

Design Research of Children's Learning App Based on Flow Theory

Kun Liu¹, Xiran Yin^{2,*}

{495909510@qq.com¹, 1510089075@qq.com^{2,*}}

Changchun University of Technology, Changchun, Jilin, China

Abstract. In recent years, with the increasing emphasis on children's education by parents, the number of educational apps has been rapidly growing, especially in the field of English learning. This study aims to integrate the relevant concepts of flow theory to analyze English learning apps available in the market. Taking the ABC Reading children's learning app as an example, this research combines the three elements of flow theory—clear goals, accurate and timely feedback, and the balance between challenge and skill—to improve the design of the app and enhance the user experience for children.

Keywords: Flow Theory, Children's Learning App, User Experience, App Design.

1 Introduction

The rise of smart devices has led to a surge in applications, particularly in the educational sector. This trend is fueled by the growing popularity of remote education and mobile internet. As early childhood is recognized as pivotal for language development, the demand for children's English education apps has risen. Online learning offers cost-effectiveness, abundant resources, and flexibility, making it convenient for both parents and students compared to traditional methods. However, challenges persist, such as low interest and motivation among children, ineffective feedback mechanisms, product homogeneity, and a lack of user engagement. Integrating flow theory into children's English learning apps can address these challenges by enhancing interest and increasing user engagement.

2 Overview of Flow Theory

2.1 Concepts of Flow Theory

The Hungarian-American positive psychologist Csikszentmihalyi proposed the flow theory, observing that individuals often experience an optimal state they termed "FLOW" when they exert their physical and mental capacities to the fullest^[1]. He likened this experience to the flow of water^[2]. Later, Novak and Hoffman investigated the process of flow experience and summarized it into three types of factors that generate flow: conditional factors, experiential factors, and outcome factors^[3]. When individuals are in a state of flow, they feel highly engaged and joyful. Flow experience is a crucial concept in flow theory, referring to the feeling of completely immersing one's energy or "mind-body" into an activity^[4].

Csikszentmihalyi also proposed that flow formation is influenced by two important factors: challenge and skill. He developed the flow model, suggesting that when users face challenges beyond their skill level, they experience anxiety and discomfort. Conversely, when users' skills surpass the challenges, excitement and novelty diminish. Flow occurs only when there is a balance between challenge and skill^[5].

2.2 Characteristics of Flow Theory

Based on user descriptions, Csikszentmihalyi summarized nine characteristics of flow, including: clear goals, immediate feedback, balance between challenge and skill, merging of action and awareness, highly focused attention, sense of potential control, gradual reduction of self-awareness, disregarding the passage of time, and intrinsic sense of engagement^[6]. Novak categorized the first three as conditional factors, while Chen et al. referred to them as pre-phase elements, stating that clear goals, immediate feedback, and balance between challenge and skill are essential prerequisites and preparations for inducing flow experiences. When users experience flow, they exhibit one or more of these characteristics^[7].

Balancing skill and challenge is crucial for achieving flow, but having clear goals and receiving timely feedback also play significant roles. These factors are adjustable and offer opportunities for applying flow theory in practical settings.

3 The Significance of Flow Theory in Children's English Learning Apps

Compared to traditional design methods, flow theory differs in interactive design. Flow theory takes user emotions as the starting point of design, placing greater emphasis on users' intrinsic motivation and emotional experiences^[8]. The focus of this paper is to ensure that children achieve optimal flow experiences while using English learning apps, thereby enhancing their learning efficiency. By applying flow theory to these apps, it's feasible to stimulate children's interest and motivation in English learning, improve their focus and engagement, and create enjoyable learning experiences. Interactive design aimed at fostering flow experiences not only enhances the practical value of the app but also addresses existing issues in learning experiences by integrating flow elements into the design, thereby improving usability and user-friendliness.

4 Design Strategies for Children's English Learning App Based on Flow Theory

Following flow theory, interaction design strategies aim to optimize children's experiences with English learning apps, boosting their learning efficiency. These strategies revolve around ensuring clear goals, offering accurate and prompt feedback, and balancing skill and challenge levels to immerse children in a state of flow during their learning journey.

Clarity in goals is essential, encompassing both interface and workflow considerations. Interface design should feature a simple, child-friendly layout with graphics and colors aligned

with their cognitive abilities. Thoughtful workflow design guides children through learning tasks progressively, aiding comprehension and sustaining their attention.

Timely feedback is crucial for fostering flow. English learning apps can offer instant feedback on children's responses, reinforcing their sense of progress and performance. Visual representations of learning progress and scores further incentivize engagement.

Balancing skill and challenge is paramount. Apps should tailor challenges to children's skill levels, gradually increasing difficulty to maintain interest and foster skill development.

In summary, interaction design for English learning apps should prioritize clear goals, timely feedback, and appropriate challenge levels. Implementing these strategies can enhance children's interest, motivation, and learning outcomes, creating enjoyable and effective learning experiences.

4.1 Designing Clear and Explicit Goals

In accordance with flow theory, goal clarity significantly impacts individual motivation levels. Children, facing greater attention challenges compared to adults, require strategies to maintain focus when using English learning apps. Ensuring clear and specific goals is paramount in app design. Interface design should feature a clean layout and child-friendly graphics and colors. Equally important is the logical arrangement of learning tasks, guiding children towards their objectives gradually. Such design fosters comprehension of the learning process and sustains attention, leading to improved learning outcomes.

Therefore, in interaction design based on flow theory, we analyze and optimize goal clarity from two perspectives: interface and workflow ^[9].

Rational Interface Design: Clearly Display Learning Objectives. In each learning activity, clear and specific learning objectives can enhance children's learning motivation, prompting them to be more focused on learning activities. On the interface of children's English learning apps, learning objectives can be displayed prominently before the task begins or on the activity page. They can also be highlighted on the interface using large fonts, striking colors, or attractive icons. Helping learners establish cognitive awareness of objectives increases their motivation and understanding of the significance of learning.

For example, "Duolingo" is a popular children's English learning app. It sets clear learning objectives in each course, such as learning specific words, grammar rules, or conversation skills. By clearly displaying objectives, learners can pursue them purposefully and gain a sense of achievement.

Providing Clear Learning Paths and Tasks. Children have a strong curiosity, but their attention span is relatively short, and their attention is easily diverted. Therefore, while helping children clarify learning objectives, operational guidance is also necessary to help them learn how to achieve these objectives, preventing them from losing their way while using the app ^[10].

Firstly, specific descriptions and meanings of learning objectives should be prominently displayed on the app interface using concise language and visual elements. This helps children understand the importance and practical applications of their learning goals, stimulating their interest and motivation.

Secondly, clear operational guidance is essential to keep children focused on their learning path. The app can present learning processes step by step, incorporating multimedia elements like animation and sound to enhance guidance. It's imperative to ensure that guidance information is concise, easy to comprehend, and suitable for children's cognitive and language abilities.

For example, "ABC mouse," a renowned children's learning app, offers structured learning paths and tasks. Learners progress through a preset course sequence, unlocking the next task upon completion. This design provides clear learning directions, enabling organized English skill development.

In addition, the app interface can display clear learning objective titles, such as "Learning New Words" or "Practicing Grammar Rules," before each task. Visual cues like icons or progress bars can further indicate goal completion status, enhancing user engagement and motivation.

4.2 Providing Accurate and Timely Feedback

In flow experiences, accurate and timely feedback serves as a crucial component for helping learners sustain their flow state. Feedback responds to learners' actions, enabling them to gauge their progress and performance, make necessary adjustments, and stay focused and engaged.

Timely feedback closely aligns with learners' actions, allowing for quick adjustments and improvements in learning strategies. Personalized feedback, tailored to learners' specific needs and skill levels, is more targeted and effective.

By providing accurate and timely feedback, learners not only maintain their flow state but also gain clear operational insights, reduce anxiety, and enhance focus and engagement. Continuous optimization and personalization of feedback enable learners to refine their learning behaviors, resulting in improved learning outcomes.

Designing Real-Time Feedback Mechanisms. In the learning process, learners benefit from immediate feedback upon completing tasks or answering questions, facilitated by real-time feedback mechanisms. This feedback covers the correctness of answers, progress, and areas for improvement. For instance, "Lingo Kids," a renowned English learning app for children, integrates a real-time feedback system. After each exercise or task, learners promptly receive feedback on answer accuracy and suggestions for improvement. This instant feedback empowers learners to understand their performance, make necessary adjustments, and sustain their motivation and engagement in learning.

Promptly Responding to Actions Enhances Children's Sense of Control. For correct learning actions, positive feedback is needed to reinforce encouragement, such as opening treasure chests, blind boxes, redeeming points for gifts, and so on. Providing rewards promotes a positive learning atmosphere, making children enjoy learning English.

For incorrect learning actions, it's also essential to provide prompts in a reasonable manner. For instance, when a child makes a mistake in recognizing a word, a reminder can be given by presenting a red "bomb" accompanied by a lowering pitch sound. In the learning module design of ABC Reading, a treasure chest collection approach is employed. Upon completing a stage of tasks, learners receive a treasure chest containing coins as a reward. Overall, this

reward mechanism can stimulate children's sense of achievement and motivation, encouraging them to progress towards the next objective, enhancing enjoyment and engagement in learning.

4.3 Balancing Skill and Challenge

Providing Content of Appropriate Difficulty According to Learners' Levels. Apps should provide learning content of appropriate difficulty based on children's English levels and abilities. If the content is too simple, learners may feel bored and unchallenged, while if it is too difficult, they may feel frustrated and helpless. Dynamically adjusting the difficulty level of learning tasks can help learners stay in their learning zone. For example, "Super English" is an English learning app designed for children. When learners demonstrate higher skill levels, the app provides more challenging exercises and tasks to encourage continued growth. Conversely, when learners encounter difficulties, the app provides simpler exercises and additional assistance to help them overcome obstacles and maintain motivation.

Designing Challenging Tasks to Promote Learners' Progress. Given the wide age range and varying cognitive abilities of children, their understanding often relies on intuitive senses such as vision, hearing, and touch. Additionally, their emotional responses to learning tasks can differ, ranging from resistance and anxiety to boredom and disinterest.

To foster children's interest and motivation and deepen their engagement in learning, it's crucial to provide appropriate challenges. This entails tailoring learning content and difficulty levels to children's ages and developmental stages. For younger children with weaker foundations, designs should incorporate rich visual and auditory elements and interactive methods to captivate their attention and curiosity. Conversely, for older children with stronger foundational abilities, tasks should gradually increase in complexity and challenge to drive learning progress.

In app design, learning task difficulty can be dynamically controlled through methods such as predicting children's abilities and analyzing learning process data. This adaptive approach ensures that tasks align with children's skill levels, promoting satisfaction and a sense of accomplishment.

By implementing these design strategies rooted in flow theory, children's English learning apps can deliver engaging and effective learning experiences, facilitating the development of English language skills while making the learning process enjoyable for children.

5 The Design Practice of Children's English Learning App Based on Flow Theory

5.1 Improvements in Clear and Distinct Learning Goals

Due to children's limited cognitive abilities and tendency to become easily distracted, rational interface design and clear learning paths and tasks can reduce the probability of children becoming distracted while using the app, enabling them to focus on achieving learning goals. Therefore, in interface design, the core tasks should be highlighted, and unnecessary steps should be minimized.

One deficiency in the homepage of ABC Reading is the lack of emphasis on the current learning task segment. All segments are presented in the same visual manner, which is not conducive to guiding children's learning. Therefore, in the design of the learning segment design page, the icons for the current learning tasks were redesigned to help children understand the current learning tasks and maintain a continuous flow experience during the process.(Fig.1 and Fig.2)



Figure 1. The original interface of ABC Reading tasks before improvement. (Image from ABC Reading "app screenshot")



Figure 2. The improved interface of ABC Reading tasks after improvement. (Self-made by the author)

Furthermore, the app's homepage features a "Today's Tasks" function, which enables children to have a clearer understanding of the day's learning objectives, thereby enhancing motivation and efficiency. After completing a portion of the learning tasks, a checkmark symbol ("✓") will appear on the right side, reminding children that the task has been completed and prompting them to proceed promptly to the next stage of learning.(Fig.3)



Figure 3. The original interface of ABC Reading tasks before improvement. (Self-made by the author)

5.2 Improvements in the "Matching Skills with Challenges" Direction

To enhance children's learning experiences, implementing a pre-learning ability assessment feature can be valuable. This feature helps children assess their English proficiency levels and receive corresponding assessment reports.

For instance, ABC Reading uses the RAZ reading system to grade tasks but lacks reasonable test question settings. By incorporating tailored test questions before learning at a specific level((Fig.4), children can skip lower difficulty levels upon successful completion. This approach prevents boredom and negative emotions, promoting more engaging learning experiences.



Figure 4. Image from ABC Reading "app screenshot"

In summary, the aim of this design enhancement is to elevate children's learning experiences through various improvements. Firstly, by refining the hierarchical and visual design of learning tasks, children can better understand goals and boost motivation. Secondly, the introduction of ability assessment enables children to gauge their English proficiency, aligning them with suitable courses. This ensures a balance between skill and challenge, fostering continuous improvement. These enhancements pave the way for achieving flow experiences, which hinge on appropriate challenges, goals, and supportive feedback. By optimizing task design and providing ability assessment features, we create conditions for sustained optimal learning experiences for children.

Design Validation Sampling. Using purposive sampling, we selected 50 children from grades 3 to 5 at "Huaxia Foreign Language Primary School" in Zhoukou City for interviews to obtain substantial information.

Data Collection. This design validation employed semi-structured informal interviews and participatory observation to collect data. We developed an interview outline based on flow theory and children's psychological characteristics, covering the following aspects:

- 1) Basic information about the children, such as age, grade, mode of transportation to school, and extracurricular activities;
- 2) Their usage of English learning apps, including app names, favorite features, frequency of use, encountered issues, whether their needs were met, and reasons for unmet needs;
- 3) Actual interaction experiences with the interface, utilizing high-fidelity interface simulation software to record usage experiences. Each interview lasted approximately 10 minutes.

Data Analysis. Through the actual application by children, relevant usage data and feedback were obtained (Partial data can be found in Fig.5, Fig.6, and Fig.7). By integrating repetitive and similar content and excluding irrelevant information, the results were summarized into the following three points:

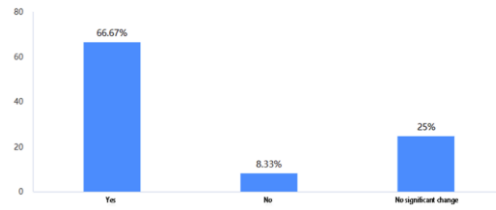


Figure 5. When using the improved ABC Reading App, do you find it easier to concentrate? (Self-made by the author)

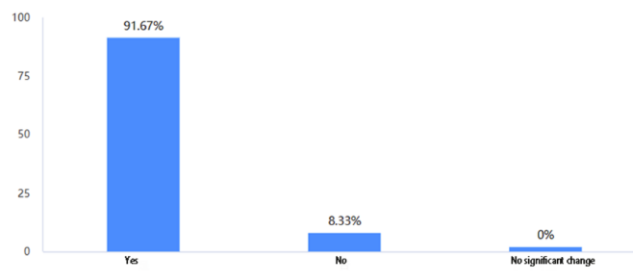


Figure 6. When using the improved ABC Reading App, do you find it easier to locate the content you need? (Self-made by the author)

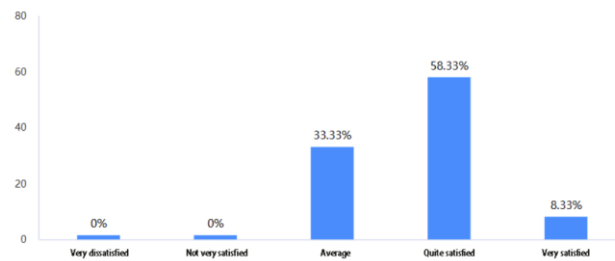


Figure 7. What is your overall satisfaction with the improved ABC Reading App interface? (Self-made by the author)

- 1) In the design of learning module pages, after improving the design of current learning task icons, most children could autonomously operate the interface, thus enhancing learning efficiency.
- 2) After introducing the capability assessment feature, all interviewed children expressed that the recommended courses matching their abilities were helpful for subsequent learning.
- 3) The interface had appropriate proportions, reasonable layout, and well-matched colors, attracting the attention of most children with bright and colorful colors.
- 4) Sound and animation during operation could maintain children's attention and increase the fun of operation.

Validation Results. Based on the above validation results, we found that children's operations on the English learning interactive interface, such as "smooth operation, lively and interesting interface, clear instructions," directly influenced their psychology and emotions. Negative emotions generated during operation could reduce their flow experience (such as inability to autonomously determine the next step of operation), while positive emotions (such as joy and excitement) could promote the orderly coordination of children's perceptual systems, thereby enhancing cognitive performance, improving attention levels, and ultimately enabling them to achieve a good flow experience. Therefore, the above design practice validated that integrating flow theory into the functionality and interactive interface of children's English learning apps is crucial for enhancing children's learning efficiency and flow experience.

6 Conclusion

As parents increasingly emphasize children's English learning, English learning apps for children need to pay more attention to children's cognitive characteristics and behavioral habits. In addition to providing high-quality learning content, these apps should also integrate education and entertainment, allowing children to complete learning tasks in enjoyable flow experiences. Based on the design concept of flow experiences, setting clear learning goals for children, providing positive feedback, and offering appropriate skills and challenges based on children's ability levels and learning progress can enable children to achieve enjoyable, focused, and efficient English learning experiences. At the same time, such designs can cultivate children's habits of actively learning English, allowing them to enjoy the learning process and continuously improve their language abilities.

References

- [1]Hong Liu, Jiayi Guo, Shijun Ge. "Flow Theory and User Experience Design." *Art and Design (Theory)* (3), 178-180(2009).
- [2]Csikszentmihalyi, T.: *Flow: The Psychology of Optimal Experience*. Harper & Row, US (1990).
- [3]NOVAK T P, HOFFMAND L. Measuring the Customer Experience in Online Environments: a Structural Mod-eling Approach[J]. *Marketing Science*, 2000, 19(1): 22-42.
- [4]Weibin Deng, Shihui Liao, Yijuan Shang, et al. "Innovative Design of Entertainment Products Based on Flow Theory." *Packaging Engineering* 39(6), 187-191(2018).
- [5]Peng Deng. "Flow: Experiencing the Potential and Pleasure of Life." *Distance Education* 32(3), 74-78(2006).
- [6]Xiaoyun Xu, Fengyan Li, Pei Yang. "A Review of Product Interaction Design Based on Flow Theory." *Packaging Engineering* 41(24), 14-21 (2020) .
- [7]Jie Chen, Fang Cong, Feng Kang. "Research on Factors Influencing Online Consumer Purchase Behavior from the Perspective of Flow Experience." *Nankai Management Review* (2), 132-140(2009).
- [8]Xifan Ou, Hao Tan. "Research on Internet Product Design Based on Flow Theory." *Packaging Engineering* 37(4), 70-74(2016).
- [9]Dawei Sun. "Application of Intelligent Conference System in Conference Management." *Residential and Real Estate* (25), 158(2019).

[10] Hao Yuan, Jin Wang. "Research on Design of Children's Guoxue Education APP Based on Flow Theory." *Art and Technology*, 35(1):200-202(2022) .