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Online Student Performance System Integrating Multidimensional Data Visualization and Chatbot for Primary School

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Abstract: Today's technology has improved to the point that it can be utilized to execute many activities in daily life with minimum effort, and the world has acknowledged the worth of education in one's life. The schools have to analyze student performance manually, which requires a lot of time and effort from teachers to work on. However, the increasing amount of student data becomes difficult to analyze using traditional statistical techniques and database data management tools. The objective of this research is to study the current problems in the online student performance system. A preliminary survey of 30 respondents was conducted in order to gather information based on previous user experiences with the online student performance system. The next objective is to develop an Online Student Performance System integrating Multidimensional Data Visualization and Chatbot for Primary School using Web Development Life Cycle that can visualize student performance systems to assist teachers and parents. Following that, this research employed a tool based on Multidimensional Data Visualization techniques. Google Charts and Dialogflow were used in this research to visualize the dashboard and construct a chatbot for the system. The last objective is to evaluate the usability of the system. There are three experts to test the research usability using the Post-Study System Usability Questionnaire (PSSUQ). The findings of the research can be used as a guideline to improve the system in the future. Overall, this research will assist teachers and parents in obtaining information about their students' academic performance. The data about the students' performance can be displayed in the dashboard as a chart, graph, or diagram, and they can also communicate with the chatbot if they require assistance or guidance in using the system and obtaining their students' performance.

Keywords: Chatbox, Data Visualization, PSSUQ, Web Development Life Cycle.

1. Introduction

During the COVID-19 pandemic in 2020, officials in many countries used school closures to reduce the spread of the virus. School closures may be an effective prophylactic action against influenza-type outbreaks because children can increase viral transmission even if they do not often experience severe symptoms. School closures have been implemented in some countries such as Australia and the United Kingdom, and students can still go to school if they choose to go to school [1]. Academic performance by students has always been an attraction in every educational institution. While there is agreement that schools should play a key role in this process, there seems to be disagreement as to what exactly that role is. Although some have argued that the primary focus of school should be the academic preparation of students. Report card grades, grade point averages, standardized test scores, teacher assessments, other cognitive test scores, and attendance have all been used to assess student performance over the years. As a result, when students feel personally valued and consider that their efforts are important and they can influence or monitor the outcomes of their academic success, student achievement is more likely to be observed and shown to make predictions about that student's performance.

For better quality of student performance, data visualization will be used for this research. Data visualization has become an increasingly popular method for displaying and exploring complex (multivariate) scientific data [2]. This is the process of converting data into a visual format, such as a map or graphic so that the information obtained can make it easier for the human brain to understand and extract knowledge from it. The research will use data visualization to show charts and graphs of student performance on a dashboard. Teachers can see and communicate with charts using data visualization because colors and objects are the first things that catch people's attention. Creating tables, diagrams, pictures, and other automated ways to represent data is being used in approach visualizations [3].

In addition, a chatbot is an instant messaging account that can provide services using an instant messaging framework to provide chat services to users in an efficient manner [4]. This will make it easier for parents to use the system without any problems. In recent years, chatbots have become increasingly popular in commerce, healthcare, and education. The system uses a chatbot to provide services for academic information such as student information, attendance, grades, and subjects' performance. It has sought to find the next step to help teachers and parents to find out about student performance. Therefore, this research has produced a new approach to distance learning by using an online student performance system to assist primary school teachers.

Therefore, this research aims to create a web-based system that will assist teachers in visualizing student performance data and help parents use the website easily using a chatbot in case they have problems. Teachers will be able to track their students' attendance, grades, and homework, as well as provide information to parents about their children's performance. Thus, the research implemented data analysis which is Multidimensional Data Visualization, to assist teachers in visualizing their student outcomes on dashboards and chatbots to provide parents with a faster information delivery chat service.

Currently, as SAPS and APDM have long emerged as online educational platforms, they must provide and visualize good student performance in their academics. For student performance and progress, schools must be able to access complete, accurate, and timely information about students. The student's academic performance is usually stored in the student management system, in different formats such as files, documents, records, images, and other formats. These available students' data could be extracted to produce useful information. However, the increasing amount of student data becomes difficult to analyze using traditional statistical techniques and database data management tools [5]. Thus, data visualization tools are needed for primary schools to extract useful information.

A large number of educational institutions have systems that can be used by students or parents of students to access student academic data. However, there are often problems especially for parents of students who find it difficult to access academic records [4]. The login page, which allows parents to enter Student Numbers and passwords, is one of the difficulties. This will be challenging as students' parents are usually unaware of their child's Student Number and password, which are often overlooked.

Young and old people in the city have been using chat apps in large numbers. WhatsApp, Telegram, and Facebook Messenger are some examples of chat service applications. Unfortunately, if this chat service is offered, it requires a chat agent to run a question-and-answer process. If this is

done manually using administrative staff, the process of providing information will be slow [4]. As consequence, in this analysis, the machine will perform a question-and-answer process in a chat conversation using a chatbot. This problem has motivated this research to develop a new system based on Multidimensional Data Visualization and Rule-Based Chatbots to assist teachers and parents in understanding student performance through the use of chatbots and outcome visualization.

The scope of this research was to develop an online student performance system that integrates multidimensional data visualization and chatbot for primary schools such as for teachers and parents. The main users of the research system are divided into two categories: front-end users and back-end users. Front-end users are primarily intended for parents and teachers, who can log in and view system details. They must chat with the chatbot to register by providing information such as name, phone number, email address, identification number, address, and password.

The system has an administrator also known as a teacher in its background. When compared to front-end users, admins will have more capabilities. On the system, administrators can add, edit, view, and delete items. In the administrator dashboard, administrators can visualize data on student performance such as exam grades, attendance, tests, and so on. As a result, administrators can use that information to make faster and more effective decisions in the future, as data visualization can assist them in improving student performance.

2. Literature Review

2.1. Face-to-Face Learning

Traditional face-to-face learning provides real-time face-to-face teaching and learning where students and teachers can communicate easily which the teacher can immediately answer students' questions and deliver any documents, papers, reports, or sources to their students without any problems. Face-to-face learning is an instructional format that will involve a physical classroom where the teachers and students are the synchronous physical presence of all participants [6]. Face-to-face learning can be in various activities in which the skills and engagement in all activities related to students' subject and in-depth learning can be explored by the students. Based on Lito & Mallillin [7], teachers can also work in their style and in ways that are tailored to the needs of their students.

2.2. E-Learning

Online learning or e-Learning is viewed as having less interactivity because of the lack of social presence, engagement, and student satisfaction. It has grown in popularity in recent years, prompting people to adopt the technology, especially to aid in teaching and learning. It is also more cost-effective and convenient than face-to-face learning as it offers opportunities for more learners to further their education [8]. Due to the Covid-19 pandemic, e-Learning is the only way for teachers to interact with their students and also the parents of the students. It is also a great way to start key-in or tracking the students' data through an online platform. According to Misra & Mazelfi [9], it is necessary to do online learning or e-learning in this pandemic although the learning processes would be difficult for students to adapt to. Myanmar, Thailand, Malaysia, Vietnam, Indonesia, Nepal, and Pakistan are seven of the top ten Asian countries with the fastest e-learning growth rates. Myanmar has the highest growth rate (50.2%), followed by Thailand (43.7%), and Malaysia (42.3%). This means that even third-world countries are adapting to current growth by incorporating e-Learning into their economies. E-Learning is used in academic programs to facilitate distance learning and allow students to learn independently. Many lecturers have turned to e-learning as a resource tool to inspire and motivate their students to become more self-sufficient. Therefore, e-Learning is not just a change of technology but it is also can help people to become more independent and teach the younger generation to be more familiar with computers.

2.3. Blended Learning

According to Etom et al. [10], blended learning also called hybrid learning is a method of combination between face-to-face and online learning. It is a method in which students can attend a traditional class while still working individually on online course components outside of the classroom. Blended learning will focus on measuring the students' perceptions at the blended learning approach characterizes how the e-Learning devices assist students with their learning and how capable they are in managing the tools. Etom et al. [10] also state that the students' expectations at the blended

learning method will concentrate on evaluating the characteristics of how e-Learning devices support students with their learning and how capable they are of managing the resources.

2.4. Overview of Research Elements

Most people are aware of big data analytics, but they do not use the term because big data is where sophisticated statistical methods are applied to large amounts of data [11], [12],[13]. It is a simple yet dynamic method of analyzing big data to discover insights such as hidden patterns, correlations, industry dynamics, and consumer desires that can assist businesses in making better business decisions. It provides a tool for organizations to evaluate data sets and collect new information. Big data analytics involves complex applications that include elements such as predictive models, statistical algorithms, and what-if analysis, which are driven by an analytics system. The data that has been compiled, stored, and cleaned is analyzed using analytics tools. Data mining, predictive analytics, machine learning, deep learning, artificial intelligence, and data visualization are some of the tools that are used. As a result, data visualization and artificial intelligence for chatbots will be the primary goal of this subtopic.

2.5. Data Visualization

Nowadays, data visualization is becoming an increasingly common tool for displaying and exploring complex scientific data as it allows users to explore and interpret the data interactively, allowing them to easily recognize fascinating patterns, infer the associations and causalities, and promote sense-making activities [12]. Data visualization is the graphical representation of information and data. Data visualization applications make it easy to see and understand trends, outliers, and patterns in data by using graphic elements such as charts, graphs, and maps. Data visualization techniques and technology are important in Big Data Analytics for analyzing large volumes of data and making data-driven decisions. It is yet another type of visual art that captures our attention and keeps us focused on the message. There are various ways to define the term “data visualization” because data and computer technology are the relationships that most of the definitions will be center to transform data into a visual or sonic form [14]. Figure 2.2 shows some of the examples of data visualization tools that can be used to generate graphical representations.

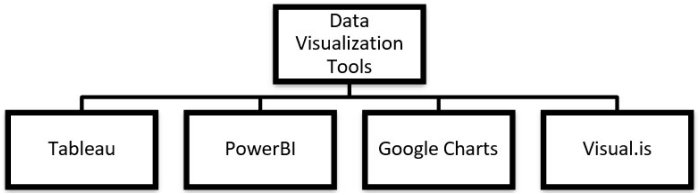

Figure 1. Data Visualization Tools

Several factors influence data visualization choices such as target audience, content, context, dynamics, and purpose. Data analysts use a wide range of techniques such as charts, graphs, maps, and others to transcribe and present data and information comparisons only. The categories of data visualization that can be used to display and represent based on the data using either qualitative or quantitative data are geospatial, temporal, hierarchical, network, and multidimensional. Figure 2.3 shows the categories of data visualization that can be used.

For this research, the technique that will be used for the system was Multidimensional for showing and displaying the student record such as student grades, attendance, number of students, and several more. In terms of method, Google Charts, a free online web software, will be used to generate the data and execute the visualizations.

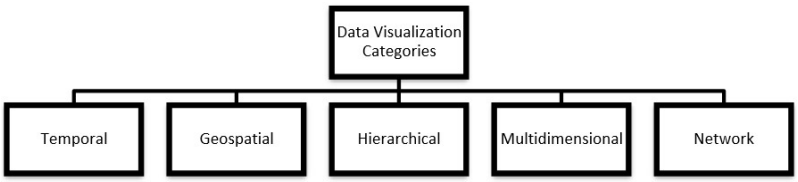

Figure 2. Data Visualization Categories

2.6. Artificial Intelligence Chatbot

According to Haristiani [15], a computer program or artificial intelligence which can conduct conversations over audio or text is a chatbot and it can also interact with users with a specific domain or subject by providing intelligent natural language responses. It also is gaining popularity and has gotten a lot of attention these days [16]. A chatbot in this research can help users such as parents and teachers can have question and answer sessions where based on Colace et al. [17], it is a virtual assistant. The introduction of a chatbot in this system as a tool to support the user activities which can help to fix or help in any problems that have occurred.

Artificial intelligence (AI) is probably the most important technological development that will have a huge impact on nearly every industry, if not all human endeavors, in the first half of this century [18]. Our lives and communities can be transformed in a variety of ways using the AI's creation and implementation because of the continuing Covid-19 pandemic, these developments are also difficult to recognize and predict [19]. By using AI, a chatbot can be created for this research which can help in communicating with the users. In AI, there are six types which are cognitive computer, machine learning, computer vision, natural language processing, deep learning, and neural network.

This research used Natural Language Processing (NLP) for the chatbot. NLP is a useful tool for assisting students with scientific learning. The natural method of language learning is combined with the technical methodology of using computer programs in NLP techniques.

There are several approaches in natural language processing which are the rule-based approach, neural network approach, and machine learning approach. For this research, the technique that will be used for the system was Natural Language Processing and the approach will be a Rule-Based Approach for developing the chatbot for this research.

As technology advances, data visualization is being used to minimize the use of texts and improve people's comprehension by using different digital representations to convey valuable knowledge realistically. Mining or collecting data methods must be reconsidered depending on various kinds of data and a specific topic to visualize the data. Natural language processing (NLP) will also be used to create a chatbot that will make it easier for users to communicate and use the system. As a result, this section will provide a brief overview of the tools and techniques available for visualizing data and NLP for chatbots, particularly on the web.

2.7. Data Visualization

Based on Baharum et al. [20], to make it easier for a user to detect the patterns, trends, and styles in a group of data, data visualization is the tool to interpret for the human brain. Visualization is becoming an increasingly valuable method for making sense of the trillions of rows of data produced every day. Data visualization can assist in telling stories by curating data into a more understandable format and identifying patterns and outliers. Data visualization in primary school can help teachers realize that when people at all levels have reliable access to the correct data and reports, they will create credible expertise and feedback that help improve services, student experiences, and more in ways that deliver results quicker. The process of constructing the system in a structured manner can be broken down into many phases. Börner et al. [21] claimed that there are several typologies of data visualizations in Table 1.

According to Börner et al. [21], the process of data visualization consists of five process steps which are acquired, analyze, visualize, deploy and interpret can be identified in data visualization. These five steps are explained briefly below:

1. Acquire

The first step of the visualization process is acquiring. Relevant datasets and other resources can be collected if well-defined insight requirements exist. Therefore, proper care must be made to acquire the best dataset possible with data scales that allow for further analysis and visualization if the quality of the data and the extent to which it is covered will have a great impact on the quality of the results.

2. Analyse
   The second step is analyzing. Data must be pre-processed before it can be viewed. Data cleaning (such as identifying and correcting errors, deduplicating data, dealing with missing data, anomalies, unusual distributions), data transformations (for example, aggregations, geocoding, network extraction), and statistical, temporal, geospatial, topical, or relational network analysis are all the examples of this step.
3. Visualize
   The third step of the data visualization process is visualizing. Picking a reference system (or base map) and designing a data overlay are the two key actions in this step. The first activity is to choose a visualization type, while the second is to map data records and variables to graphic symbols and graphic variables (such as position and retinal variables).
4. Deploy
   The fourth step of the process is deploying. Through various human–user interfaces and metaphors, different deployments will facilitate various types of interactions. Buttons, menus, and tabs allow for selection, sliders and zoom controls allow users to filter by time, region, or topic, while hover and a double click will allow users to retrieve details on demand, and many coordinated windows are linked by link and brush are the different interface controls that will allow for a variety of interactions.
5. Interpret
   The last step process is interpreting. The author and/or stakeholders will read and interpret the visualization. By doing this method, it can turn the visualization results into insights and stories that can be applied in the real world.

There are various techniques to consider when visualizing data, including temporal, geospatial, hierarchical, multidimensional, and network data visualization, in which the data is visualized in charts, graphs, maps, and other ways depending on the approach classification. In the following subtopics of methods or techniques, these techniques will be briefly explained.

Table 1. Typology of Data Visualization

TYPOLOGY	DEFINITIONS
Insight Needs	Different insight needs or basic task types have various stakeholders, which must be fully comprehended before effective visualizations for communication and/or exploration can be created.
Data Scales	Different data scales (qualitative or quantitative) may exist for data variables that will affect which analyses and visual encodings can be employed.
Analyses	Before a dataset can be shown, it must first be examined. There are many types of analyses which are statistical, temporal, geospatial, topical, and relational.
Visualization	Data, documents, and structures are examples of visual information communication as opposed to written or spoken information transmission.
Graphic Symbols	Data visualization relies on graphic symbols to provide a visual representation of data records. Any complete structure must recognize and build on earlier efforts to classify and name these symbols, as well as acknowledge and improve on prior efforts to identify and label these symbols.
Graphic Variables	Graphic variables (such as color or size) of graphic symbols are often used toindicate attribute values in data records.
Interactions	A simple visualization feature that adjusts visualization parameters according to user input.

3. Methodology

The methodology is significant since it shows an understanding of how the research will be managed and completed.

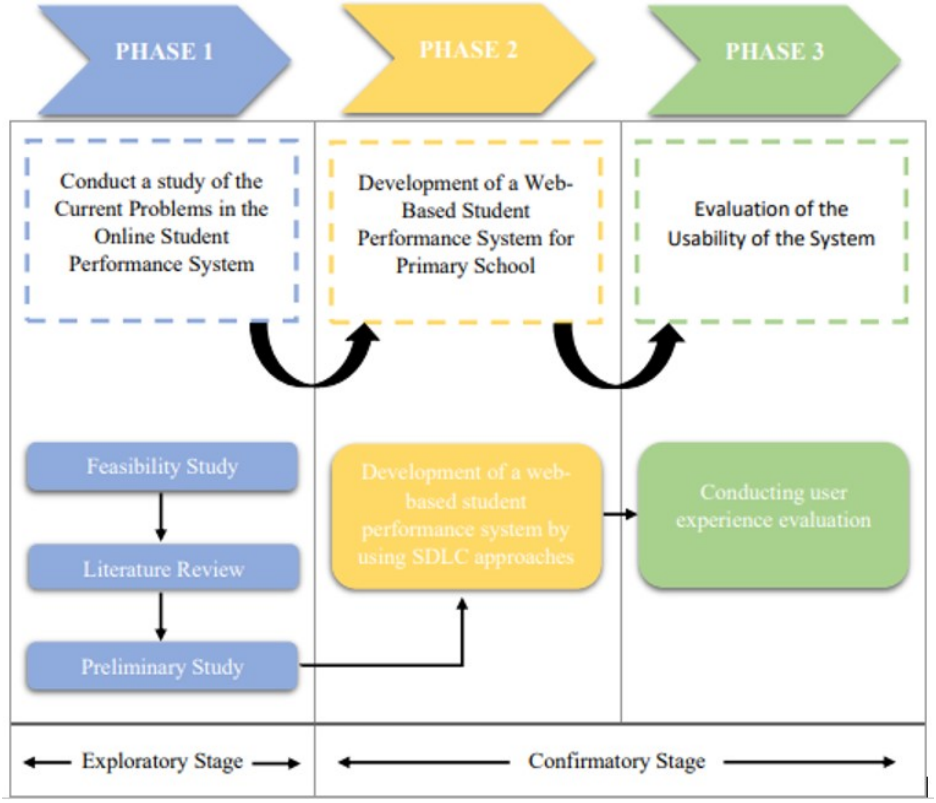

Figure 3. Research Design and Methodology of the Research

Figure 3 shows the research methodology of this research. The overall methodology of this research consists of three phases:

- Phase 1: Conduct a study of the Current Problems in the Online Student Performance System
- Phase 2: Development of a Web-Based Student Performance System for Primary School
- Phase 3: Evaluation of the Usability of the System

The process of constructing a multidimensional data visualization and chatbot web-based system in this research requires a certain level of planning to make the research's steps and implementation easier. There were various models for mobile application and web development in the System Development Life Cycle (SDLC) such as the waterfall model, agile method, and many other models of development methods that were used to develop a research. Hence, a great web development design method was chosen to lead the planning process and the development of a completed website research. For this research, from the planning to testing phases of the Web Development Life Cycle (WDLC) were being used.

The WDLC involves understanding the client's requirements, market research, knowledge about the target audience, planning, design, development, testing, and maintenance. Based on Sarkar [22], the WDLC was an organizational process for developing and maintaining websites, and it consists of five phases that allow for the entire design process to be completed. Figure 4 shows a typical web development process as a new methodology for the WDLC model.

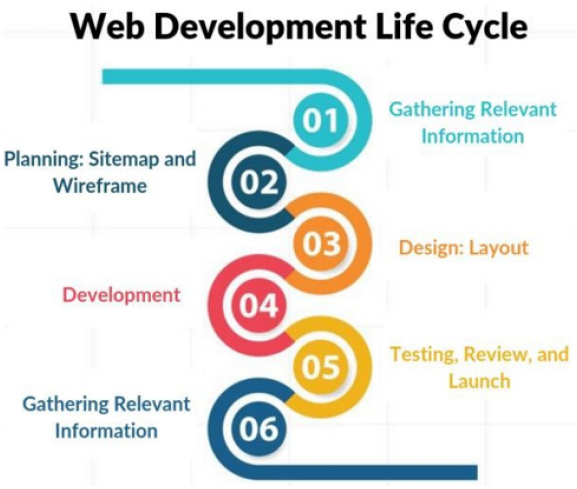

Figure 4. Web Development Life Cycle Model

4. Finding and Discussion

4.1. Interface

The user interface was the system's most important feature since it is the mechanism that allows people to communicate with and use the system. The user interface had to be user-friendly and simple to comprehend for the system to be used. The main user interface consisted of four buttons, which each linked to a different page based on the user's selections. It also included a login button for logging in as a teacher or user. Figure 5 displays the system's main user interface.

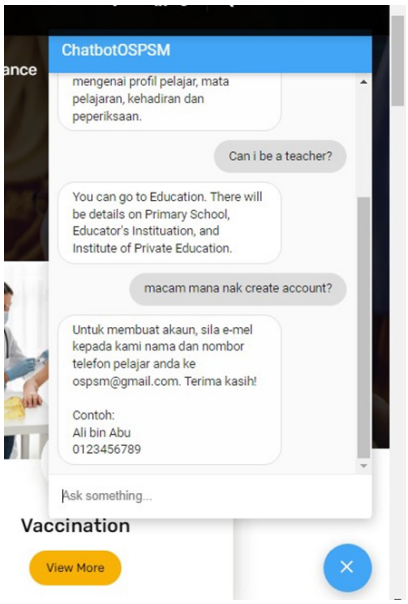

Figure 5. User Interface for the ChatboxOSPSM

4.2. Testing

Usability testing was the process of assessing the usability of a design with a group of users who were representative of the target audience. It frequently required observing users while they attempt to perform activities and can be applied to a range of designs. It was typically done numerous times, from the start of a product's development till its release. The experts were required to test the OSPSM during the research's evaluation testing. Only three experts were required to test the system during

usability testing. The system's usability testing was deemed suitable for validation because the three respondents were all experts. The results of the usability testing were analyzed using a linear scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

The experts also noted that the OSPSM's results were simple to comprehend. The comprehensive results, which included the priority values for the evaluation and the OSPSM, were computed. The results of the usability evaluation were analyzed based on the mean average. When the results were achieved, these outcomes provided the experts with increased confidence for decision-making in the final stages. The items being examined and the mean average for each item acquired from the three experts in evaluating the usability of OSPSM were shown in Table 2.

Table 2. The Items Being Evaluated and the Mean Average for Each Item

	Statements about OSPSM	Mean Average
1	It was simple to use this system.	3.3
2	I was able to keep track of the information quickly using this system.	4
3	I felt comfortable using this system.	4.3
4	It was easy to learn to use this system.	4.7
5	I can visualize the data that I want to know.	5
6	I needed to learn a lot of things before I could get going with this system.	2.7
7	It was easy to find the information I needed.	4.3
8	The information provided for the system was easy to understand.	4.3
9	When I made a mistake using this system, I could recover easily and quickly.	3.7
10	The information (such as online help, on-screen messages, or chatbot) provided with this system was clear.	4.7
11	I liked using the interface of this system.	*4.7*
12	The interface is pleasant.	*4.7*
13	The interface is easy to navigate.	*5*
14	This system has all the functions and capabilities I expect it to have.	*3.7*
15	Overall, I am satisfied with this system.	*4.7*

Based on Table 2, the result of the usability evaluation can be explained below:

- System Usefulness (Question 1 to 6)
  The experts provided several variations in this specification of the system's usefulness. The mean average for question 1 is 3.3, indicating that two experts moderately agree with the statement and one expert strongly agrees with it. For question 2, the results varied by an expert, with moderately agreeing, agreeing, and strongly agreeing that the system was able to keep track of the information quickly. The statement for question 3 received a 4.3 mean average from two experts who agreed and one expert who strongly agreed. Next, the statement from question 4 that it was simple to learn how to use the system received a mean average of 4.7, with two experts strongly agreeing and the other agreeing with the statement. As all experts strongly agree with the statement, the mean average for question 5 was 5. Eventually, question 6 received a 2.7 mean average because there were strongly agree, moderately agree, and agree on responses to the statement that they needed to learn a lot of things before they could use the system. The usefulness of this system varies from expert to expert.
- Information Quality (Question 7 to 10)
  According to the evaluation, two experts agreed that the system was easy to find information, and the other expert strongly agreed, as the mean average result for that statement was 4.3. Question 8 received a 4.3 mean average as well, indicating that the experts comprehend the information provided by the system. There were two moderately agreeing statements in

question 9 and one strongly agreeing statement, yielding a 3.7 mean average result. Finally, the 4.7 mean average for question 10 indicated that the two experts strongly agreed and one expert agreed that the information (such as online help, on-screen messages, or chatbot) provided by this system was clear.

- Interface Quality (Question 11 to 15)
  Two experts strongly agreed that they enjoyed using the system's interface, and the other expert agreed, resulting in a mean average of 4.7. Next, the interface is pleasing, as evidenced by its 4.7 mean average rating from experts. The experts mostly strongly agree that the interface was simple to navigate by using the system, which results in a score of 5 out of a possible 5. Following that, 3.7 of the mean average for the system with all of the functions and capabilities is expected, with two experts agreeing and the other moderately agreeing. The 4.7 mean average results for the last statement indicated that the experts were satisfied with the system.

Even though the OSPSM included all of the expected functions and capabilities for system evaluation, the experts were not all pleased with the pleasantness of the interface. Overall, the experts believed that the system met their expectations.

5. Conclusion

This research aims to improve users' ability to visualize data by visualizing student performance data gathered from primary school. By using data visualization, it is easier to successfully deliver more data information to people in the form of charts and graphs rather than words. Google Chart was used to build the data visualizations, which included a Pie Chart, a Bar Chart, and a Line Chart, and it was integrated with the JavaScript framework. It can assist users in interacting with the entire visualization system. This system created a chatbot allowing the user to obtain information or assistance concerning the system or the school. It will be useful since it can communicate with the user. Dialogflow was used to create the chatbot, which was then combined with JavaScript. As a result, the system assists users in visualizing student performance through interaction and capabilities given by the system, as seen by usability testing and user feedback.

This research has several limitations, even though it was well-developed and its objectives were completed. The first disadvantage is that the data is not updated regularly. This feature is useful since it saves users time when updating data while building new visualizations, which is crucial because teachers must regularly update their students' performance. Since the data was only configured for a single extraction, the system can only display data based on the current subject, class, attendance, and examination results. Aside from that, the system is unable to alert the user if there is an update regarding the student. Because this system aimed to visualize data and engage with a chatbot, users needed to have direct access to their accounts whenever they interact with the visualizations and chatbot. Finally, as this system was created entirely in English, some users were unable to comprehend it. Because the focus of this research was on data visualization and chatbot, it can only present data visualizations that assist users in interacting with the visualizations and a chatbot that can provide general information.

Although there are certain limitations to this online student performance system integrating multidimensional data visualization and chatbot for primary school, it still has room for growth in future work. Several recommendations can be identified from the limitations.

1. Create a mobile application that allows users to readily visualize student performance, and continue to extract and update data.
2. Add a notification that notifies users of the most recent system update.
3. Make the system available in Bahasa Malaysia to assist people who struggle to understand English.

References

[1] S. Goulas and R. Megalokonomou, "School attendance during a pandemic," *Economics Letters*, pp. 193, 2020. [Online] Available at https://doi.org/10.1016/j.econlet.2020.109275 [Accessed: Jan. 23, 2022].

[2] M. J. Pastizzo, R. F. Erbacher and L. B. Feldman, "Multidimensional data visualization," *Behavior Research Methods, Instruments, and Computers,* vol. 34, no. 2, pp. 158-162, 2020.

[3] E. T. Ampofo and B. O. Owusu, "Academic Ambition and Effort in the Public Senior High Schools," *International Journal of Academic Research and Reflection*, vol. 3, no. 5, pp. 19–35, 2015.

[4] A. Heryandi, "Developing Chatbot for Academic Record Monitoring in Higher Education Institution," *IOP Conference Series: Materials Science and Engineering,* vol. 879, no. 1, 2020.

[5] C. L. Sa, D. H. B. Abang Ibrahim, H. Dahliana, "Student performance analysis system (SPAS). 2014 the 5th International Conference on Information and Communication Technology for the Muslim World," *ICT4M 2014*.

[6] A. M. Nortvig, A. K. Petersen, and S. H. Balle, "A Literature Review of the Factors Influencing E-Learning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement," *Electronic Journal of E-Learning,* vol. 16, no. 1, pp. 46–55. 2018.

[7] L. Lito, D. Mallillin, "Different Domains in Learning and the Academic Performance of the Students," Journal of Educational System, vol.4, no. 1, pp. 1–11, 2020.

[8] S. Bali and M. C. Liu, "Students perceptions toward online learning and face-to-face learning courses," *Journal of Physics: Conference Series,* vol. 1108, no. 1, 2018.

[9] F. Misra and I. Mazelfi, "Long-Distance Online Learning during Pandemic: The Role of Communication, Working in Group, and Self-Directed Learning in DevelopingStudent's Confidence," *Atlantis Press*, vol. 506, pp. 225–234, 2021.

[10] R. Etom, J. Pabatang, K. Dapanas, R. Consolacion, J. Iniego, A. Jumao-as, A. Pabua, A and K. Tee, "The use of elearning tools in blended learning approach on students' engagement and performance," *Journal of Physics: Conference Series,* vol. 1835, no. 1, 2021.

[11] M. I. Baig, L. Shuib and E. Yadegaridehkordi, "Big data in education: a state of the art, limitations, and future research directions," *In International Journal of Educational Technology in Higher Education*, vol.17, no. 1, pp. 1–23, 2020.

[12] N. Bikakis, "Big Data Visualization Tools. In: Sakr, S., Zomaya, A.Y. (eds) Encyclopedia of Big Data Technologies," Springer, Cham. [Online] Available:https://doi.org/10.1007/978-3-319-77525-8_109. [Accessed: February. 23, 2022].

[13] M. Golfarelli, and S. Rizzi, "A model-driven approach to automate data visualization in big data analytics," *Information Visualization*, vol. 19, no. 1, pp. 24–47.

[14] Q. Li, "Overview of Data Visualization," *In Embodying Data*, pp. 17–47, 2020.

[15] N. Haristiani, "Artificial Intelligence (AI) Chatbot as Language Learning Medium: An inquiry. *Journal of Physics: Conference Series*, vol. 1387, no. 1. 2019.

[16] O. Zawacki, V. I. Marín, M. Bond, and F. Gouverneur, "Systematic review of research on artificial intelligence applications in higher education – where are the educators?," *International Journal of Educational Technology in Higher Education*, vol. 16, no. 1, pp. 1–27, 2019.

[17] R. Farrahi, F. Rangraz, E. Nabovati, M. Sadeqi and R. Khajouei, "The relationship between user interface problems of an admission, discharge and transfer module and usability features: A usability testing method," *BMC Medical Informatics and Decision Making*, vol.19, no. 1, pp. 1–8.

[18] W. Holmes, M. Bialik and C. Fadel, "Artificial Intelligence in Education Promises and Implications for Teaching and Learning," [Online] Available: http://bit.ly/AIED- [Accessed: Feb. 23, 2022].

[19] J. Borenstein, and A. Howard, "Emerging challenges in AI and the need for AI ethics education," *AI and Ethics*, vol. 1, no. 1, pp. 61–65.

[20] Z. Baharum, A. Amran, B. A. Kamsul, N. A. Ahmad and N. H. Azmi, "Data visualization for distribution of people with disabilities," *Journal of Physics: Conference Series,* vol. 1860, no. 1, 2021.

[21] K. Börner, A. Bueckle, and M. Ginda, "Data visualization literacy: Definitions, conceptual frameworks, exercises, and assessments," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 116, no. 6, pp. 1857–1864, 2019.

[22] A. Sarkar, "Overview of Web Development Life cycle in Software Engineering," *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, vol. 3, no. 6, 2018.