Development of Mobile Application Prototype 'Jeninius' for Imagination and Creativity in Special Education

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ABSTRACT

This study forms part of a larger research initiative focused on designing and developing a mobile application named 'JENINIUS' to facilitate teaching and learning among special education students through the cultivation of imagination and creativity. Imagination is widely recognised as the foundation for creativity, and both are considered essential competencies for students in the 21st century learning environment. However, creativity remains one of the most challenging elements to teach effectively, with difficulties arising from multiple sources including misconceptions about creativity being exclusive to certain students, and the challenges teachers face in planning lessons that foster creativity amidst demanding workloads. A significant gap exists in the development of mobile applications specifically designed to nurture creativity and imagination among students with special needs. This research addresses this gap by exploring and establishing a prototype design for mobile applications suited for special education contexts. The study involved two primary objectives: (1) identification of special education needs that can be addressed through the design and interaction enabled by mobile applications; and (2) development of a user interface and user experience prototype for a mobile application tailored to these needs. Employing the Rapid Prototyping (RP) methodology, this research progressed through five systematic phases: needs assessment and content analysis, objective setting, prototype construction, prototype utilisation, and evaluation/maintenance. Data were collected from 35 experts and practitioners in special education through focus group discussions and a 23-item online survey. The constant comparison analysis method was employed to analyse qualitative data, while descriptive statistics were used for survey responses. Findings revealed five key components pertinent to mobile application design for students with special needs: (1) consistency of colours for navigation, (2) contrasting colours to highlight importance, (3) iconography and font variants, (4) readability, and (5) positionality. Survey data showed high agreement levels (M > 4.0) for elements related to colour contrast, icon consistency, simplified language, and intuitive navigation. These findings align with existing literature on accessible user interface design while contributing new insights specific to the special education context. The research concludes with recommendations for establishing design standards for inclusive mobile applications, aligned with Sustainable Development Goal 4: Quality Education.

Keywords - special education, mobile application, user interface design, user experience, imagination, creativity, accessibility, inclusive design

INTRODUCTION

Background of the Study

Imagination constitutes a mental representation of phenomena that transcends conventional human logic and reasoning. The imagery activity is fundamentally involved in the creative process, as creative ideas emerge through the capacity to imagine. This ability to imagine serves as an essential prerequisite for generating and translating creative ideas into tangible outcomes (Azhar, 2004). The capacity for imagination is inherent in every individual and can be exercised at any time and under any circumstances, regardless of age or background. Therefore, to foster creativity, the ability to imagine stands as one of the most important traits that must be nurtured in human development.

While imagination is often associated with fantasy and elements commonly perceived as non-existent, genuine imagination forms the foundation of every creative activity and constitutes an essential component of all aspects of human life. This perspective suggests that every creation in our environment—every artefact produced by human hands—represents a product of imagination. As Ribot (1906) eloquently articulated, every invention, whether significant or modest, exists first as a construct held together by imagination alone before being implemented and embodied in reality. This creative structure is erected in the mind through the agency of new combinations and relationships, demonstrating the fundamental role of imagination in human progress and innovation.

The construction of imagination is typically based on materials obtained from reality; consequently, environment and experience play crucial roles in shaping one's imaginative capacity (Perrone, 2015). The relationship between imagination and experience is closely intertwined, with each continuously influencing the other. Beyond experience, imagination can also be influenced by emotions, with different feelings and emotional states requiring different forms of imaginative expression. Schirrmacher (2002) extends this understanding by explaining that creativity is fundamentally dependent on one's environment, asserting that every creator, including individuals of exceptional intelligence, is a product of their time and environmental context.

Vygotsky's (2004) theoretical framework provides essential insights into the relationship between creativity and imagination. His work emphasises that imagination serves as an essential catalyst in all human creative activities. This creative behaviour enables human beings to orient themselves toward the future, envision possibilities, and consequently transform their present circumstances. According to Vygotsky, the operation of imagination constitutes an essential function for life itself. The most important principle in designing imagination operations depends on the richness and breadth of individual experience, as imagination is invariably constructed with materials supplied by reality. This theoretical position has significant implications for educational practice, particularly in contexts where experiential learning and environmental enrichment can foster imaginative development.

The intersection of imagination, creativity, and technological advancement presents particular opportunities and challenges in educational settings. In contemporary society, where educational values and norms intersect with rapidly advancing technology, there exists an urgent need to examine the transactional value of imagination and creativity as they relate to technological tools available for educational purposes (Gadsden, 2008). This focus becomes especially pertinent when the scope narrows to the specialised area of special education and the unique needs of students with disabilities. The current research emerged from this recognition of the need to understand this point of convergence, with the aim of generating findings that will benefit future instructional designers and software application developers in preparing inclusive interfaces that accommodate the diverse needs of all learners.

Problem Statement

Despite the recognised importance of imagination and creativity in educational development, creativity remains one of the most challenging elements to teach effectively (Robinson, 2011; Beghetto, 2010). This difficulty stems from multiple sources, including the widespread misconception that creativity is exclusive to certain gifted students, and the challenges educators face in planning lessons that invoke creativity amidst substantial workloads beyond direct instruction. These challenges are amplified in special education contexts, where students may require additional scaffolding and adapted materials to engage in creative activities.

A significant gap exists in the development of mobile applications specifically designed to cultivate creativity and imagination among students with special needs. While the proliferation of educational technology has produced numerous applications for general education, the special education sector remains underserved with respect to applications that are both pedagogically sound and accessible (Dogan & Delialioglu, 2020). The Malaysian context presents particular challenges, as localised content and culturally appropriate interfaces are essential for effective engagement with special education students in the country.

Furthermore, existing literature on user interface (UI) and user experience (UX) design has predominantly focused on mainstream users, with limited attention to the specific requirements of users with cognitive, sensory,

or physical disabilities (Punchoojit & Hongwarittorrn, 2017). The absence of established design standards for special education applications presents a barrier to the development of high-quality, inclusive educational technology. This research addresses these gaps by systematically investigating the design requirements for mobile applications in special education contexts and developing a prototype that embodies best practices in accessible design.

Research Objectives

The research objectives for this study are as follows:

1. To identify the special education needs relevant to designing a prototype of an interactive mobile application; and

2. To develop a prototype of a mobile application suited for special education that promotes imagination and creativity.

Significance of the Study

This research contributes to multiple stakeholders in the educational technology ecosystem. For practitioners in special education, the findings provide evidence-based guidelines for selecting and evaluating mobile applications for their students. For instructional designers and software developers, the research offers a framework for creating inclusive interfaces that accommodate diverse learner needs. For researchers, the study contributes to the growing body of literature on accessible design while identifying areas requiring further investigation. Ultimately, the research supports the achievement of Sustainable Development Goal 4: Quality Education, by promoting inclusive and equitable quality education for all learners, including those with special needs.

LITERATURE REVIEW

Theoretical Framework: Imagination and Creativity

The theoretical underpinning of this research draws primarily from Vygotsky's (2004) sociocultural theory of creativity and imagination. Vygotsky posited that imagination is not merely a cognitive function but a socially mediated activity that develops through interaction with cultural tools and social practices. According to this framework, the development of imagination in children requires exposure to rich experiential environments and meaningful social interactions. This theoretical position has profound implications for educational technology design, suggesting that applications intended to foster imagination must provide opportunities for exploration, experimentation, and social engagement.

Vygotsky's theory further emphasises the concept of the Zone of Proximal Development (ZPD), which describes the space between what a learner can accomplish independently and what they can achieve with appropriate support. Mobile applications for special education can serve as scaffolding tools within the ZPD, providing the graduated support necessary for students to engage in creative activities that might otherwise be inaccessible. This scaffolding function is particularly relevant for students with special needs, who may require additional support to participate fully in creative learning experiences.

In constructing creativity in children, two essential elements require attention: imagination and expression (Susan, 2010). Early childhood imagery operates at an extremely high level, and children should be afforded sufficient opportunity and space to imagine, thereby enabling creative thinking. According to Egan (1999), imagination is a necessity for ensuring continuous thinking and creativity in modern society. Gadsden (2008) further emphasised that art allows individuals to imagine, enabling them to experience others' realities and cultures, transport themselves across time and space, and perceive the world from different vantage points. These theoretical perspectives collectively support the design of educational applications that prioritise freedom of expression and imaginative exploration.

User Interface Design for Special Education

User interface (UI) design for special education populations requires careful consideration of diverse cognitive, sensory, and motor abilities. The principles of Universal Design for Learning (UDL) provide a foundational framework for creating inclusive interfaces that accommodate learner variability (CAST, 2018). UDL emphasises three primary principles: multiple means of engagement, multiple means of representation, and multiple means of action and expression. These principles translate into design requirements for mobile applications, including varied input methods, multimodal content presentation, and flexible response options.

Research on accessible design has identified several key considerations for users with special needs. Punchoojit and Hongwarittorrn's (2017) systematic literature review on mobile user interface design patterns highlighted the importance of contrasting colours for users with visual impairments and colour blindness. Their findings indicated that high contrast ratios between text and background significantly improve readability and reduce cognitive load for users with various disabilities. Additionally, the use of consistent colour schemes for navigation elements helps users with cognitive disabilities to develop mental models of application structure and functionality.

Wei and Wang's (2020) research on contemporary user interface design emphasised the critical role of iconography in representing ideas and functionality. Icons serve as visual shortcuts that reduce reliance on textual information, making interfaces more accessible to users with reading difficulties or limited language proficiency. However, the effectiveness of icons depends on their clarity, consistency, and cultural appropriateness. Icons that accurately represent their associated functions reduce user confusion and support more intuitive interaction patterns.

Heikkinen's (2020) investigation of mobile user interface usability stressed the importance of element positioning in supporting usability. The spatial arrangement of interface components affects users' ability to locate and interact with desired functions. For users with motor impairments, appropriate positioning ensures that interactive elements are easily reachable, while for users with cognitive disabilities, logical positioning supports predictable navigation patterns. The concept of positionality extends beyond mere placement to encompass the hierarchical organisation of interface elements in ways that communicate importance and relationships.

Mobile Applications in Special Education

The integration of mobile applications in special education has demonstrated considerable potential for supporting diverse learning needs. Research indicates that mobile devices offer unique affordances for special education, including portability, touchscreen interfaces that accommodate various motor abilities, and the capacity for personalised learning experiences (Kagohara et al., 2013). The immediacy of feedback provided by mobile applications supports skill acquisition and retention, while the self-paced nature of mobile learning accommodates individual learning speeds and preferences.

However, the effectiveness of mobile applications in special education depends critically on design quality. Applications designed without consideration for accessibility may inadvertently exclude students with specific disabilities, while applications that oversimplify content may fail to challenge students appropriately (Ok & Kim, 2017). The challenge for designers lies in creating applications that balance accessibility with pedagogical richness, ensuring that all students can engage meaningfully with educational content while being appropriately challenged in their zone of proximal development.

The Malaysian context presents additional considerations for mobile application design in special education. The Ministry of Education Malaysia has emphasised the importance of inclusive education under the Malaysia Education Blueprint 2013-2025, with specific attention to the integration of technology in special education programmes. However, the availability of locally developed, culturally appropriate educational applications remains limited, with many special education teachers relying on applications developed for international markets that may not align with local curricula or cultural contexts.

Rapid Prototyping in Educational Technology Development

Rapid Prototyping (RP) has emerged as an effective methodology for educational technology development, enabling iterative refinement based on user feedback (Tripp & Bichelmeyer, 1990). Unlike traditional waterfall development models, RP embraces an iterative approach where initial prototypes are quickly developed, tested with target users, and refined based on feedback. This approach is particularly valuable in special education contexts, where user needs may be diverse and difficult to anticipate without direct input from practitioners and students.

Sommerville (2016) describes prototyping as the development of early software versions to display concepts, explore design choices, and identify potential problems. The efficiency gains from prototyping stem from early identification of design flaws and user requirements that might otherwise remain hidden until later, more costly stages of development. In the context of special education applications, prototyping enables designers to validate assumptions about user needs and interface requirements before committing significant resources to full development.

The RP methodology aligns with established instructional system design frameworks such as ADDIE (Analysis, Design, Development, Implementation, Evaluation), while offering greater flexibility and responsiveness to user feedback. Both approaches emphasise systematic progression through defined phases, but RP allows for more rapid cycling between design and evaluation phases. This flexibility is particularly valuable when designing for special education populations, where individual differences may necessitate multiple design iterations to achieve satisfactory usability.

METHODOLOGY

Research Design

This research employed a design-based research approach utilising the Rapid Prototyping (RP) methodology to guide the systematic development and evaluation of the JENINIUS mobile application prototype. Design-based research is characterised by its iterative nature, its grounding in real-world educational contexts, and its focus on producing both practical outcomes and theoretical contributions (Anderson & Shattuck, 2012). The RP methodology provided a structured framework for progressing from initial needs assessment through prototype development and refinement.

The RP methodology employed in this study comprised five sequential phases: (1) assess needs and analyse contents; (2) set objectives; (3) construct prototype; (4) utilise prototype; and (5) evaluate and maintain. Each phase built upon the outcomes of preceding phases while allowing for iterative refinement based on emerging findings and user feedback. This structured yet flexible approach enabled systematic progress toward research objectives while remaining responsive to the insights gained through practitioner engagement.

Participants

Participants were selected using purposive sampling technique to ensure representation of relevant expertise in special education and educational technology. A total of 35 experts and practitioners participated in the study, including special education teachers, educational technology specialists, and curriculum developers with direct experience in special education settings. Selection criteria included a minimum of three years of professional experience in special education and familiarity with educational technology applications.

The sample size was determined based on recommendations for qualitative research involving expert consultation and iterative design processes (Creswell & Poth, 2018). The 35 participants provided sufficient diversity of perspectives while remaining manageable for the intensive engagement required in focus group discussions and iterative feedback sessions. Participants were recruited from special education programmes across multiple states in Malaysia, ensuring representation of diverse educational contexts and student populations.

Data Collection Procedures

Phase 1: Needs Assessment and Content Analysis

The initial phase involved comprehensive needs assessment conducted through focus group discussions with the 35 expert participants. Focus groups were organised into sessions of 7-8 participants each, with discussions facilitated by members of the research team. Discussion protocols were developed to explore participants' experiences with existing educational applications, their perceptions of current gaps in available technology, and their recommendations for ideal application interfaces and interactions for students with special needs.

Following the focus group discussions, a 23-item online survey was administered to triangulate the qualitative findings and identify specific UI and UX features relevant to special education contexts. The survey instrument was adapted from Martin's (2018) study on developing user interfaces for mobile data collection applications, with modifications to ensure relevance to the special education context. Survey items addressed five domains: colour and visual design, typography, iconography, readability and language, and interaction and navigation. Responses were collected using a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Phase 2: Setting Objectives

The second phase involved synthesis of findings from the needs assessment to identify pertinent UI and UX components and their relevance to the JENINIUS creative and imaginative materials. Analysis of focus group transcriptions and survey responses enabled the research team to establish clear design objectives for the prototype. These objectives addressed both functional requirements (what the application should do) and usability requirements (how the application should behave to ensure accessibility and ease of use).

Phase 3: Constructing Prototype

Prototype construction proceeded through two stages: low-fidelity and high-fidelity prototyping. Low-fidelity, paper-based prototypes were initially constructed using examples of content from the JENINIUS characters and storylines. These paper prototypes enabled rapid exploration of layout options and navigation structures without the investment of software development resources. Paper prototypes were reviewed internally by the research team and refined based on initial observations. Subsequently, high-fidelity prototypes were developed using professional prototyping software hosted online. The high-fidelity prototypes incorporated realistic interfaces, interactions, and visual design elements, enabling evaluation of the user experience under conditions approximating the final application. The prototyping software enabled creation of interactive flows that simulated actual application behaviour, including navigation between screens, responses to user input, and animation effects.

Phase 4: Utilising Prototype

The high-fidelity prototype was distributed to the 35 expert participants for evaluation and feedback. Participants were provided with access to the interactive prototype and asked to navigate through all available screens and features. Structured feedback forms were used to collect participants' assessments of specific design elements, including colour schemes, typography, iconography, navigation patterns, and overall usability. Participants were also encouraged to provide open-ended comments and suggestions for improvement.

Phase 5: Evaluation and Maintenance

The final phase involved iterative refinement of the prototype based on participant feedback. A total of three feedback-loop cycles were conducted between the development team and the practitioners. Each cycle involved collection of feedback, analysis of recommendations, implementation of design modifications, and redistribution of the revised prototype for further evaluation. This iterative process continued until participant feedback indicated satisfactory achievement of design objectives and high levels of user acceptance.

Data Analysis

Qualitative data from focus group discussions were analysed using the constant comparison method (Strauss & Corbin, 1998). This analytical approach involved systematic comparison of data segments to identify recurring patterns, similarities, and differences. The analysis proceeded through three stages: open coding, axial coding, and selective coding. Open coding involved line-by-line examination of transcripts to identify initial concepts and categories. Axial coding established relationships between categories, while selective coding integrated categories into coherent themes. Quantitative data from the online survey were analysed using descriptive statistics, including means and standard deviations for each item. Items with mean scores above 4.0 were considered to indicate high agreement among participants, while items with mean scores below 3.0 were considered to indicate areas of disagreement or concern. The combination of qualitative and quantitative analyses enabled triangulation of findings, strengthening the validity of conclusions drawn from the data.

Validity and Reliability

Multiple strategies were employed to enhance the validity and reliability of the research. Triangulation was achieved through the use of multiple data sources (focus groups and surveys) and multiple methods of analysis (qualitative and quantitative). Member checking was conducted by sharing preliminary findings with participants and soliciting feedback on the accuracy of interpretations. The iterative nature of the RP methodology provided ongoing opportunities to validate findings against practitioner expertise and real-world applicability.The survey instrument demonstrated acceptable reliability, with internal consistency established through review by the research team and pilot testing with a subset of participants. Modifications were made based on pilot testing feedback to ensure clarity of item wording and appropriateness of response options. The adapted instrument maintained alignment with the original validated instrument while incorporating modifications necessary for the special education context.

FINDINGS

Qualitative Findings from Focus Group Discussions

Analysis of focus group discussion transcriptions using the constant comparison method revealed five primary themes pertinent to the design and development of mobile application interfaces for the special education field. These themes represent key considerations that emerged consistently across multiple focus group sessions and participant perspectives.

Theme 1: Consistency of Colours for Navigation

Participants emphasised the critical importance of maintaining consistent colour schemes for navigation elements throughout the application. Consistency in colour usage helps students with special needs develop mental models of application structure and functionality. When navigation buttons consistently use the same colour, students can more easily identify interactive elements and predict their functions. Participants noted that students with cognitive disabilities often struggle with applications that use varying colour schemes across different screens, as this inconsistency creates confusion and increases cognitive load.

Theme 2: Contrasting Colours to Highlight Importance

The strategic use of contrasting colours to highlight important elements emerged as a significant theme. Participants recommended using high contrast ratios between text and background to support readability, particularly for students with visual impairments. Additionally, the use of accent colours to highlight primary action buttons and important information helps direct student attention appropriately. Participants cautioned against excessive use of bright or saturated colours, which can be overwhelming for students with sensory sensitivities.

Theme 3: Iconography and Font Variants

The importance of clear, consistent iconography and appropriate typography featured prominently in discussions. Participants stressed that icons should clearly represent their associated functions and remain consistent throughout the application. Icons serve as visual shortcuts that reduce reliance on text, making interfaces more accessible to students with reading difficulties. Regarding typography, participants recommended the use of clear, sans-serif fonts at adequate sizes, with appropriate use of font weight and style to create visual hierarchy without overwhelming students.

Theme 4: Readability

Readability emerged as a multifaceted theme encompassing language complexity, sentence structure, and text presentation. Participants advocated for simplified language using familiar vocabulary appropriate to students' developmental levels. Short sentences and simple grammatical structures were recommended to support comprehension. Beyond linguistic factors, readability also involves considerations such as adequate line spacing, appropriate text alignment, and avoidance of dense blocks of text. Participants emphasised that instructions should be clear, concise, and positively worded to encourage engagement.

Theme 5: Positionality

The positioning of interface elements relative to each other and to the screen emerged as a crucial design consideration. Participants noted that consistent positioning of common elements (such as navigation buttons, headers, and content areas) across screens supports predictable navigation and reduces cognitive load. The placement of important elements within easily reachable areas of the screen was highlighted as particularly important for students with motor impairments. Additionally, the hierarchical arrangement of elements should communicate relationships and importance, guiding students through intended interaction flows.

Quantitative Findings from Online Survey

The 23-item online survey provided quantitative data that triangulated and extended the qualitative findings. Table 1 presents the complete survey results, including mean scores and standard deviations for each item. Analysis of these data reveals patterns of agreement and divergence among participants regarding specific design recommendations. The survey results indicate highest agreement in the Interaction and Navigation category (M = 4.22), followed by Readability and Language (M = 4.36) and Colour and Visual Design (M = 3.98). The Iconography category demonstrated moderate-high agreement (M = 3.55), while Typography showed the most variability in responses (M = 3.44). Items receiving the highest agreement ratings included the importance of avoiding deep navigation chains (M = 4.69), using contrasting colours (M = 4.56), simplifying sentences and phrases (M = 4.56), and including Previous/Next navigation buttons (M = 4.56).

Note: Responses measured on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree)

TABLE1 Online Survey Results (N = 35)

Survey Item	Mean	SD
Colour and Visual Design		
Skrin yang berwarna-warni (mempunyai lebih dari tiga warna) akan membuatkan aplikasi lebih menarik untuk pelajar berkeperluan khas	3.00	0.894
Penggunaan warna yang konsisten dapat membantu dalam menonjolkan elemen-elemen navigasi yang terdapat pada rekabentuk paparan skrin	4.31	0.680
Penggunaan warna yang berbeza (contrast) juga perlu bagi menonjolkan antara satu-satu elemen di dalam paparan skrin	4.56	0.629

Perlu menggunakan gabungan warna dan ikon bagi membantu pengguna yang buta warna dalam melihat perubahan elemen dalam satu-satu paparan antaramuka	4.44	0.727

Typography

Penggunaan mukataip 'sans-serif' dapat membantu pengguna dalam membaca maklumat yang tertera di atas paparan skrin dengan lebih jelas	3.13	1.204
Ketebalan mukataip dapat membantu dalam memberi variasi penekanan kepentingan kepada mukataip	3.88	0.806
Saiz mukataip yang besar dapat membantu dalam memberi variasi penekanan kepentingan kepada mukataip	3.94	1.063
Perenggan yang panjang mestilah menggunakan huruf besar supaya senang dibaca	2.81	1.346

Iconography

Setiap elemen memerlukan 'ikon' bagi membantu pengguna dalam memahami antaramuka dan fungsi-fungsi yang terpapar di dalam skrin	4.06	0.854
Penggunaan ikon adalah wajib walaupun ikon yang digunakan itu kurang tepat dalam menggambarkan tujuan sebenar elemen/fungsi	3.25	1.080
Penggunaan ikon perlu konsisten	4.38	0.719
Label bagi ikon tidak perlu diletakkan	2.50	1.155

Readability and Language

Mudahkan ayat dan frasa	4.56	0.629
Ayat yang digunakan perlu lebih mesra pengguna dan berunsur positif	4.56	0.629
Hindarkan penggunaan perkataan-perkataan yang teknikal	4.00	1.033
Gunakan kata kerja pada label-label elemen yang interaktif	4.31	0.704

Interaction and Navigation

Mengurangkan interaksi pelajar berkeperluan khas yang memerlukan penggunaan papan kekunci	3.38	0.806
Menyediakan pilihan-pilihan yang telah ditetapkan kepada pelajar berkeperluan khas bagi memudahkan proses interaksi di dalam aplikasi	4.19	0.750
Labelkan bahagian-bahagian yang memerlukan interaksi dan maklumbalas dari pelajar berkeperluan khas	4.44	0.629
Navigasi dalam aplikasi perlu mudah supaya pelajar berkeperluan khas dapat mencapai kehendak/keperluan mereka	4.31	0.698
Elakkan navigasi yang berangkai terlalu dalam	4.69	0.479

Perlu memberi penanda lokasi dimana pelajar berkeperluan khas berada pada masa itu dalam aplikasi (i.e. breadcrumb)	4.00	0.966
Perlu disertakan butang 'Sebelum'/'Seterusnya' untuk memudahkan pelajar berkeperluan khas menavigasi ke lokasi yang diingini di dalam aplikasi	4.56	0.512

Summary of Survey Findings by Category

Table 2 presents the aggregated mean scores by survey category, providing an overview of participant agreement levels across the five design domains examined.

TABLE2 Mean Scores by Survey Category

Category	Mean Score	Agreement Level
Colour and Visual Design	4.08	High
Typography	3.44	Moderate
Iconography	3.55	Moderate-High
Readability and Language	4.36	High
Interaction and Navigation	4.22	High

Prototype Development Outcomes

Based on the findings from both qualitative and quantitative analyses, the JENINIUS application prototype was developed through iterative refinement. The initial version incorporated design principles derived from the needs assessment, including consistent colour schemes for navigation, high contrast ratios for text and important elements, clear iconography with labels, simplified language, and intuitive navigation patterns.

The prototype underwent three cycles of feedback and refinement with the 35 expert participants. Version 1 of the high-fidelity prototype was distributed for initial evaluation, with feedback collected on specific design elements and overall usability. Modifications were implemented based on this feedback, resulting in Version 2, which was again distributed for evaluation. This iterative process continued through Version 3 and culminated in Version 4, the final prototype that incorporated all participant recommendations and achieved satisfactory acceptance levels.

Key design features of the final prototype include: a dark-themed interface with high contrast text for improved readability; consistent use of green accent colours for primary navigation and interactive elements; clear, labelled icons for all major functions; simplified navigation with Previous/Next buttons and breadcrumb indicators; creative content modules featuring the JENINIUS characters and storylines designed to stimulate imagination; and a gallery feature enabling students to document and share their creative work.

DISCUSSION

Interpretation of Findings

The findings of this study reveal four primary design elements critical for mobile application development in special education contexts: (1) consistency and contrasting colours, (2) iconography and font variants, (3) readability, and (4) positionality. These elements were identified through rigorous analysis of qualitative data and confirmed through quantitative survey responses and iterative design feedback loops. The convergence of findings across multiple data sources strengthens confidence in the validity and practical relevance of these design principles.

The emphasis on colour consistency and contrast aligns with established principles of accessible design and confirms findings from previous research. Punchoojit and Hongwarittorrn's (2017) systematic review similarly highlighted the importance of contrasting colours for users with visual impairments and colour blindness. The current study extends these findings by demonstrating their particular relevance in special education contexts, where students may exhibit diverse visual and cognitive profiles that amplify the importance of clear visual differentiation between interface elements.

The findings regarding iconography corroborate Wei and Wang's (2020) research on contemporary user interface design, which emphasised the role of icons in representing ideas and functionality. In special education contexts, clear iconography becomes particularly critical as it reduces reliance on text-based navigation, accommodating students with reading difficulties or limited language proficiency. However, the survey results revealed nuanced perspectives on iconography, with participants expressing moderate disagreement with the notion that icons are necessary even when inaccurate (M = 3.25) and strong disagreement with omitting icon labels (M = 2.50). These findings suggest that while icons are valuable, they must be accurate representations of their functions and should be accompanied by text labels to support comprehension.

The readability theme encompasses considerations beyond simple text legibility to include language complexity, sentence structure, and overall information presentation. The strong agreement on items related to simplified language (M = 4.56) and positive, user-friendly phrasing (M = 4.56) reflects the importance of linguistic accessibility in special education applications. These findings align with Universal Design for Learning principles that advocate for multiple means of representation to accommodate diverse learner needs.

The positionality theme identified in this study addresses a relatively underexplored aspect of accessible design. While Heikkinen (2020) commented on element positioning in relation to usability, the specific application of positional considerations to special education mobile interfaces has received limited attention in the literature. The current findings suggest that consistent, predictable positioning of interface elements is particularly important for students with cognitive disabilities, who may struggle with interfaces that require constant reorientation across different screens.

Implications for Practice

The findings of this study have several practical implications for stakeholders involved in educational technology development and implementation. For software developers and instructional designers, the identified design principles provide a framework for creating more inclusive mobile applications. The specific recommendations regarding colour consistency, icon clarity, language simplification, and predictable positioning can be incorporated into design guidelines and evaluation rubrics for special education applications.

For special education practitioners, the findings offer criteria for evaluating and selecting mobile applications for use with students. Teachers and therapists can assess potential applications against the identified design principles, prioritising applications that demonstrate attention to accessibility and inclusive design. The survey instrument developed for this study could be adapted for use as an evaluation tool in educational settings.

For policymakers and administrators, the research supports the importance of accessibility standards in educational technology procurement and development. The alignment of findings with Sustainable Development Goal 4 emphasises the role of inclusive design in achieving quality education for all learners. Investment in accessible educational technology development can contribute to broader goals of educational equity and inclusion.

Limitations and Future Research

Several limitations of this study should be acknowledged. First, the sample of 35 participants, while appropriate for the qualitative and design-based methodology employed, limits the generalisability of quantitative findings. Future research with larger samples would enable more robust statistical analyses and potentially reveal additional patterns in the data. Second, the study focused on expert and practitioner perspectives; direct

involvement of students with special needs in the evaluation process would provide valuable insights into actual user experiences and preferences.

Third, the prototype developed in this study has not yet undergone full implementation and evaluation with student users. While the iterative design process with expert participants strengthens confidence in the prototype's usability, field testing with the target population is necessary to validate effectiveness in promoting imagination and creativity among students with special needs. Future research should include controlled studies examining learning outcomes associated with use of the JENINIUS application.

Fourth, the current study focused on mobile application interfaces without examining the broader ecosystem of technology integration in special education classrooms. Future research could explore how mobile applications like JENINIUS integrate with other educational technologies and pedagogical approaches to support comprehensive learning experiences. Additionally, longitudinal studies would provide insights into sustained engagement and learning outcomes over extended periods of application use.

CONCLUSION

This research has addressed a significant gap in the development of mobile applications designed to cultivate imagination and creativity among students with special needs. Through systematic application of the Rapid Prototyping methodology, the study identified key design principles and developed a functional prototype that embodies best practices in accessible interface design. The five themes emerging from qualitative analysis—consistency of colours for navigation, contrasting colours to highlight importance, iconography and font variants, readability, and positionality—provide a foundation for future development efforts in this domain.

The triangulation of qualitative and quantitative findings strengthens confidence in the identified design principles, while the iterative refinement process with expert practitioners ensures practical relevance and usability. The JENINIUS prototype demonstrates how theoretical principles can be translated into functional design solutions that address the unique needs of special education students.

In conclusion, there is a clear need for continued research with larger samples and across multiple use-cases to contribute to the growing body of knowledge in this interdisciplinary field. The findings from this research provide a foundation for establishing more standardised design guidelines for user interfaces that support special education practitioners and students. As educational technology continues to evolve, ensuring that developments are inclusive and accessible remains paramount to achieving the vision of quality education for all learners, as articulated in Sustainable Development Goal 4.

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