



CREATING MOBILE-RESPONSIVE LEARNING INTERFACES BASED ON FRONT-END TECHNOLOGIES

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<https://doi.org/10.5281/zenodo.15430490>

Abstract: This article highlights the role of modern front-end technologies, particularly the Vue.js framework, in developing user interfaces for digital educational platforms aimed at primary school students. It substantiates the use of a component-based structure in interface design, emphasizing their adaptability and alignment with the age and psychological characteristics of learners. The study analyzes the efficiency and flexibility of interfaces developed in accordance with UI/UX principles.

Keywords: Front-end, Vue.js, UI/UX, primary school, responsive design, component, digital platform

Introduction

In today's modern society, the process of digital transformation is bringing profound changes across all sectors, especially in the field of education. In particular, the use of digital technologies at the primary education level not only makes the teaching process more interactive, but also enables the organization of learning tailored to the individual needs of students. Enriching the learning process through digital tools requires special attention when working with young children, as their psychological characteristics—such as attention, memory retention, and visual perception—have a significant impact on their learning.

In this regard, the interfaces of digital learning platforms developed for primary school students must be adapted to their age, psychological development, perceptual level, and interaction with technology. This, in turn, necessitates the use of user experience-based design (UI/UX) and modern front-end technologies.

Vue.js is a component-based, lightweight, and flexible javascript framework widely used for building user interfaces in web applications. It is especially effective in creating mobile-responsive interfaces. Learning interfaces developed with Vue.js can be lightweight, visually appealing, functional, and tailored to user needs, which is particularly important for primary school students.

Today, there is a growing trend toward using component-based architecture in the development of user interfaces for educational platforms. This approach not only allows for code reusability but also enables rapid customization and testing of interfaces. As a result, it becomes possible to modularize educational content and adapt each section to students' learning levels.

This article analyzes the stages of designing and developing mobile-responsive interfaces based on Vue.js technology for primary school students. The research integrates user psychology, design principles, and technical capabilities to propose practical solutions for creating effective interface models.

Literature review

In recent years, the importance of user interface (UI) and user experience (UX) design in digital learning platforms has significantly increased. This is particularly crucial in primary education, where interfaces must be tailored to the age and psychological characteristics of young learners.

Don Norman's influential work, *The Design of Everyday Things*, provides a deep exploration of the concept of user-centered design. According to Norman, a product or system should be designed in alignment with users' needs, intuition, and behavior. His core design principles—such as signifiers, visibility, feedback, mapping, and affordance—help users navigate systems easily and recover from errors without frustration. When applied to educational platforms, these principles enhance intuitive and efficient user interactions, which is especially important for young users like primary school students. For them, a clear, visual, and interactive design becomes an essential part of the learning experience [1].

One of the most reliable sources for learning and applying Vue.js technology in practice is the book “Vue.js 3 By Example” by John Au-Yeung. This guide offers a step-by-step explanation of the core features of Vue.js 3 — such as component creation, routing (via Vue Router), state management (using Vuex or the Composition API), integration with restful apis, as well as testing and optimization. Notably, the simplicity and flexibility of this technology are highlighted as key advantages, especially for developing educational interfaces aimed at beginners [2].

When designing mobile learning application interfaces for primary education, it is essential to consider children's psychology, age-specific characteristics, and levels of cognitive development. In this context, the article “User Interface Design Guidelines for Children Mobile Learning Applications” by Halimatus Saadiah A. Latiff, Rozilawati Razali, and Fatin Filzahti Ismail is one of the most relevant scholarly contributions. The article thoroughly analyzes children's behavior when using digital devices and their interaction with interfaces from both psycho-pedagogical and technological perspectives. Based on content analysis and experimental evaluations conducted by the authors, the following interface design principles have been identified as effective:

- ✓ Minimalism – Children cannot process excessive visual load; thus, interfaces should be simplified, with large, clear buttons.
- ✓ Attractive colors – Bright and contrasting colors capture attention and help focus.
- ✓ Icons and pictograms – Graphic elements, rather than text, make it easier for children to understand.
- ✓ Auditory feedback – Sound responses to button presses help children recognize that their actions have produced results.
- ✓ Interactivity – Game-like elements make the learning process engaging and effective.
- ✓ Simple navigation – Shallow menu structures, large buttons, and clear icons help children find their way easily.

These recommendations can be fully applied in the development of educational interfaces based on Vue.js, especially through the component-based design approach, which allows each element to be optimized visually, functionally, and semantically.

The authors of the article conducted experimental testing of interface designs intended for children of various age groups (5–12 years old) and evaluated the impact of each element

on user experience. They also used the heuristic evaluation methodology to develop an interface structure suitable for children [3].

In the article titled “Design and Implementation of a Vue.js-Based College Teaching System” by Song, Zhang, and Xie, the experience of developing and effectively implementing an educational system based on Vue.js technology is described. The user interface components in the system were developed with a modular structure, allowing for reusability. Notably, interfaces were created that enable users to quickly and efficiently access educational materials, complete tests, and view results in real-time. These interfaces are based on Vue.js’s virtual DOM and reactivity features. This experience can also be technically adapted for the development of interfaces suitable for primary school learners [4].

The study “Investigating a Visual Interface for Elementary Students to Formulate AI Planning Tasks” by Park, Mott, Lee, and Gupta explores the possibilities of enabling elementary students to formulate AI-related plans through visual interfaces. The article aims to enhance students’ analytical thinking, problem-solving skills, and participation in AI planning processes through interfaces designed in accordance with the developmental characteristics of young learners.

The interfaces created in the study have a block-based structure, allowing students to visually represent complex command sequences. The interface design incorporated minimalism, clarity, and colors and symbols that align with children's psychology. This approach, in turn, demonstrates the necessity of applying modern component-based front-end technologies, such as Vue.js, in early education interfaces [5].

In the article “UX/UI Design of Online Learning Platforms and Their Impact on Learning: A Review” by Miya and Govender, the impact of user interface (UI) and user experience (UX) design in online learning platforms on learning effectiveness is comprehensively discussed. The article emphasizes that educational interfaces should not only be functional but also intuitive, aesthetically pleasing, and psychologically tailored to user needs. UX/UI design plays a critical role in capturing students’ attention, motivating them, and reducing cognitive load, particularly in terms of early education platforms [6].

The article “Transforming E-Learning with Vue.js: Key Features and Benefits for Modern Platforms” discusses the advantages of using Vue.js’s component architecture, reactive system, and strong community support in creating modern e-learning platforms [7].

The analysis of the above literature indicates that when creating digital platforms for early education, user-centered design principles, Vue.js's component architecture, and the adaptation of visual interfaces to students’ age and psychological characteristics are of critical importance. This contributes to improving the quality of education and increasing students' interest in lessons.

Research methodology

In this research, a methodology for designing and creating a mobile-responsive user interface for digital learning platforms for primary school students was developed based on front-end technologies. The platform serves to create a comfortable and interactive learning environment in the context of the digital transformation of the educational process.

The research methodology was implemented in the following stages:

1. Requirements Analysis

- ✓ The cognitive characteristics and learning styles of primary school students were analyzed.



- ✓ The necessity of a simplified, user-friendly interface with convenient navigation for teachers and parents was established.

2. Interface Architecture Planning

- ✓ The main pages of the platform were defined as follows: "About Us", "Students", "Teachers", "Contact" (Figure 1).
- ✓ User actions (user flow) and UI/UX mockups for each page were planned.
- ✓ When the "Students" page is clicked, a list of classes (Grades 1–4) is displayed; when a class is selected, a list of subjects appears, and upon selecting a subject, the relevant topics are shown, with topic details displayed upon selection (cascading selection principle).

3. Technological Solutions Selection

- ✓ For the front-end, Vue.js 3 (based on the Composition API) and Vite were used for development.
- ✓ To ensure mobile responsiveness, components were developed based on Tailwind CSS.
- ✓ The backend was created using Django, integrated with the frontend via a REST API.



Figure 1. External View of the Platform

When the "Students" page is selected, a list of classes is displayed. When a class button is clicked, a list of subjects available in that class is shown (Figure 2).

Figure 2. Figure 2. Subject Page Within a Class

When a subject is selected, a list of topics within that subject and a list of elements related to the selected topic are displayed on the screen (Figures 3 and 4). The subject topics are approximate and used for template purposes. Currently, the front-end part of the platform is in the process of being designed and developed.

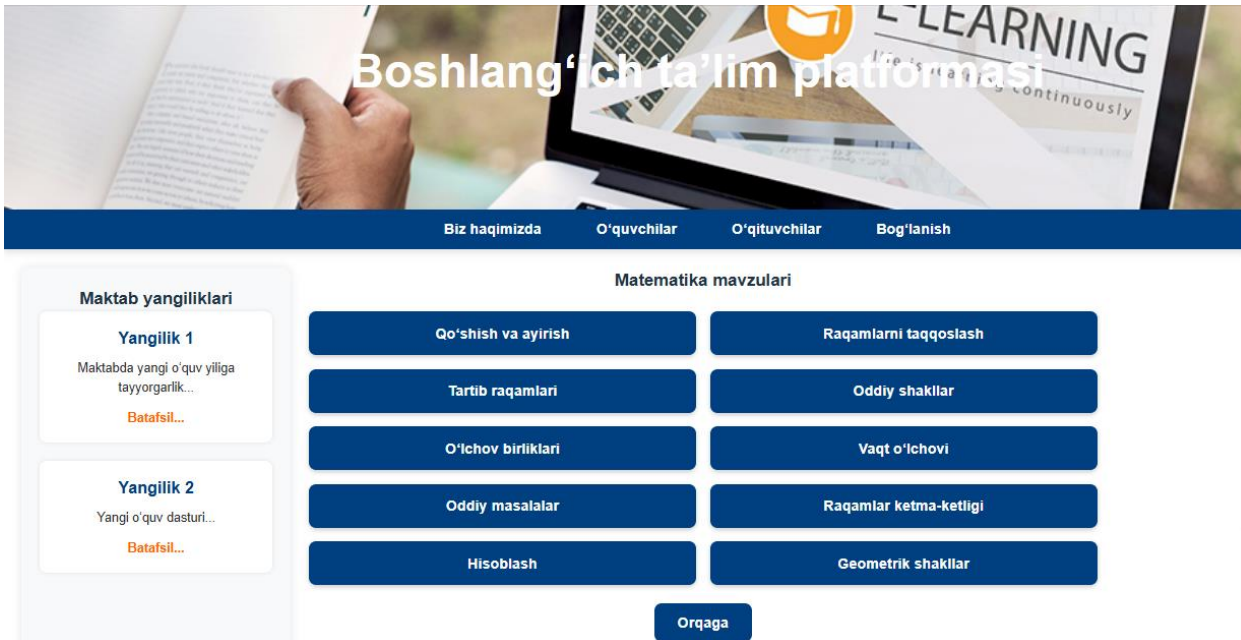


Figure 3. List of Subject Topics.

Nazariy qism:

1 dan 10 gacha bo'lgan raqamlarni qo'shish va ayirishni o'rganish. Misol: $2 + 3 = 5$, $5 - 2 = 3$.

Video:

[Videoni ko'rish](#)

O'yin:

Raqamlar o'yini: Berilgan raqamlarni qo'shing yoki ayiring!

Topshiriqlar:

5 ta misol ishleng: 1) $4 + 2$, 2) $7 - 3$, 3) $6 + 1$, 4) $8 - 4$, 5) $5 + 3$.

Mantiqiy savollar:

2 ta mantiqiy savol: 1) Agar 3 ta olma va 2 ta banan bo'lsa, jami nechta meva bor? 2) 5 ta sharikdan 2 tasi yorilib ketdi, qancha sharik qoldi?

Figure 4. Content of Subject Topics.

ANALYSIS AND RESULTS

The user interfaces of the developed platform were analyzed based on several criteria:

1.Mobile Responsiveness

A. Components created using Tailwind CSS ensured proper and ergonomic layout across all screen types.

B. Interface elements were adapted to screen sizes using media queries for dynamic adjustment.

2.Simplicity and Intuitiveness of Navigation

A. Users navigate through Class → Subject → Topic → Details, which aligns with a step-by-step learning model.

B. Each button and component has a clearly defined function, which is crucial for primary school students.

C. Routes were structured clearly and simply using Vue Router.

3.Interactivity and Usability

A. Each component operates based on dynamic rendering: for example, when a class is selected, only the corresponding subjects are automatically generated based on that selection.

Interfaces built with Vue.js offer the following advantages:

1. High Adaptability: Interfaces load quickly and adapt to various mobile devices.
2. Component-Based Architecture: Each element is managed as a separate file, allowing for modularity and easy expansion.
3. Student-Friendly Design: Colors, icons, and font sizes are adapted to suit the age, attention span, and visual perception of students.
4. Interactivity: Reactive data binding in Vue.js reflects real-time changes.
5. Results from User Testing: Tests conducted with 7–10-year-old students showed they quickly understood and could independently use the interface.

Conclusion and recommendations

Component-based interfaces developed using Vue.js demonstrate high effectiveness in digital platforms designed for primary school students. These interfaces help make the educational process intuitive, engaging, and efficient.

Recommendations:

1. UI/UX design principles must be followed in the development of educational interfaces.
2. Each lesson module should have dedicated components, and learning materials should be presented visually.
3. Responsive design should be a top priority to ensure compatibility across all screen sizes.

Interfaces should be continuously improved based on student feedback.

Foydalanilgan adabiyotlar ro'yxati:

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