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# Optimizing Mobile Educational Content Layout Using AI Technology: Focusing on Vertical Aspect Ratio Design

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***Abstract***

*This study focuses on optimizing the layout of mobile educational content using AI technology, with a particular emphasis on vertical aspect ratio design. Against the backdrop of changing educational content consumption patterns due to the increased mobile device usage and advancements in AI technology, this research analyzes the characteristics and effects of vertical aspect ratio design and explores its potential combination with AI technology. The research methodology combines John Yablonski's UX laws and the concept of human effective field of view with AI technology to analyze the impact of vertical aspect ratio design on the educational content user experience and learning effectiveness. Results show that vertical aspect ratio design effectively focuses users' attention, reduces cognitive load, and contributes to increased learning immersion. Specifically, when combined with AI technology, vertical aspect ratio design proves effective in providing personalized learning experiences, enhancing learning abilities, developing creativity, and optimizing data analysis across various domains. This study is expected to contribute to the qualitative improvement of educational content by emphasizing the importance of vertical aspect ratio design in mobile learning environments and proposing optimization methods using AI technology. Future studies are anticipated to further develop these findings, providing important guidelines for mobile educational content development and the advancement of AI educational technology.*

***Keywords:*** *Mobile learning, Vertical ratio design, AI-enhanced education, UX optimization, Personalized learning*

## 1. INTRODUCTION

In recent years, the rapid increase in mobile device usage has led to significant changes in digital content consumption patterns. Notably, the rise in educational content consumption using vertical aspect ratios has led to the widespread adoption of mobile learning environments. Simultaneously, advancements in artificial intelligence (AI) technology have enabled personalized learning, necessitating new approaches to educational content design.

According to the '2023 Digital Information Gap Survey' by the Korean Ministry of Science and ICT (2024), the smartphone penetration rate in South Korea has reached 96.1%, with average daily mobile internet usage

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time at 2 hours and 44 minutes [1]. This indicates that mobile learning environments are accessible to the majority of the population. Moreover, the Mobile Learning Global Market Report 2024 projects that the global mobile learning market will grow at a compound annual growth rate (CAGR) of 30.4% up to 2028 [2].

Alongside the growth of the mobile learning market, the application of AI technology in education is progressing rapidly. Educational leaders such as the UK, US, and Finland have already introduced personalized learning systems utilizing AI, and AI-based educational services are gradually expanding in Korea as well. However, according to the Ministry of Science and ICT, as of July 2023, Korea's AI-based educational service technology level is assessed at 87.7% compared to that of the United States, indicating a technology gap of about 1.2 years [3].

In this context, the combination of vertical ratio design and AI technology is emerging as a crucial factor in optimizing mobile learning environments. However, existing educational content design has primarily focused on horizontal ratio design, and research on the effectiveness of content utilizing vertical ratio design remains inadequate. In particular, there is a lack of systematic analysis of the impact of combining AI technology with vertical ratio design on educational content.

This study aims to identify the characteristics of vertical ratio design in mobile educational environments and explore ways to construct vertical ratio design guidelines for the delivery of effective mobile educational content. The research's originality lies in its analysis of the impact of vertical ratio design on the educational content user experience and learning effectiveness by combining John Yablonski's UX laws and the concept of the human effective field of view with AI technology. Through this study, we seek to maximize the synergistic effect of AI technology and vertical ratio design, ultimately contributing to improving educational effectiveness in mobile learning environments. The outcomes of this study may provide important guidelines for the development of mobile educational content and the advancement of AI educational technology in Korea.

## 2. THEORETICAL BACKGROUND

### 2.1 Characteristics of Vertical Ratio Design in Mobile Educational Environments

Vertical ratio design aligns with the natural usage patterns of mobile devices, enhancing user experience. According to an experiment conducted by NHK Close-up Modern, when the same video content was produced in both horizontal and vertical ratios and provided to 10 men and women in their 20s, eye movement was observed to be scattered in various directions in the horizontal ratio, while there was little eye movement in the vertical ratio. This demonstrates that vertical ratio design can effectively focus users' attention.

Figure 1 is reconstructed in Cho's (2024) study [4], based on the content from NHK Close-up Modern (NHK, 2023) [5].

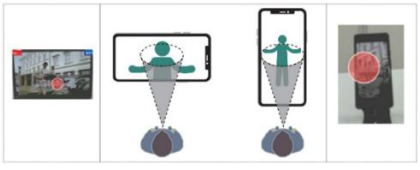


**Figure 1. Results of eye-tracking experiment on gaze movement**

These experimental results are related to the effective field of view of humans (about 30 degrees) when receiving visual information, and vertical ratio screens have the advantage of being able to effectively place information within this range. Viewers interpret visual information through visual perception, moving their viewpoint within their field of view while watching content. In horizontal ratio screens, information placed

beyond the effective field of view causes eye movement to be dispersed in multiple directions, while in vertical ratio screens, information is placed within the effective field of view, resulting in minimal eye movement [6].

To support the point that vertical ratio design positively affects mobile learning immersion, we can refer to the researcher's previous paper (Cho, 2023). This study emphasized that vertical ratio screens provide users with high immersion and effectively induce visual focus in the convergence of metaverse and short-form content. In particular, it noted that vertical ratio content is naturally consumed on mobile devices, providing an environment where users can immerse themselves without separate screen rotation [7].

These characteristics can be similarly applied in mobile learning environments, and it is judged that vertical ratio screens can contribute to increasing learner immersion and improving learning outcomes.

### 2.2 UX Design Principles and Vertical Ratio Design Utilizing AI

John Yablonski's 'Laws of UX' presents ten psychological laws applicable to user experience design [8]. This study focuses on Fitts's Law, Hick's Law, Jakob's Law, and Miller's Law, which are closely related to vertical ratio design.

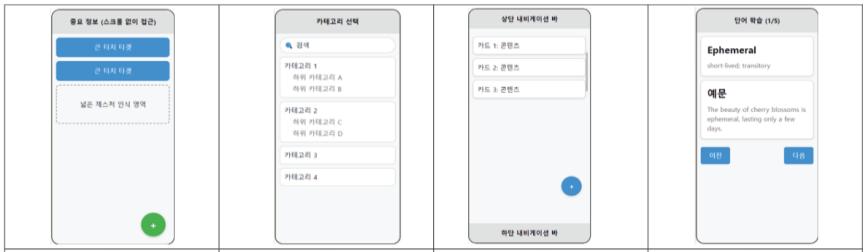
Fitts's Law explains the relationship between the size and distance of the target object and the user's motion time. In vertical ratio design, Fitts's Law plays a particularly important role. As the vertical length of the screen increases, vertical scrolling becomes the main interaction method. Accordingly, it is important to make the touch target size of interactive elements such as buttons and links sufficiently large, and to fix frequently used functions at the bottom or side of the screen where they can be easily reached by the user's thumb [8].

Hick's Law suggests that decision-making time increases logarithmically as the number of choices increases. In vertical ratio design, information should be appropriately grouped and presented in stages considering this principle. For example, long lists or complex data should be divided into multiple pages or scrollable areas to help users process information more systematically and make decisions more easily [8].

Jakob's Law emphasizes that users prefer familiar design patterns. In vertical ratio design, vertical scrolling has become the main navigation method, so it is effective to utilize this. Use a fixed navigation bar at the top or bottom of the screen for consistent navigation, indicate the user's current position through scroll indicators, and adopt a card-format layout to allow easy scanning of information [8].

According to Miller's Law, the capacity of short-term memory in humans is 7±2 items. In vertical ratio design, this law can be considered to reduce learners' cognitive load by appropriately grouping and presenting information in stages. For example, Miller's Law can be effectively applied in smartphone vocabulary design by placing only one word per page and arranging the word and its meaning vertically [8].

Figure 2 illustrates examples of UX and cognitive principles applied to vertical ratio design, reconstructed by the author based on Yablonski's (2020) study [8].




| Fitts's Law: Design utilizing large touch targets and wide gesture recognition areas to allow users to reach their goals quickly and accurately. | Hick's Law: A category selection screen that reduces decision-making time by limiting the number of options available to users. | Jakob's Law: Designing with top and bottom navigation bars to follow user-familiar patterns. | Miller's Law: Design that enhances learning efficiency by providing only five words, allowing users to process an appropriate amount of information. |
|---|---|---|---|

**Figure 2. Examples of UX and Cognitive Principles Applied to Vertical Ratio Design**

These UX design principles can be more effectively applied when combined with AI technology. AI can analyze user behavior patterns to provide personalized interfaces and automatically adjust the presentation of information according to user preferences. Additionally, AI can analyze users' learning progress in real-time to provide content of appropriate difficulty and reorganize information to minimize cognitive load. Through this, the effect of vertical ratio design can be maximized, providing a more personalized and efficient learning experience.

This study explored the possibility of combining AI technology with laws that are particularly important in maximizing the effect of vertical ratio design. This could serve as an important guideline for future mobile educational content development.

### 2.3 Visual Focus Analysis of Vertical Ratio Design

The main sensing technologies used to evaluate concentration are face tracking and eye tracking. According to research by Visual Camp (2023), eye tracking technology can effectively measure user concentration in vertical ratio design. Longer fixation times are evaluated as higher concentration, and these times are found to be longer in vertical ratio screens [9]. These results show that vertical ratio design can more effectively maintain user attention.

Figure 3 illustrates concentration and eye fixation when viewing content [9].

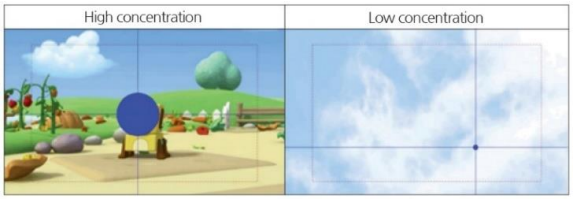



**Figure 3. Results of eye-tracking experiment on gaze movement**

According to research from Shinohara Laboratory at Tokyo University of Technology, introduced in NHK Close-up Modern (2023), in horizontal ratio screens, while head movement can expand horizontal vision, concentration decreases when other information is present beyond the effective 30-degree field of view, causing dispersed gaze. In contrast, vertical ratio screens are easier to focus on visual information as the horizontal width is within the 30-degree effective field of view, reducing eye strain. Therefore, when consuming content on vertical ratio screens, there is less eye movement, reducing muscle strain and making it easier to concentrate. Additionally, in the same laboratory's study on brain blood flow changes, while brain activation increased in both vertical and horizontal ratio screens when new information appeared, the brain activation level in vertical ratio screens was maintained for a longer period, confirming higher sustained concentration [4].

These results emphasize the potential and value of vertical ratio design and suggest the need for further in-depth exploration of the effects of vertical ratio screens in future research.

### 2.4 AI Technology Utilization and Case Studies in Mobile Learning

The use of AI technology in mobile learning environments plays a crucial role in providing personalized learning experiences. Sigosoft (2023) presents personalization, user behavior prediction, and enhanced security as key reasons for integrating AI and machine learning into mobile apps. These features can be applied to educational apps to improve the learning experience. The application of AI technology in mobile learning can

be categorized into personalized learning experiences, learning ability enhancement, creativity development, and data analysis and optimization [10].

Recent studies have reported the effectiveness of AI-based personalized learning. Han Ye-jin's (2022) research explored the design elements of AI-based personalized learning. This study presented instructors, learners, content, and platforms as key design elements, emphasizing the importance of personalized learning that considers individual learning styles, preferences, and learning levels in the learner element [11]. Kim Tae-rim (2023) reported that AI-based personalized math learning significantly improved academic achievement and positively influenced attitudes towards artificial intelligence in a study targeting 4th-grade elementary school students [12].

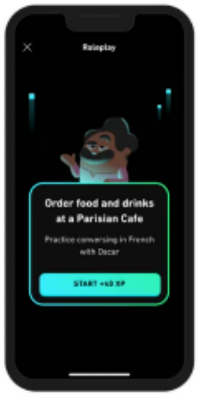
### 2.4.1 Personalized Learning Experiences

Personalized learning experiences provide customized learning paths through user behavior prediction and content tailored to individual learning styles. Representative examples of this approach include Duolingo and Yanadoo.

Duolingo launched 'Duolingo MAX' in March 2023, incorporating GPT-4. This service supports real-time feedback and conversational learning through 'Explain My Answer' and 'Roleplay' features. Applying vertical ratio design, it offers AI-based advanced language learning functions including personalized feedback and interactive role-play scenario features [13].

Yanadoo's 'AI Native Talk' service recreates expressions, tones, and reactions frequently used by AI native speakers with different profiles. This allows learners to engage in natural conversations even when they mix Korean or use incorrect grammar when unable to recall English expressions [14].

Figure 4 compares the interfaces demonstrating personalized learning experiences of Duolingo MAX [15] and Yanadoo's [16] 'AI Native Talk'.




**Duolingo Max:** Conversation practice with interactive scenarios.


**Yanadoo's 'AI Native Talk':** Conversations with friends in AI-generated situations.

**Figure 4. Comparison of personalized learning experiences of 'AI Speaking Talk'**

### 2.4.2 Experiences Learning Ability Enhancement

In the area of learning ability enhancement, AI is used to improve reading skills and promote cognitive development. Khan Academy Kids and Math King are representative examples.

Khan Academy Kids is an educational app for ages 2-8, designed to provide easy and fun personalized learning experiences using AI by combining basic subjects like Letters, Reading, Math, and Logic with

categories such as Books, Videos, Create, and Offline [17].

Figure 5 shows the library screen of Khan Academy Kids [18].

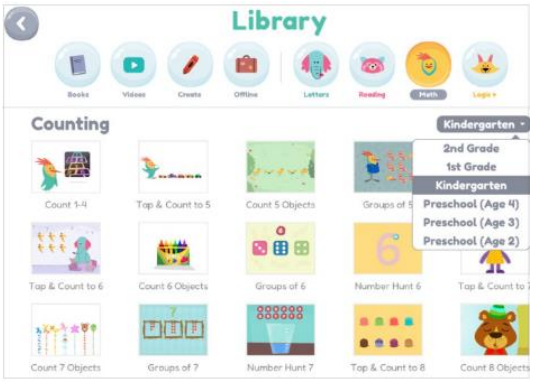



**Figure 5. Comparison of personalized learning experiences of 'AI Speaking Talk'**

Suhakdaewang (literally 'Math King' in English) is a self-directed math learning platform centered on AI technology. By utilizing the advantages of vertical ratio design to efficiently arrange problems and solution processes on a single screen, it enhances learning efficiency and identifies learners' weaknesses through error analysis, providing additional learning materials. It also analyzes users' problem-solving tendencies to provide personalized learning experiences and performs various functions such as weakness analysis, providing upper percentiles for mock exams, and setting target scores for university admission [19].

Figure 6 shows the AI problem-solving screen and AI analysis screen of Suhakdaewang [20].

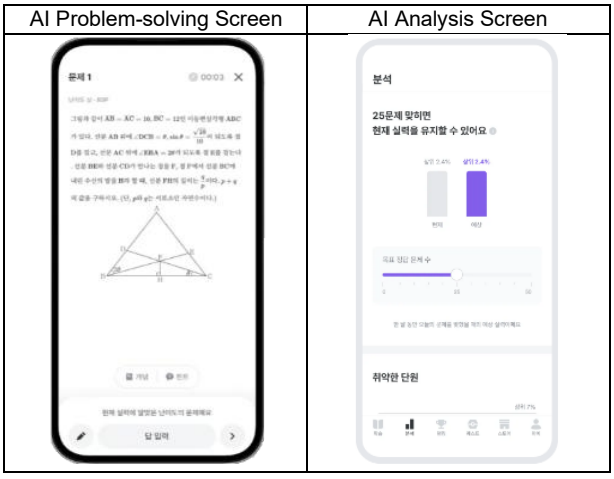



**Figure 6. Suhakdaewang AI Courseware Interface**

### 2.4.3 Creativity Development

In the creativity development area, AI and augmented reality are combined to support nature exploration and provide creative storytelling tools. Kahoot! DragonBox and genQue are representative examples in this field.

Kahoot! DragonBox is an app for learning mathematical concepts, designed as a game to make understanding complex mathematical concepts like algebra and geometry easy and intuitive [21].

Figure 7 shows the learning interface of Kahoot! Numbers by DragonBox [22].

**Figure 7. Learning screen of Numbers by DragonBox**

GenQue is a service that combines ChatGPT with Artificial Society's proprietary technology, providing features for users to create educational passages and questions. It can generate copyright-free text, significantly reducing the time and cost of producing educational content [23].

Figure 8 shows the key features and user interface of the genQue service [24].

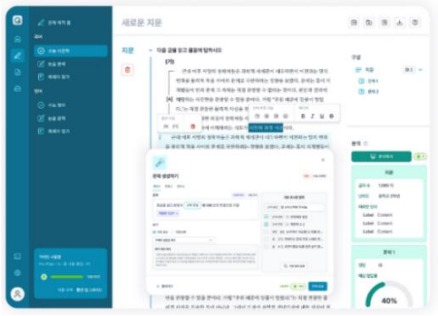


**Figure 8. Learning screen of Kahoot! Numbers by DragonBox**

### 2.4.4. Data Analysis and Optimization

In the area of data analysis and optimization, AI technology analyzes learners' behavior patterns, achievements, and preferences in real-time to provide individually optimized learning processes. This allows for presenting problems of appropriate difficulty according to the learner's progress or recommending content that matches individual learning styles. Additionally, AI identifies learners' strengths and weaknesses to establish personalized learning plans and continuously monitors learning effectiveness to adjust learning strategies as needed.

The application of such AI technology contributes to enhancing learning effectiveness by providing learners with personalized experiences. According to a report by Koalia Stories (2024), AI technology is being utilized in various ways in mobile apps for children, including learning personalization, reading learning support, cognitive ability development, interactive world exploration, and customized storytelling [25].

In conclusion, the utilization of AI technology is contributing to increasing learning motivation and engagement by providing children with personalized, interactive, and engaging learning experiences. Furthermore, the integration of AI and machine learning is expected to play an important role in enhancing the functionality of mobile education apps and improving learner performance. With the future development of AI technology, it is anticipated that more sophisticated and effective learning support systems will be developed, leading to qualitative improvements in mobile learning environments.

## 3. CONCLUSION AND SUGGESTIONS

This study explored new possibilities in mobile learning environments by presenting optimization methods for vertical ratio design of mobile educational content utilizing AI technology. The research results confirmed that vertical ratio design, when combined with AI technology, is effective in enhancing learners' visual focus and providing personalized learning experiences. It demonstrated that vertical ratio design aligns appropriately with the usage characteristics of mobile devices and can provide personalized learning experiences through a combination with AI technology. This is an important finding that can positively impact learners' levels of immersion and achievement.

The cases of fusion between AI technology and vertical ratio design identified through case analysis demonstrated the potential for application in actual educational settings. These results could serve as important guidelines for future mobile educational content development and delivery. In particular, the significance of this study can be identified as presenting the possibility of a new educational paradigm through the fusion of UX design principles and AI technology.

As the use of AI technology is rapidly spreading in the global education market, Korea's AI educational technology is also developing quickly. However, there remains a technological gap between Korea and other advanced nations, and continuous research and development on the effective combination of vertical ratio design and AI technology are necessary to overcome this.

In future research, we intend to more deeply verify the impact of vertical ratio design on actual learning outcomes. We plan to objectively demonstrate the effectiveness of vertical ratio design through empirical research targeting various learning content and user groups.

Based on these research results, it is necessary to develop practical guidelines that allow content creators to effectively utilize vertical ratio design to clearly convey and emphasize information. In this process, methods for content creators to produce content responsibly while adhering to ethical standards should also be considered.

The results of this study can contribute to the qualitative improvement of educational content by highlighting the importance of vertical ratio design in mobile learning environments and presenting optimization methods using AI technology. This is expected to serve as important foundational data for future mobile educational content development and AI technology integration.

In conclusion, this study presented an important direction that the fusion of AI technology and vertical ratio design can lead in terms of innovation in mobile educational content. Based on these research results, it is expected that a more effective and personalized mobile learning environment can be established in the future, ultimately contributing to improvements in the quality of education and realizing a learner-centered educational paradigm.

## ACKNOWLEDGEMENT

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