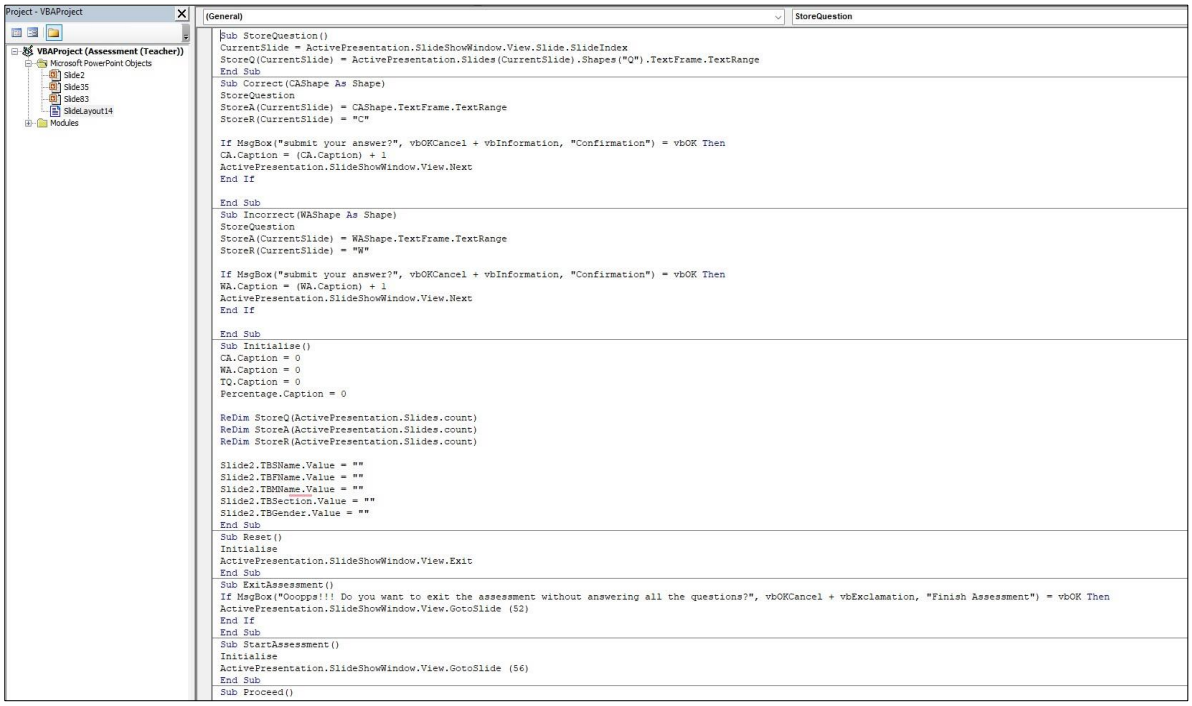


Figure 16

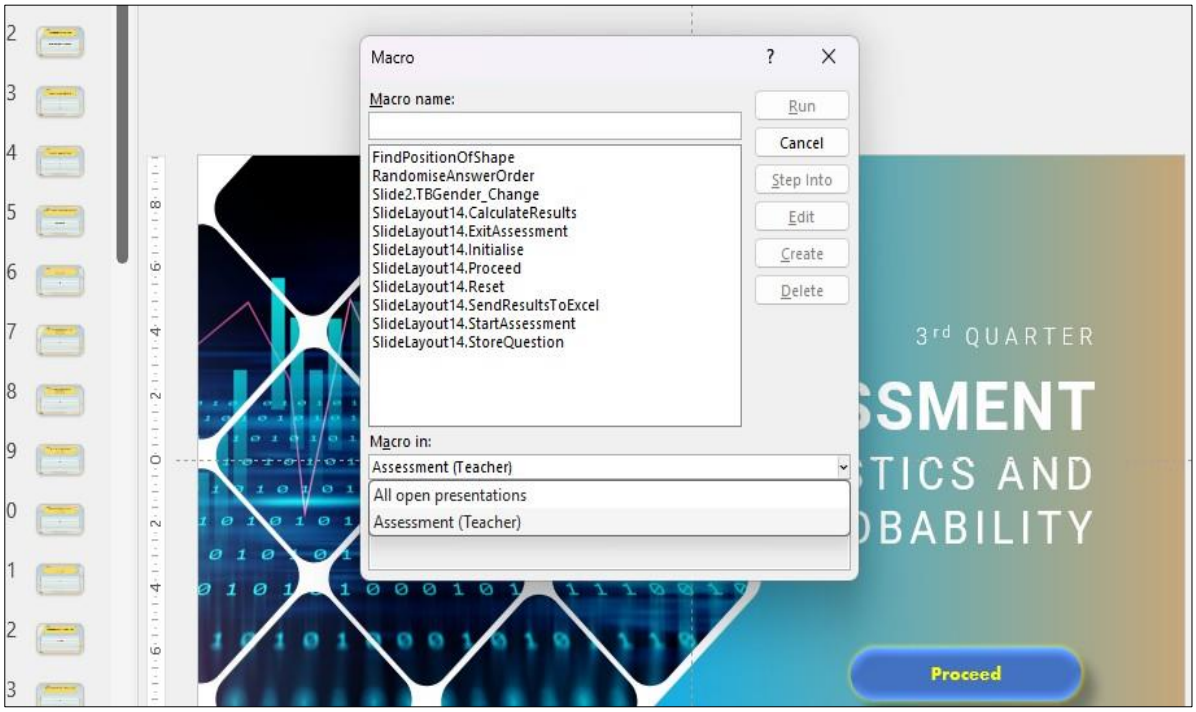
Codes for the navigation and functionalities of buttons of the CBA tool



```
Sub StoreQuestion()
CurrentSlide = ActivePresentation.SlideShowWindow.View.Slide.SlideIndex
StoreQ(CurrentSlide) = ActivePresentation.Slides(CurrentSlide).Shapes("Q").TextFrame.TextRange
End Sub
Sub Correct(CAShape As Shape)
StoreQuestion
StoreA(CurrentSlide) = CAShape.TextFrame.TextRange
StoreR(CurrentSlide) = "C"

If MsgBox("submit your answer?", vbOKCancel + vbInformation, "Confirmation") = vbOK Then
CA.Caption = (CA.Caption) + 1
ActivePresentation.SlideShowWindow.View.Next
End If

End Sub
Sub Incorrect(WAShape As Shape)
StoreQuestion
StoreA(CurrentSlide) = WAShape.TextFrame.TextRange
StoreR(CurrentSlide) = "W"

If MsgBox("submit your answer?", vbOKCancel + vbInformation, "Confirmation") = vbOK Then
WA.Caption = (WA.Caption) + 1
ActivePresentation.SlideShowWindow.View.Next
End If

End Sub
Sub Initialise()
CA.Caption = 0
WA.Caption = 0
TQ.Caption = 0
Percentage.Caption = 0

ReDim StoreQ(ActivePresentation.Slides.count)
ReDim StoreA(ActivePresentation.Slides.count)
ReDim StoreR(ActivePresentation.Slides.count)

Slide2.TBSName.Value = ""
Slide2.TBFName.Value = ""
Slide2.TBMName.Value = ""
Slide2.TBSection.Value = ""
Slide2.TBGender.Value = ""
End Sub
Sub Reset()
Initialise
ActivePresentation.SlideShowWindow.View.Exit
End Sub
Sub ExitAssessment()
If MsgBox("Ooopps!!! Do you want to exit the assessment without answering all the questions?", vbOKCancel + vbExclamation, "Finish Assessment") = vbOK Then
ActivePresentation.SlideShowWindow.View.GotoSlide (52)
End If
End Sub
Sub StartAssessment()
Initialise
ActivePresentation.SlideShowWindow.View.GotoSlide (56)
End Sub
Sub Proceed()
```

Figure 17

Macros setting of the CBA tool



3.4. Offline Computer-Based Assessment tool validation

Table 2

Validators' assessment of the CBA tool

Criteria	CVI	Interpretation
Functionality	1.00	Valid
Usability	0.90	Valid
Efficiency	1.00	Valid
Technicality	0.95	Valid
Accessibility	0.85	Valid
Overall CVI	**0.94**	**Valid**

Results indicate that the developed CBA tool is valuable and can help teachers to perform better. Parallel to the results found by Shute and Rahimi (2017) with CBA, teachers will have more time to perform other teaching-related tasks and be able to offer individualized learning opportunities to students. In addition, Joy (2023) concluded that computer-based tests save administration time and resources by creating easy-to-transfer digital records of student progress and development while Blundell (2021) explained that using digital technology in school-based assessments has a promising future. There is more opportunity to do so with the rising use of digital devices in schools. This demonstrates that the CBA can present many opportunities for the teaching and learning process in raising the quality of education. Overall, the offline CBA tool in Statistics and Probability received positive feedback from the validators regarding its usefulness in helping teachers prepare assessment-related reports. As a result, educational institutions should consider adopting the tool.

4. Conclusion and Recommendation

An innovative approach using offline CBA tools can assist teachers in addressing the issues on the difficulties in conducting quarterly assessments and preparing assessment- related reports. The CBA tool was designed following the 50-item, multiple-choice test utilizing MS PowerPoint and MS Excel with the following features: offline setting, shuffling of choices, changing of answers, exit assessment button, immediate results display, passers certificate, and data collection. Based on the experts' assessment, the developed CBA tool is

valid regarding functionality, usability, efficiency, technicality, and accessibility. Using CBA can help educators generate accurate and timely assessment results. However, one of the primary challenges is computer availability and the ICT knowledge of teachers and students.

Schools with a number of students should consider adopting innovative approaches like CBA to prevent assessment issues. However, they should provide students and teachers with basic ICT knowledge through training and workshops to successfully utilize CBA. Furthermore, the school administration may plan strategies to schedule and assign the students who will participate in CBA if there are not enough computers available.

Implementing the developed CBA tool can help establish further the validity of the tool and the reliability of the results. The tool can be further enhanced by exploring different types of tests and modifying the program settings, like adding a time limit and shuffling questions that may be incorporated according to the type of test. Similarly, future developers may utilize Microsoft Excel in encoding the questions and choices to avoid the deformation of the design in PowerPoint in creating CBA tools.

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