

Autism Spectrum E-Learning Platform for Skill Enhancement and Support

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Abstract

Autism is a neurodevelopmental disorder caused by brain differences, affecting learning, understanding surroundings, and social interactions. Parents, especially those inexperienced with autism, take time to understand their child's educational needs. This project proposes a digital learning portal to support autistic children's learning and provide a safe environment for parent-child engagement. Developed using a structured approach and a prototyping model, the portal leverages HTML, PHP, JavaScript, and CSS in Visual Studio Code. It features interactive lessons tailored to various learning styles, progress tracking for monitoring development, and a communication platform for collaborative planning between parents and specialists. The development process includes requirement analysis through surveys and questionnaires, design and prototyping, implementation, and extensive testing and evaluation. Results indicate the portal effectively supports individualized learning and enhances parent-child engagement. User feedback highlights the portal's user-friendly and functional design. Future work should integrate advanced analytics for personalized learning recommendations and expand the resource library with more diverse content for different age groups. The system aims to help parents find the best learning strategies and materials for their autistic children, aiding in knowledge and skill acquisition while tracking progress and development.

1. Introduction

Autism, also known as autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and the presence of restricted interests and repetitive behaviors [1]. The word spectrum referred to a wide range of ways and variety degrees of severity within each type. According to the Ministry of Health (MOH) data, the number of diagnoses for autism spectrum disorder (ASD) in Malaysia have risen steadily over the past decade, The latest annual figure for 2021 showed a total of 589 children aged 18 and below being diagnosed with ASD, up to five per cent from 562 children in 2020. Behavioral and psychiatric comorbidities are common in individuals on the autism spectrum, and can have a substantial impact on overall health, quality of life, and long-term prognosis [2]. Hence, it is crucial that the best support is provided to ensure a good life.

Kids with autism rely heavily on traditional education and therapeutic approaches [3] to support their learning process and many institutions have provided services and various methods that are helpful. They can either seek professional help from specialists such as a child psychiatrist or pediatric neurologist or get enrolled

in a private institution for individualized education and therapy. Many parents also prefer to homeschool their child due to personal reasons and preferences. However, not every parent or guardian is able to afford or provide this kind of support as it requires a large budget, time, and effort. While parents who choose to homeschool might not be able to access the best education for their child, finding the right learning strategies or keeping track of their child's progress, strength, and weakness.

Hence, an autism educational website can address the unique learning challenges of children with autism by providing a customizable, interactive, and supportive learning environment. This paper will discuss more in depth the development of the website. Section 1 is the introduction, Section 2 will explain the literature review, Section 3 will explain the methodology, Section 4 will show the results and discussion and lastly Section 5 will conclude this paper.

2. Literature Review

Literature reviews discuss about the definitions of each term related to The Autism E-Learning platform and the comparison between different website similar to the proposed system.

2.1 Case study of autism learning process

Autism is a lifelong condition without a cure, however there are multiple ways to help autistic people manage their symptoms and improve overall qualities of life including therapies and support programs. One of the biggest autism support organizations in Malaysia is the National Autism Society of Malaysia (NASOM) which is a non-profit organization providing support and services in lifelong learning and development for children with autism through various programs. The current program implemented are the STAR program which is a comprehensive behavioral instructional program designed to teach students with autism the critical communication, academic, social, and daily living skills needed in the general education environment. However, the number of autistic individuals has rapidly increased over the years. The rapid growth of individuals with autism, especially children, will increase the demands in autism intervention programs which can be a challenge for institutions or education services. Hence, there is a possibility of limited access to education for autistic children which prevents them from getting the support they need. Therefore, an autism spectrum digital learning portal development can provide a platform that serves as an alternative to the current learning process. The digital learning portal can hold large capacity of users to fulfill all the needs of each individuals seeking education.

2.2 E - Learning system

The term E-Learning is increasingly used to include any open and distance learning using information and communication technologies [4]. It is an educational platform that integrates technology into the learning processes by delivering educational content and material with the objective of supporting teaching and learning activities. The purpose is to make education more flexible and accessible. The proposed autism learning system chooses to implement E-learning due to the benefits such as flexibility and student-centered learning, reduced costs and increased collaboration, easy navigation, and exchange of ideas, variety of courses and learning styles, career advancement opportunities, enhanced time management skills, and immediate feedback. Due to these advantages, E-learning is an ideal solution to provide an educational platform that is constantly available and easy to use.

2.3 Web-based system

Web based system is a software application or platform that operates online and can be accessed using the internet and web browser. The functionality and features of the system can be used solely through the web browser without the need for any additional software installation. As the system is usually hosted on a remote server it makes it available in different locations or devices with internet connection. Web-based systems can execute processes including information sharing, collaboration, communication, and data storage. The development of the Autism spectrum digital learning portal uses the web-based approach as it provides easy access which enables autistic children and their parents to easily access the materials and resources using various devices. Other than that, web -based platforms can implement interactive elements such as videos and quizzes that help enhance user's learning experience especially for autistic child. Lastly, web-based platforms are a great approach to facilitate collaboration between parents and specialists. Hence, a web-based approach is a perfect approach to an autism spectrum digital learning portal.

2.4 Comparison with the Existing Systems

Three similar systems have been compared to identify the differences with the proposed system. Table 2.1 summarizes the comparison of the features contained in three websites, namely, My.pandai.org, QuizzerWhizzer and Quizziz including the proposed system.

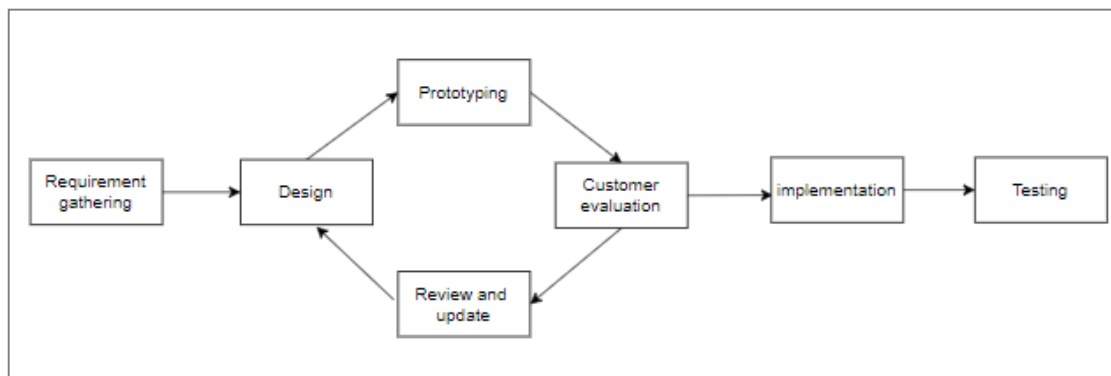
Table 2.1 System's Comparison

Features/System	My.pandai.org	Quizzerwhizzer.com	Quizziz.com	Autism spectrum E-Learning platform
User registration and log in	√	√	√	√
Interactive learning module	√	√	√	√
Discussion forum	X	√	X	√
Evaluation and assessment tool	√	X	X	√
Specialist/expert directory	X	X	X	√
Bulletin or news page	√	√	X	√
Generate report	√	√	√	√

Based on the table 2.1 All of them did not include a specialist or expert directory in their system which can be inconvenient for when further guidance and assistance is needed. While other disadvantages are that some of them did not have a discussion forum, evaluation and assessment, and bulletin and news page. The lack of these modules limits knowledge and information that can be obtained by users, especially those seeking them. The proposed system on the other hand, contained all the said modules making it a more complex system compared to others.

3. Methodology

The development of the Autism digital learning portal utilizes the prototyping model. The prototype model was chosen for the development of the portal due to its flexibility to implement any changes if required. The model consists of requirement gathering, design, prototyping undergoes a cycle of evaluation and updates until the design is approved, then goes into the implementation and finally testing. Figure 3.1 shows the prototyping model. Table 3.1 shows the details of each phase and task conducted. It also shows the outputs which can be tangible or intangible that are submitted within the scope of a project [5].

**Fig. 3.1** Prototyping model**Table 3.1** Software development activities and their task

Phase	Task	Output
Requirement gathering and analysis	<ul style="list-style-type: none"> Conduct interview. Gather user requirement. 	<ul style="list-style-type: none"> List of user Requirement Data flow diagram(DFD) Entity relation diagram(ERD)
Design	<ul style="list-style-type: none"> Designing system architecture, component, and interaction. 	<ul style="list-style-type: none"> User interface design and sketches System architecture
Prototyping	<ul style="list-style-type: none"> develop simplified version of the system. 	<ul style="list-style-type: none"> System prototype

Phase	Task	Output
Customer evaluation	<ul style="list-style-type: none"> Have user test the system prototype. 	<ul style="list-style-type: none"> User feedback
Review and update	<ul style="list-style-type: none"> Gather feedback and review. Update and change system based on feedback 	<ul style="list-style-type: none"> Improved prototype
Implementation	<ul style="list-style-type: none"> Develop final system 	<ul style="list-style-type: none"> Complete system
Testing	<ul style="list-style-type: none"> Users test the final system 	<ul style="list-style-type: none"> Final report

4. Result and Discussion

This section explains the functional area and non-functional area of the website as well as context diagram, DFD, ERD and flowchart to illustrate the system functionality and flow of information. This section also highlights the implementation process to develop the system.

4.1 Functional and Non-Functional Requirements

Functional requirements define how the system should work while the non-functional requirements refer to how the system should perform. The functional requirements and the non-functional requirements are shown in the table 4.1 and table 4.2 respectively.

Table 4.1 *Functional requirements.*

No	Module	Description
1	User registration, log in and profiles	<ul style="list-style-type: none"> Allow the new users to register new account before login. Allow the existing users to login with the email and password. Redirect the valid users to dashboard when successful login.
2	Interactive learning modules	<ul style="list-style-type: none"> Allow the children to access educational material. Allow children to interact with element by clicking button or icon. Allow children to answer quizzes and receives badges and performance report
3	Discussion forums	<ul style="list-style-type: none"> Allow parents to ask question or start a discussion. Allow the parents to comment, share and reply to other's post
4	Evaluation and assessment tools	<ul style="list-style-type: none"> Allow parents to answer questions about child's symptoms or condition. Allow parents to get feedback based on question answered related to an analysis of their child's condition
5	Consult specialist	<ul style="list-style-type: none"> Allow parents to browse through the page to find specialist contact information Allow parents to consult with specialist
6	Bulletin or news page	<ul style="list-style-type: none"> Allow parents to find news, research finding and post related to autism. Allow specialist to post and share information on the news page
7.	Manage information	<ul style="list-style-type: none"> Allow Administrator to access and updates data
8.	Generate report	<ul style="list-style-type: none"> Allow parents to see their child's performances report based on activity and lesson done. Allow parents to see child progress

Table 4.2 *Non-functional requirements.*

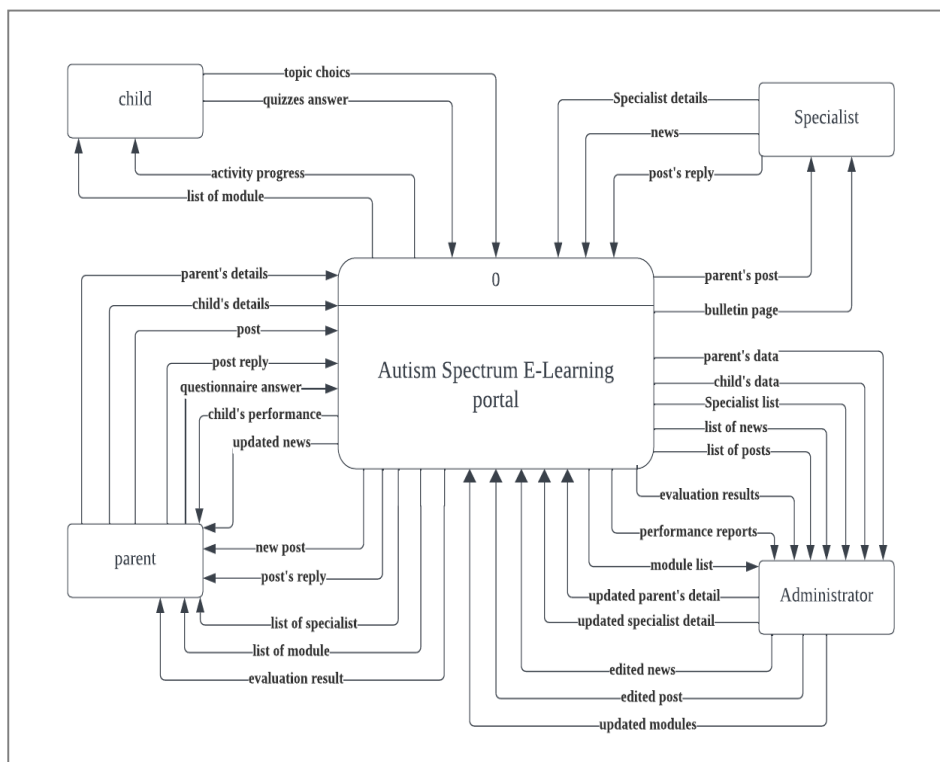
No	Requirement	Description
1	Performance	<ul style="list-style-type: none"> Any interaction between the user and the system should not exceed 3 seconds. The system should always be available and ready to be use
2	Operational	<ul style="list-style-type: none"> The system should be compatible with any web browser. The system should be easy to maintain and update.
3	Security	<ul style="list-style-type: none"> User profile will be protected and can only be access with correct id and password Only parents and child can see personal records and data.
4	Usability	<ul style="list-style-type: none"> The system should be easy to understand and navigate. The system should be able to guide and assist users through error message and tips.

4.2 System Analysis

This section explains the relationship between a system and its external entities, the flow of data through each module and the overall flow of the system.

4.2.1 Context Diagram

Context diagrams show an overview of the relationship between the system and its external entities. A context diagram shows a high-level view of the system to define an entity based on its scope, boundaries, and relation to external components like stakeholders [6]. For the website, All the entities must log in and register themselves by entering their details on the registration page or log into an existing account. Child, through their parent's account can view the learning module and quizzes available, receive and activity progress. Parents can also view the performance report, new posts, comment on others in the discussion forum, do an evaluation, view recent news, see a list of specialists and consult them. For specialists, they can upload news in the bulletin page, view parent's post and reply to them. The administrator can see all the data and edit or update it.

**Fig. 4.1** *Context diagram*

4.2.2 Data Flow Diagram (DFD)

Data Flow Diagram (DFD) illustrates the flow of information or inputs received from the external entities or the user which then goes into each process. Figure 4.2 shows 7 processes involved in the Autism spectrum E-Learning platform. The processes consist of registration, access interactive learning module, post discussion, evaluation and assessment, search specialist, manage bulletin page and generate report. Moreover, there are a total of 5 data stores used to store the necessary data for the processes. These processes will receive input from the entities, child, parents, specialist and administrator while also generating the appropriate output.

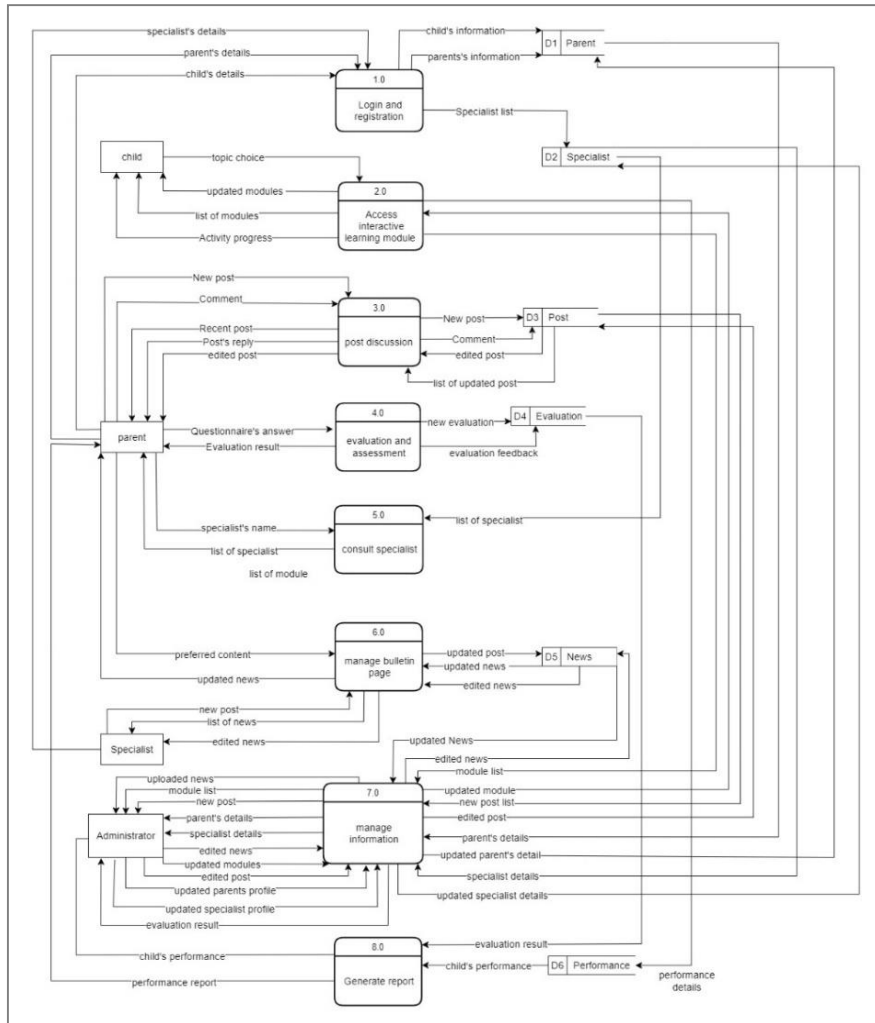


Fig. 4.2 Data flow diagram (DFD)

4.2.3 Entity Relationship Diagram (ERD)

An entity relationship diagram also known as an ERD or E-R diagram, is a methodology that describes how the data of a system is stored at a high level of detail [7]. The ERD is a way to visually represent the relationship among each entity and events in the system. The ERD for this project is shown in Figure 4.3.

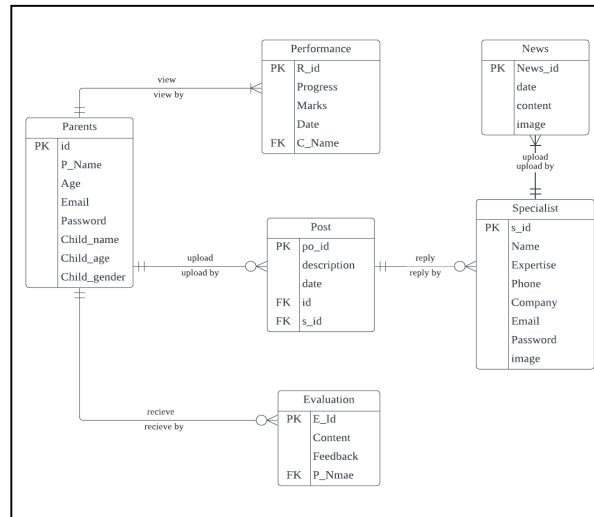


Fig. 4.3 The Entity relationship diagram (ERD)

The ERD in figure 4. shows the representation of the relationship between the entities and the process involved. There are 6 databases in the ERD representing the entity with each containing its own attributes. The databases are for parents that have a one-to-many relationship to performance report, a one-to-zero-or-many relationships with post. while parents and evaluation have a one-to-zero-or-many relationships. Post and specialist also have one-to-zero-or-many relationships. Lastly, specialists have a one-to-zero-or-many relationships with news.

4.2.4 Flowchart

Flowchart is used to show the steps, order and choices in a process [8]. There are 4 flowcharts showing the flow of the system for child, parent, specialist and admin.

4.2.4.1 Flowchart Diagram (Child & Parent)

Based on figure 4.4 and 4.5, Parent can help their child register by entering information details. If they have already registered, they can proceed with the log in process by entering the data needed such as email and password. Once the profile is verified, they can then enter the website. Child gets to view a list of modules and activity consist of educational material as well as quizzes where they can choose which activity, they prefer to do such as learning new topic, try quizzes and view performance report. Parents will undergo the same process as the child in which they have to register into the website or log into by entering email and password, if they had already registered. Once successfully logged in, they will be directed to the bulletin page in the dashboard where the updated news will be displayed. The parents can proceed to choose either to view their child's performance, open discussion forums, do an evaluation or consult with specialists by browsing through the specialist's directory and chat with them. Lastly, they can log out of the website once done.

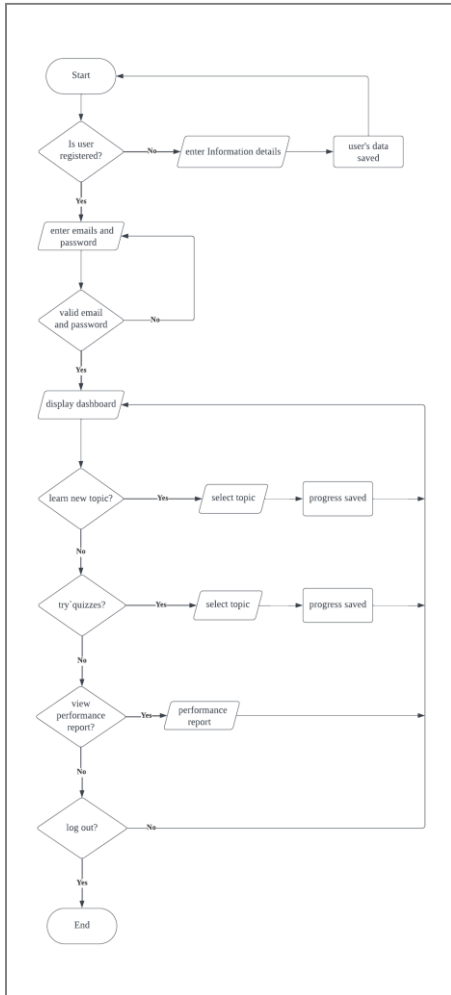


Fig. 4.4 Flowchart diagram for child

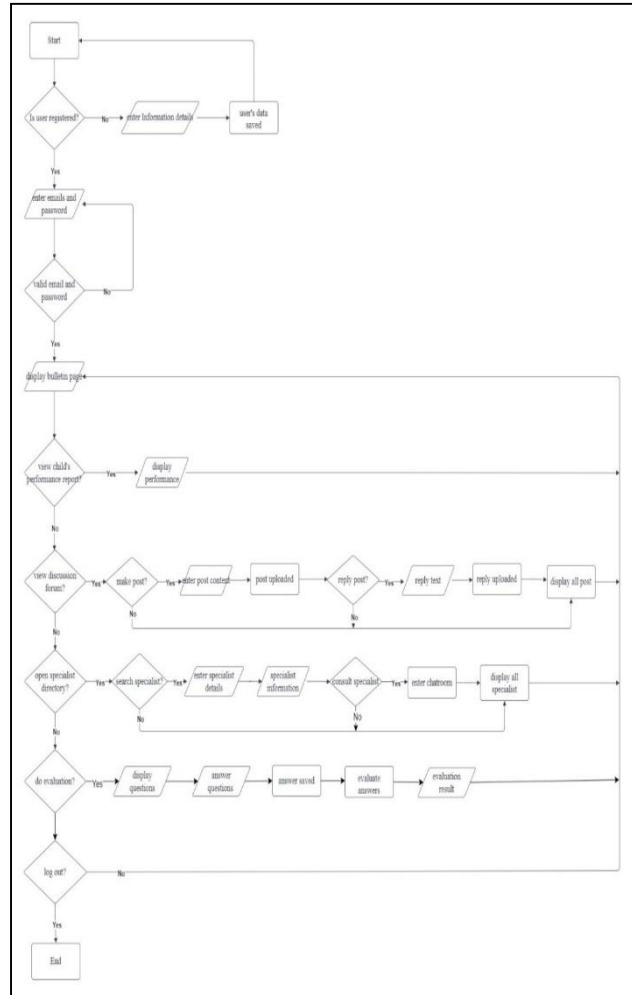


Fig. 4.5 Flowchart diagram for parent

4.2.4.3 Flowchart Diagram (Specialists & administrator)

The specialist’s and Administrator flowchart is shown in Figure 4.6 and 4.7. Before proceeding onto the website, they will also have to register themselves by entering their details or enter email and password to log in. In the dashboard, specialists can select to update bulletin posts by sharing new information or research findings or open discussion forum where they can read other parent’s post and reply to the posts. They can also view all the chat sent by parents from the consult specialist page. Meanwhile, the administrator can view all the data on the website, make necessary changes and update the page. They can view and manage all the user’s profile, learning module and quizzes, post, evaluation result, news, consultation, and user’s performance report.

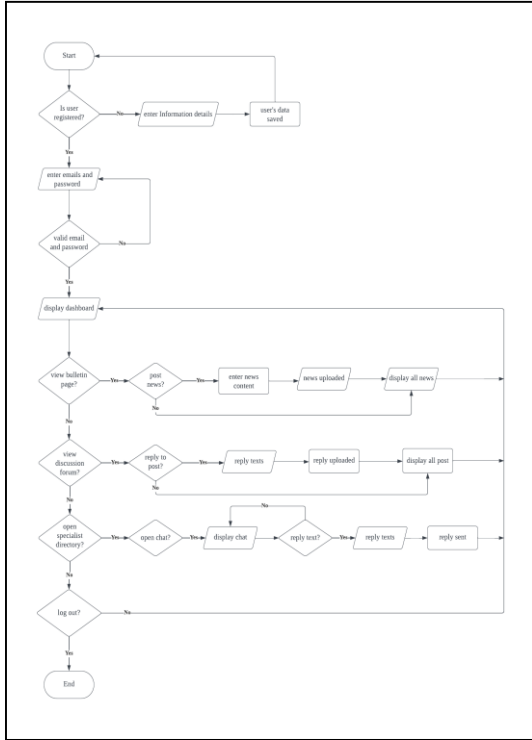


Fig. 4.6 Flowchart diagram for specialists

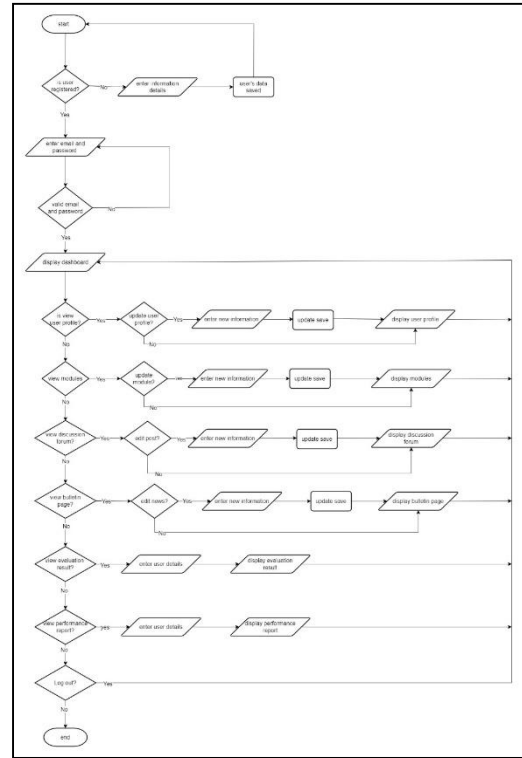


Fig. 4.7 Flowchart diagram for administrator

4.3 System Architecture

System architecture defines the structure and behaviour of the system. It shows how the system will be built and its functionality. The architecture of the Autism Spectrum E-Learning Portal is shown in the figure 4.8 below.

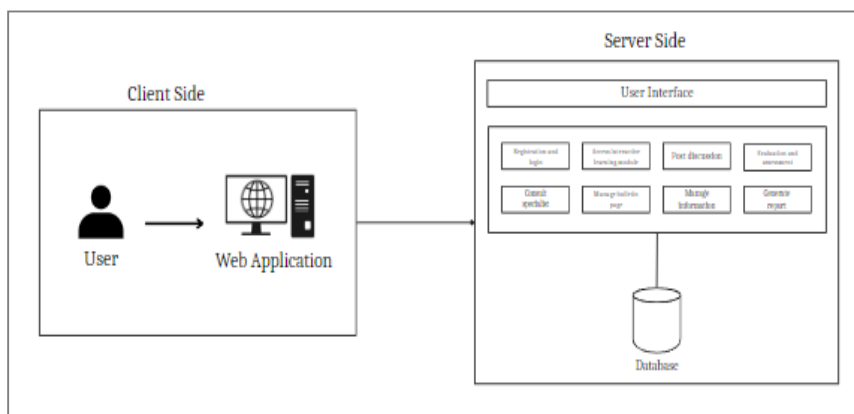


Fig. 4.8 System architecture diagram

4.4 Implementation

The Autism E-Learning Website utilizes HTML, PHP, JavaScript and CSS for overall website layout and functionality development using software such as Visual Studio Code and XAMPP for database management.

4.4.1 User Registration and Login Module

The registration process requires parent and specialist to input their details such as name, email and password. The parent has to input their child’s name, age, gender to proceed to login while specialist have to enter their company, expertise and contact. Once registration is done, they can proceed with the login and authentication.

Fig. 4.9 Login and account registration interface

4.4.2 Interactive Learning Module

The Learning modules provides different learning topic including alphabet, numbers, colours and time. user can access numerous quizzes to try after they finish learning the topic. The quizzes will record their score and will be display in the result box. Figure 4.10 and 4.11 shows the learning material and quizzes interface.

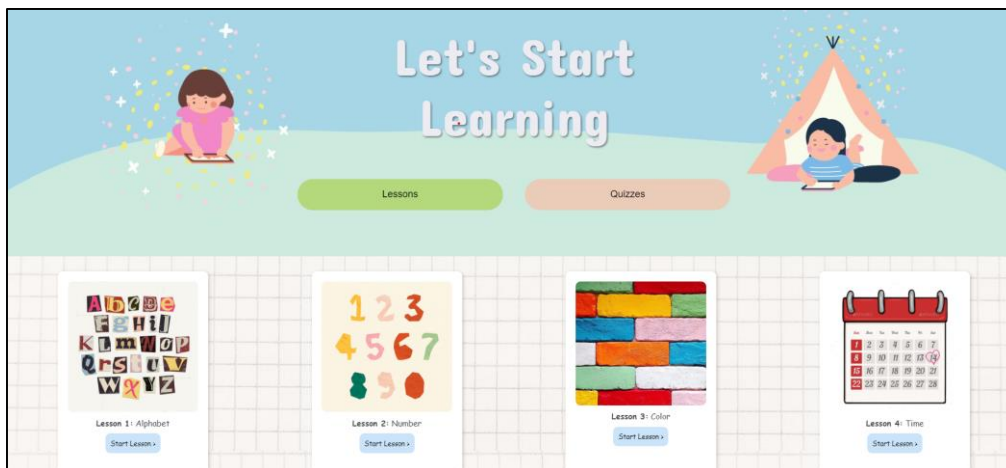


Fig. 4.10 Learning module interface

Fig. 4.11 Quiz and result interface

4.4.3 Discussion Forum Module

The discussion forum allows parent to create post related to autism. Other user and specialist can view the post and reply or comment below. The interface for the discussion forum can be seen in Figure 4.12.

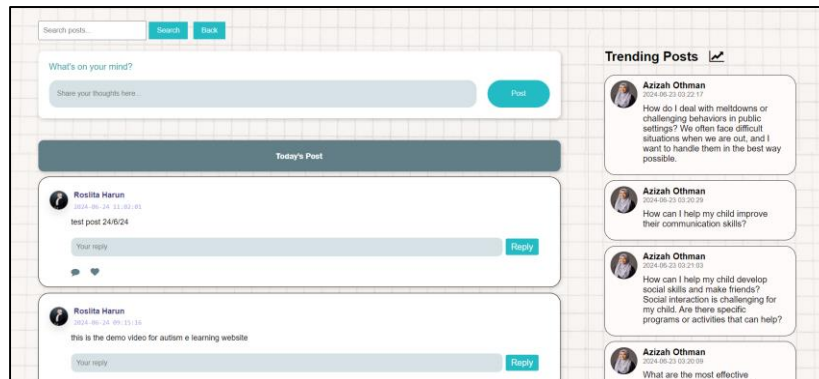


Fig. 4.12 Discussion forum interface

4.4.4 Evaluation and Assessment Tools

Evaluation and assessment module provide a list of question related to children symptom and behaviour which parent can answer to identify the spectrum of autism their children might be categorized in. This module calculate score based on answer and display the result at the end. Figures 4.13 and 4.14 show the evaluation questionnaire and result respectively.

Back to Home

Part 1: Speech/Language/Communication

1. Knows own name

Not true Somewhat true Very true

2. Responds to No or 'Stop'

Not true Somewhat true Very true

3. Can follow some commands

Fig. 4.13 Evaluation questionnaire

Back to home

Evaluation Report

Part Name	Score	Description
Speech/Language/Communication	20	Individuals with a mild score on the Speech scale tend to have average to above-average communication skills. They may have some minor difficulties with articulation, fluency, or comprehension, but these issues do not significantly impact their daily interactions.
Sociability	43	Those with a moderate score on the Sociability scale may experience noticeable difficulties with social interactions, such as struggling to initiate conversations, feeling anxious in social situations, or having trouble understanding social cues. While they may be able to adapt and compensate, their social difficulties can still affect their relationships and daily activities.
Sensory/Cognitive	43	Those with a moderate score on the Sensory/Cognitive scale may experience noticeable difficulties with sensory processing or cognitive tasks, such as struggling to filter out background noise, having trouble with memory or attention, or experiencing sensory overload. While they may be able to adapt and compensate, their difficulties can still affect their daily activities and relationships.
Health/Physical/Behavior	57	Those with a moderate score on the Health/Physical/Behavior scale may experience noticeable difficulties with physical health, sleep, or behavioral regulation, such as struggling with chronic pain, having trouble sleeping, or exhibiting impulsive behaviors. While they may be able to adapt and compensate, their difficulties can still affect their daily activities and relationships.

Total Overall Score: 163 (Severe)

Individuals in this range face significant challenges in multiple areas. They have substantial difficulties with communication, social interactions, sensory processing, cognitive tasks, and physical health. These issues greatly impact their daily lives, often requiring extensive support to manage.

Fig. 4.14 Evaluation result

4.4.5 Consult Specialist Module

This module displays a list of specialists registered on the website. The details information such as contact number and company is included to easily reach out if needed. Specialist directory is shown in the Figure 4.15 below.

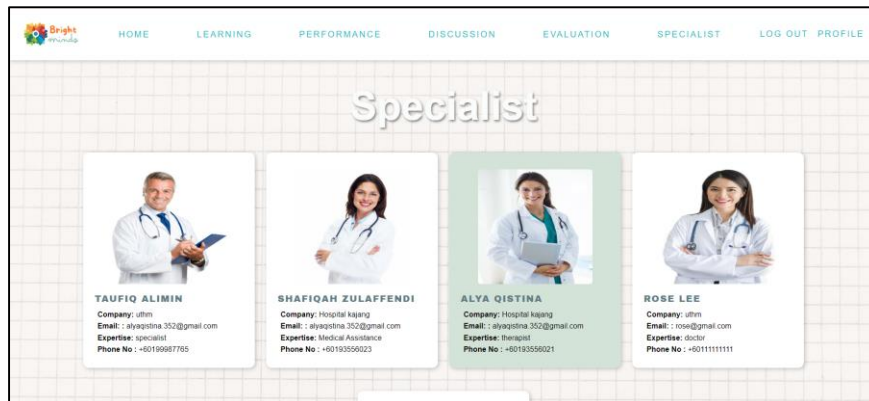


Fig. 4.15 Specialist directory

4.4.6 Bulletin or News Page Module

The bulletin page displays the news uploaded by specialist. Specialist can create post by inputting content and image. Figure 4.16 shows the bulletin and news page.



Fig. 4.16 Bulletin and news page

4.4.7 Manage Information Module

Allows admin to access all the information on the website. Admin can manage and edit information and data such as user, specialist, news and post. This can be seen in the figure 4.17 and 4.18.

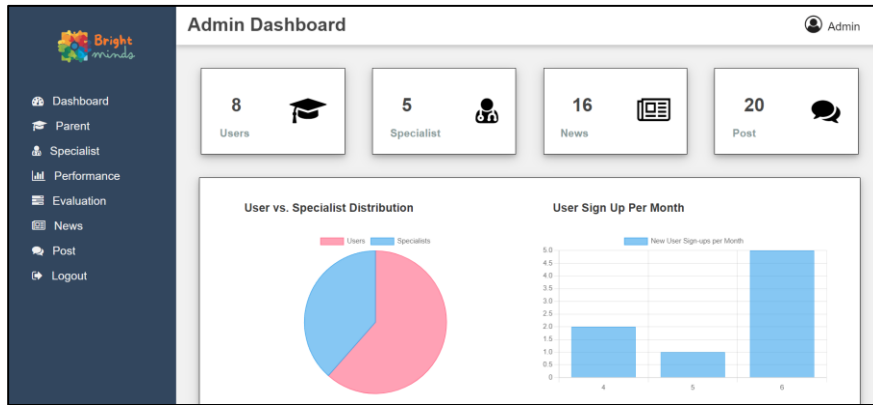


Fig. 4.17 Admin dashboard

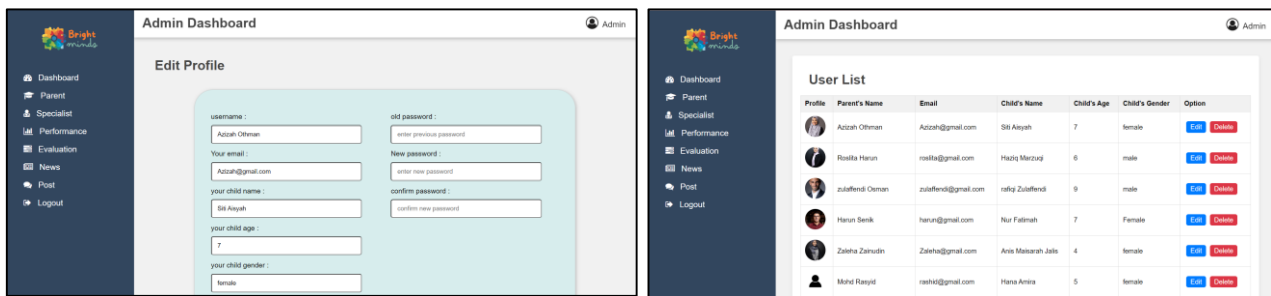


Fig.4.18 Admin edit profile

4.4.8 Generate report

Figure 4.19 shows report of children’s performance that are displayed on the performance page where parent can see their child’s progress and marks of the previous quizzes done. They can also see the evaluation result and diagnosis.

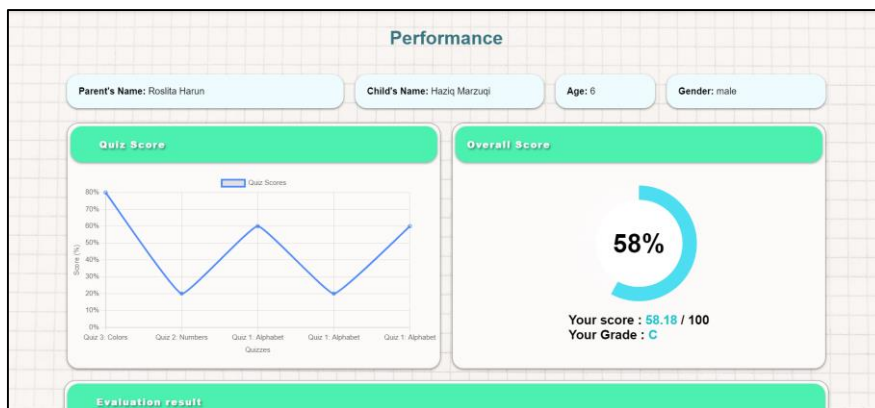


Fig. 4.19 Performance report

4.5 Test Case

The testing phase is the last phase of the development process. The testing method use in this phase is the functional testing which validates the software system against the functional requirements or specifications [9] and User Acceptance Testing (UAT) used to assess how efficiently the software can provide the intended solutions to the target audience [10]. Table 4.3 and Figure 4.20 shows the Functional testing and UAT results.

Table 4.3 *Functional testing*

Test case	Description	Expected result	Result
1. Account Registration and login			
M1-1	User can register for an account	User able to create for account	Pass
M1-2	A user can login into the system	User able to login into the system	Pass
M1-3	Wrong credential is entered	The system restrict login	Pass
2. Interactive Learning module			
M2-1	User able to access learning materials	The user access learning materials successfully	Pass
M2-2	User can access quizzes	The user access quizzes successfully	Pass
M2-3	User can see quiz score	The system track and display score	Pass
3. Discussion Forum module			
M3-1	User can view the discussion posts and replies	The user views the discussion posts and replies	Pass
M3-2	User can create own post	The user able to create own post	Pass
M3-3	User can comment on other's post	The user able to comment on other's post	Pass
4. Evaluation and assessment module			
M4-1	User can answer the questionnaire	The user able to answer the questionnaire	Pass
M4-2	To check whether a user can view result	The user should be able to view result	Pass
5. Consult specialist module			
M5-1	User can browse through the therapist list	The user able to browse through the therapist list	Pass
M5-2	User can consult with therapist though contact information	The user able to consult with therapist though contact information	Pass
6. Bulletin or news page module			
M6-1	User can see the news or post by specialist	The user able to see the news or post by specialist	Pass
M6-2	Specialist can create post	The specialist able to create post	Pass
7. Manage information module			
M7-1	Administrator can access all the information	Admin able to access all the information	Pass
M7-2	Administrator can delete or edit data	The admin able to delete or edit data	Pass
M7-3	System should update data accordingly	The system update data accordingly	Pass
8. Generate report module			
M8-1	User can receive and view child's report and performance	The user able to receive and view child's report and performance	Pass

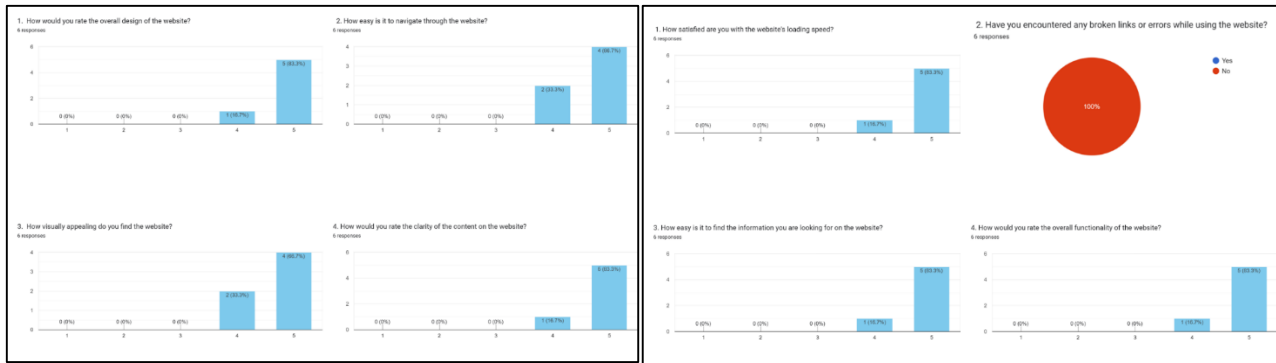


Fig. 5.30 Website interface and functionality evaluation result

Based on the test conducted, a total of 4 to 5 respondents are very satisfied with the overall design and clarity of the website. While 1 person answer satisfied with for the rest of question related to design, visual appearance and navigation of the website. For the functionality aspect, most respondents answered very satisfied with the loading speed. Whild most did not have any issues with the links and button nor trouble finding the information they want. This shows that the website managed to function as expected while having a user-friendly interface.

5. Conclusion

An autism educational website was developed to address the unique learning challenges of children with autism by providing a customizable, interactive, and supportive learning environment. By offering comprehensive educational resources, autistic children can receive the proper support and opportunities to explore their knowledge. The platform also serves as a community space for parents to connect through shared posts, comments, and discussions while receiving professional help and valuable insights from certified specialists. The website successfully met its objectives by providing up-to-date content and resources that are accessible regardless of place and time, promoting participation and engagement by all users. However, there are some setbacks, such as limited learning topics suitable for all ages, with content potentially not appropriate for children over 10 years old. Additionally, parents can only register one child at a time, which can be challenging for those with more than one autistic child. Therefore, the future system should expand its content to suit a wider age range and implement a multiple child registration system which could greatly improve the existing system.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

This journal requires that all authors take public responsibility for the content of the work submitted for review. The contributions of all authors must be described in the following manner:

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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