Enhancing Children's Academic Learning Experience: Natural Language Interface Designs in Educational Application

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Abstract. User Interaction (UI) designs, a crucial part of the modern internet industry, have been envolving and becoming more and more sophisticated and advanced. Recently, with the development of Machine Learning in Computer Science, Natural Language Interface (NLI) designs, a new division of the UI designs, appears into public's view. With its special focus on using Natural Language Processing (NLP) to enable applications respond and execute useful actions in response to users' input, UI designers are able to implement an array of new functions into the application, allowing children (12 to 18 years old) to better interact with the applications. This research primarily focuses on how NLI designs in educational settings are able to enhance their learning experience and academic performance. In particular, with a deep literary analysis, this research incorporates several important findings about NLI designs' positive effects on children's academic learning experience and performance. Through thorough investigations, this research concludes that while there are several technical limitations on NLI designs due to the limited level of technology, they can still facilitate children's learning experience and academic performance by satisfying children, letting them stay longer in the application, and providing them a better guide, which enables them to have a better navigation in the application's learning environment.

Keywords: Natural Langauge Interface; User Interface; Human-computer Interaction.

1. Introduction

In recent years, technology has rapidly changed how people live and how they approach education. This shift to digital platforms has introduced a new way of learning, where online tools and interactive interfaces are now crucial parts of education. One notable advancement in this field is Natural Language Interface (NLI) designs, driven by the progress in Machine Learning. This study aims to explore how NLI designs can improve the learning experience for the young generation, specifically those between the ages of 12 and 18.

As education moves towards digital platforms, understanding the potential of NLI designs becomes crucial. These designs have the power to alter how people learn, providing a more engaging and dynamic environment. By investigating how NLI designs can aid learning, people will have the opportunity to equip a new generation of learners with tools that match their digital-native instincts, ultimately leading to a more effective and interactive educational experience.

Moreover, this research addresses an important gap in our current knowledge. While interest in NLI technology is growing, there is a clear need for practical research that systematically evaluates its impact on educational outcomes. The insights gained from this study hold the potential to not only improve teaching methods but also guide the development of educational technologies that better suit the needs of modern learners.

In summary, this study intends to close the gap between technological advancements and educational progress. Its goal is to foster a more inclusive, captivating, and efficient learning environment for young students. By recognizing the potential of NLI designs, researchers lay the groundwork for a future where education is not only accessible but also tailored to the unique needs and learning styles of each student. This, in turn, can foster a generation of lifelong learners who are skilled at navigating the challenges of an increasingly digital world.

2. Literature Review

2.1. Natural Language Processing (NLP) Overview

In natural language interfaces (NLIs), natural language processing (NLP) is exteremely important to enable and enhance their functionalities. NLI enables users to interact with their native language to the computer applications, therefore creating a higher capability of effective information retrieving goals [1]. NLP, a critical internal structure in NLI, is worth a deeper analysis.

NLP is a particular area of study concerned with computers' ability to comprehend what humans say in natural language using advanced computer algorithms and techniques [2]. As a branch of the subject of Computer Science, it not only involves theoretical and algorithmic development but also practical experiments. To let non-experts be able to harness the benefits of NLP fully, Grosz et al. experimented and even built a transportable natural-language interface system named "TEAM," which was proven to be helpful in letting non-experts quickly adapt NLP into their applications [1].

First started to receive attention from other scholars in the late 1950s, NLP quickly spread to the world as a new way of maximizing the utilities of computers. As described by Jones, NLP's development can be divided into several phases. In the first phase (Late 1940s to Late 1960s), most computer engineers focused on machine translation (MT). In the following phase from Late 1960s to late 1970s, which is more AI-focused, they focus more on the significance of world language and its role in constructing and enhancing NLP technologies. Afterward, the evolution of NLP technologies started with a focus inclined more toward data inputs and outputs [3]. The quick evolvement of NLP proves that, although NLI designs (involving NLP) were a relatively new subject compared to other areas in Computer Science, with its introduction just in 1980, NLP technologies have a large potential to be utilized in the future.

2.2. Implications of NLP

Natural language processing (NLP) incorporates various procedures aimed at analyzing and understanding human speech and language data. With the help of NLP, developers can construct various applications in the real world.

First, from the research conducted by Kang et al., people learned that NLP can be employed as a technique to achieve business success. They carefully analyzed articles from over 24 leading business journals and claimed that the use of NLP in business or other disciplines brings an aspiring possibility of increasing business interest [4]. From this example, it is clear that the applications of NLP, specifically in business, bring people a beneficial effect in improving their business.

Second, from the research conducted by Zeman et al., in which they developed a multi-purpose open-source NLP framework named "TectoMT." Under the framework, as they described, the foundational use of NLP is excessive. "TectoMT" integrates multiple uses (i.e., tokenization) of NLP all in one place, enabling the threshold for companies and developers to use NLP to be minimized [5]. Therefore, it boosts the development of NLP by organizing all of the NLP's potential applications all in one place.

Third, as Shaik et al. have described in their research, NLP applications help students learn better and achieve higher academic achievements. That is, they found a potential application of NLP in education, claiming that NLP techniques can play an essential role in analyzing student feedback (i.e., wrong answers and questions on a test) and correspondingly giving customized solutions for students to improve their study [6].

2.3. Overview of Natural Language Processing (NLP)

Throughout the world, NLI designs have been implanted into applications in many industries, and it has been proven effective in increasing users' overall satisfaction level. A simulation study conducted by Antrobus et al. involves using NLI designs to improve users' acceptance and trust of self-driving vehicles, was proven to be effective in helping users better accept the evolvement of autonomous vehicles, increasing their overall satisfaction toward the vehicles. In the study,

researchers compare the utility of two user interaction (UI) designs, one involving traditional designs (using visual and other traditional elements) and another one with NLI designs (using audio and natural clues) implanted in the UI designs, to increase users' satisfaction and acceptance level toward autonomous vehicles [7]. Their research also marks NLI designs' potential success in increasing users' overall satisfaction levels in other industries.

Not only in the technology industry, NLI designs have also been proven to be successful across many other industries. First, research conducted by Huq et al. in the medical education industry, which involves using NLI designs to make students feel more confident and knowledgable, was also successful, proving that NLI designs also have a potential for educating college medical students and, resultingly, making them feel more confident in studying [8]. Second, NLI designs have even proved successful in helping to regulate a complex closed ecological life support system by letting handlers feel more precise when solving unexpected issues in the system [9]. To conclude, NLI designs have been marked successful in many industries, from autonomous vehicles to medical education and ecological technology.

3. Result

3.1. lncreasing Children's Overall Satisfaction Level

NLI designs provide people with an optimistic view such that tehse designs can increase children's satisfaction levels, particularly in the education industry. Gagan and his associates conducted research wherein they integrated an interactive, conversational aide to improve the communication abilities and self-confidence of children who have been diagnosed with autism spectrum disorder (ASD). By comparing participants' previous performance in interacting with society, they discovered that incorporating a lively user interface, which is the basis for a virtual talking companion they included in the research, may increase their confidence in interacting with their social-emotional learning companions [10]. Some may say that since these are children with psychological disorders, any related results, such as the success of NLI designs to elevate children's ability to confidently communicate with others, associated with this group of participants, may not be generalized into a larger group, all the children.

However, Layard et al. believed that mental disorders and related diseases is one of the most influential predictors of life-long satisfaction [11]. This means that children with mental illness may even find it harder to be satisfied in their lives. Therefore, the participants (children with ASD) in their research are stronger candidates for evaluating the effectiveness of NLI designs to satisfy children, providing the context that they are harder to be satisfied compared to other normal children. To conclude, NLI designs can help children to be satisfied, which provides a solid foundation to reason that NLI designs will enhance children's academic learning experience.

3.2. Longer Retention Rate for Children to Remain in the Application

Prolonged user engagement is a critical metric in evaluating the effectiveness of educational applications. NLI designs contribute significantly to this aspect by creating immersive and personalized learning experiences.

The adaptability of NLI systems to individual learning styles and paces is a key factor. These insights can serve as a foundation for tailoring personalized interventions based on interaction patterns [12]. The NLI system's ability to adjust the difficulty level in real-time based on the user's performance played a pivotal role in sustaining engagement.

Especially for children with shorter attention spans who may not be inclined to spend hours reading text, the integration of Natural Language Interfaces into software products provides them with simplified and intuitive means of interaction. This allows users to engage with the software through voice commands or text-based conversational interactions, instead of relying solely on traditional graphical user interfaces. This is particularly beneficial for younger children who may not be as tech-savvy, as NLIs streamline interactions and make them more instinctive. The utilization of an

Intelligent Personal Assistant (IPA) via Voice User Interfaces (VUIs) holds the potential to function as a valuable tool in creating scripts and designing learning scenarios [13]. This augmented IPA capability exhibits potential benefits in virtual laboratories, simulated environments, and even during quiz completion, all of which contribute to a more engaging and lasting learning experience.

3.3. Better Navigational Support for Children

Compared to traditional user UI designs, such as graphical user interface (GUI), NLI designs clearly make it easier for users to use the application, hence increasing their experience when using the application, providing the point that these designs offer more navigational support. Letting children to use their laptops more may increase their overall grades, and children with higher grades tend to use these laptops more fluently [14]. Therefore, it is suggested that there is a positive and strong correlation between the NLI designs' usability and children's overall grades. In addition, since a more personalized technology has the capability in helping children to alleviate classroom constraints, it increases students' overall learning efficiency, especially in Math [15].

Moreover, NLI designs in applications also particularly reduce users' effort to navigate the application [14]. Therefore, it further reflects NLI designs' effectiveness for customizing and personalizing users' experience, along with a lower cost (i.e., time) to navigate in the application and a more customized experience. With this, it is suggested that NLI designs can provide extensive support in children's learning experience. In conclusion, the usability, capability, and effectiveness of using computers with more natural interactions prove that NLI designs can bring positive effects on children's education by providing a better learning experience.

4. Discussion

4.1. Significance of Research

This research is significant for several reasons. Firstly, it views NLI designs from another perspective that most of the other research have overlooked: a perspective from education for children. With this particular focus, this research may help educators to rethink the value of NLI designs in educational application. Specifically, it lets them to further look at the essence of modern technology to understand how a more natural and closer user interface can significantly affect children's learning experience and outcomes. Secondly, this research incorporates many academic sources from various industries ranging from ecological technology to autonomous driving and back to traditional teaching, which increases the variability and adaptability of this research as future researchers may use this research as a starting point, including conducting further research and applications in other industries, but not limited to education. Finally, this research also contains many experimental and applicational sources to support its arguments better. For example, through examining a detailed analysis of Gagan et al.'s experiment, this research addresses how NLI designs can affect children's increasing interaction ability, which is a crucial ability for children to develop their studies.

4.2. Limitations of Research

Several limitations in this research may possibly undermine its findings, but they can be addressed through future studies. First, some may argue that since this research contains no first-hand experiments, it is unreasonable to claim its findings are valid. However, due to limited resources, including time and cost, it is not feasible for the authors of this research to conduct such experiments in a large scale. In addition, original experiments are not always valid and accurate. Furthermore, the sources incorporated in this research are all peer-reviewed and valid research, and they can particularly support the central argument of this paper well. Next, this research's way of connecting and combining these sources into the argument is also logical, providing that each sub-argument can be essentially proved by at least part of the cited resource.

5. Conclusion

In summary, this research highlights the transformative impact of Natural Language Interface (NLI) designs on the educational experience of children. By harnessing the power of Natural Language Processing (NLP), NLI designs redefine user interaction, offering dynamic and engaging learning environments.

Through a comprehensive analysis, this study establishes the positive influence of NLI designs on academic performance and learning satisfaction. Despite initial technological constraints, NLI designs prove instrumental in enhancing user experiences, prolonging engagement, and providing effective guidance within the learning ecosystem. By recognizing the potential of NLI designs, we lay the foundation for a future where education is not only accessible but also tailored to the unique needs and learning styles of each student.

Ultimately, this work serves as a guiding light for educators, paving the way for a more engaging and effective learning environment. By leveraging NLI designs, this research unlocks a new era of personalized education, propelling people to go to a future where learning is customized to individual needs. Furthermore, parents may realize the benefits of letting their children to interact with the newest technologies, specifically the educational applications with NLI designs. Then, this study also opens a new avenue for further exploration, inviting researchers to research into the unlimited potential of NLI designs across diverse industries.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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