# PROGRAMMING LEARNING APP FOR KIDS: CUSTOMIZED KIDS ASSISTANCE SYSTEM

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## 2. Abstract

Sri Lanka's economy is facing significant challenges due to the escalating USD crisis, which has adversely impacted key sectors such as tourism, tea exports, and garments. While the IT sector has historically been a stabilizing force, its potential remains untapped. The increasing trend of outsourcing to South Asian countries, particularly India, has highlighted a critical knowledge gap in programming among Sri Lankan youth. This disparity is hindering the country's ability to compete effectively in the global IT market and capitalize on the outsourcing boom.

To bridge the programming knowledge gap and position Sri Lanka as a competitive IT hub, this research proposes a novel mobile application. The app is designed to introduce coding concepts to children through an engaging and interactive story-based learning approach. By making programming accessible and enjoyable from a young age, the app aims to cultivate a strong foundation in IT skills. Additionally, the app will incorporate a customized child assistance system to provide tailored support and guidance, ensuring that learners progress at their own pace.

The successful implementation of this mobile application is expected to have a profound impact on Sri Lanka's IT landscape. By nurturing a generation of proficient programmers, the country can significantly enhance its capacity to participate in the global IT market. This, in turn, will contribute to economic growth, job creation, and foreign exchange earnings. Moreover, the app has the potential to serve as a model for other developing countries facing similar challenges, promoting knowledge sharing and collaboration on a global scale.

Key Words: Machine Learning, Mobile Solution , e-learning

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## 7. List of Abbreviations

| Abbreviations | Description |
|---|---|
| NLP | Natural Language Processing |
| CKAS | Customized Kids Assisting System |
| ICT | Information and Communication Technology |
| IT | Information Technology |
| GDP | Gross Domestic Product |
| KBA | Knowledge Base Agent |
| QA | Question & Answer |
| GPT | Generative Pre-trained Transformer |
| AI | Artificial Intelligence |

# 8. Introduction

## 8.1. Background Literature

Sri Lanka's tourism industry stands as a cornerstone of its economy, contributing significantly to GDP (12.5%). It generates substantial foreign exchange, supporting a diverse range of businesses and livelihoods across the country. Tourism serves as a catalyst for infrastructure development, leading to improved transportation, accommodations, and public services that benefit both visitors and locals. The industry plays a crucial role in showcasing Sri Lanka's rich cultural heritage and natural beauty, fostering a sense of national pride and encouraging preservation efforts. Furthermore, tourism has the potential to drive sustainable development by promoting eco-friendly practices and supporting local communities. While the COVID-19 pandemic dealt a severe blow to the sector, its inherent resilience and ability to rebound make it a key driver of economic recovery and future growth.

The COVID-19 pandemic inflicted a severe blow to Sri Lanka's tourism industry, resulting in far-reaching economic and social consequences. A dramatic decline of 30% in tourist arrivals during the first quarter of 2020 compared to the previous year marked the beginning of a catastrophic downturn. This plunge was primarily attributed to stringent travel restrictions, global lockdowns, and widespread health concerns. The economic repercussions were equally devastating. The industry, a significant foreign exchange earner, suffered projected revenue losses of between USD 107 million to USD 319 million. This financial crisis triggered a domino effect, impacting businesses across the tourism value chain. Hotels, travel agencies, and transportation services faced unprecedented challenges, leading to widespread job losses and increased unemployment.

Beyond the immediate impact on the tourism sector, the crisis reverberated through the broader economy. Interconnected industries such as hospitality, agriculture, and retail experienced a decline in business due to the reduced tourist activity. Moreover, the slowdown in tourism hampered infrastructure development and foreign direct investment, hindering the industry's long-term growth prospects. The pandemic also

compelled a shift in consumer behavior, with travelers prioritizing health and safety. To recover, the tourism industry must adapt to these new preferences and implement strategies to rebuild trust. The crisis has underscored the urgent need for comprehensive recovery plans, including financial relief for businesses, job retention initiatives, and innovative approaches to utilizing tourism resources [1].

The COVID-19 pandemic severely impacted Sri Lanka's tea industry. Global supply chain disruptions, coupled with a sharp decline in global tea demand, caused significant challenges for the sector. Export volumes plummeted due to these factors, forcing a shift in focus towards new markets. The crisis accelerated the adoption of digital tea auctions, a long-overdue transformation that holds potential for future growth. However, small and medium-sized enterprises within the industry were particularly vulnerable to the pandemic's effects, highlighting the need for targeted support. Overall, the pandemic exposed the tea sector's vulnerabilities and necessitated a strategic response to rebuild and strengthen its position in the global market [2].

Sri Lanka's garment industry is a vital economic pillar, serving as a major source of employment and foreign exchange earnings. The sector employs a substantial portion of the workforce, particularly women, contributing significantly to the nation's GDP. As a key export-oriented industry, garments have been a driving force behind Sri Lanka's economic growth. The industry's interconnectedness with other sectors underscores its importance within the broader economy. While the COVID-19 pandemic posed significant challenges, the sector's resilience has been evident in its ability to adapt to changing circumstances, highlighting its potential for future growth and development. The Sri Lankan garment industry, a cornerstone of the nation's economy, suffered a catastrophic downturn due to the COVID-19 pandemic. The industry, which had been a significant source of employment and foreign exchange, experienced a sharp decline in export earnings. With global demand plummeting due to lockdowns and economic contractions in major markets, garment manufacturers faced a perfect storm of challenges. A precipitous drop in export orders resulted in mass job losses, casting a long shadow over the livelihoods of hundreds of thousands of workers and their families.

The pandemic-induced disruptions to global supply chains exacerbated the crisis, hindering the procurement of essential raw materials and the timely delivery of finished products. Consequently, production schedules were thrown into disarray, and operational costs surged. Small and medium-sized enterprises, which form the backbone of the garment sector, were particularly vulnerable to the pandemic's impact. Facing a dramatic reduction in sales and mounting financial pressures, many struggled to stay afloat. The overall economic contraction in Sri Lanka, exacerbated by the decline in the garment industry, had far-reaching consequences, impacting the nation's GDP growth and overall economic stability. The pandemic exposed the fragility of the garment industry's reliance on global markets and highlighted the urgent need for diversification and resilience-building strategies. As Sri Lanka navigates the path to recovery, rebuilding the garment sector will be crucial for restoring economic growth and creating employment opportunities [3].

Sri Lanka's economy, heavily reliant on tourism, tea exports, and garment manufacturing, has been severely impacted by the COVID-19 pandemic. The abrupt decline in these sectors due to global travel restrictions, supply chain disruptions, and reduced demand has led to a substantial loss of foreign exchange earnings. Consequently, the country has experienced significant USD inflation as its economic stability has been compromised. The economic crisis precipitated by the collapse of Sri Lanka's key revenue streams—tourism, tea exports, and garment manufacturing—has had a devastating impact on the lives of ordinary citizens. The sharp decline in these sectors has triggered a cascade of challenges, including widespread job losses, income reduction, and a surge in poverty rates. This economic hardship has disproportionately affected vulnerable populations, such as daily wage earners and low-income families.

The shift to online education, necessitated by the pandemic, has exacerbated existing educational disparities. While intended to mitigate the disruption to learning, it has highlighted the digital divide, with many students lacking adequate access to technology and internet connectivity. Beyond economic hardship, the crisis has also

had profound social consequences. The increased stress and isolation brought about by lockdowns and restrictions have contributed to a rise in domestic violence and mental health issues. Moreover, the disruption of social networks and community support systems has eroded the overall well-being of the population. In essence, the economic downturn has created a complex web of challenges that have eroded the quality of life for Sri Lankans across all segments of society [4].

Information and Communication Technology (ICT) has emerged as a pivotal driver of economic growth and development in Sri Lanka. By fostering the evolution of a robust IT industry, the nation has the potential to diversify its economic base, reducing overreliance on the garment sector. This sectoral shift offers a promising avenue for job creation, particularly for graduates confronting unemployment challenges. Furthermore, the integration of ICT into commercial and industrial operations is poised to enhance Sri Lanka's global competitiveness through the expansion of e-commerce activities. Beyond economic imperatives, ICT is instrumental in optimizing governance and public administration, facilitating the timely dissemination of essential information to underpin economic progress.

Information and Communication Technology (ICT) has emerged as a pivotal force driving Sri Lanka's economic development. Substantial investments in telecommunications infrastructure have laid the groundwork for a digitally connected nation. This enhanced connectivity has facilitated efficient business operations, improved access to global markets, and accelerated the adoption of digital services. E-governance has been a cornerstone of Sri Lanka's digital transformation. By streamlining public administration, reducing bureaucratic hurdles, and enhancing service delivery, the government has created a more conducive business environment. This, in turn, has attracted domestic and foreign investments, stimulating economic growth.

ICT has been instrumental in developing human capital. Online education platforms, vocational training programs, and digital literacy initiatives have expanded access to knowledge and skills, equipping the workforce for the demands of the digital age. The

IT sector itself has emerged as a significant job creator, contributing to youth employment and reducing unemployment rates. Sri Lanka has witnessed a burgeoning startup ecosystem, fueled by ICT. The availability of digital tools and platforms has empowered entrepreneurs to develop innovative solutions to local challenges. This entrepreneurial spirit has driven economic growth and created new job opportunities. By leveraging ICT, Sri Lanka has integrated more effectively into the global economy. Businesses can now access international markets, expand their customer base, and increase exports. Moreover, ICT has facilitated foreign direct investment by providing potential investors with real-time information about the business environment [5].

In conclusion, ICT has been a catalyst for Sri Lanka's economic transformation. Its impact is evident in various sectors, from agriculture to healthcare. Continued investment in ICT infrastructure and human capital development will be crucial for sustaining this momentum and achieving the nation's economic goals. During this pandemic period The outsourcing has been emerged rapidly. Outsourcing refers to the strategic delegation of specific organizational functions or processes to external service providers. By contracting with specialized third-party entities, organizations can optimize resource allocation, enhance operational efficiency, and focus on core competencies. This practice enables firms to leverage external expertise, reduce costs, and mitigate risks associated with non-core activities.

Commonly outsourced functions encompass a broad spectrum, including but not limited to information technology, human resources, customer service, finance and accounting, marketing and sales, supply chain management, and legal services. The COVID-19 pandemic has accelerated the adoption of outsourcing as a strategic business decision. Organizations across industries have recognized the numerous benefits it offers in navigating the challenges posed by the crisis [6].

By outsourcing non-core functions, businesses can significantly reduce operational costs. Eliminating expenses related to recruitment, training, and office infrastructure has been crucial for maintaining profitability during these economically challenging times. Moreover, outsourcing provides access to specialized skills and expertise that

may be scarce in-house, particularly in areas such as technology and remote operations. The pandemic has underscored the importance of operational flexibility. Outsourcing enables organizations to quickly scale up or down their workforce in response to changing market conditions and customer demands. This agility is essential for surviving and thriving in an unpredictable business environment [6].

Finally, outsourcing can accelerate digital transformation and innovation. By partnering with external experts, businesses can gain access to new ideas, processes, and technologies, enhancing their ability to adapt to the evolving market landscape.
Outsourcing, the strategic delegation of organizational functions to external providers, has evolved into a prevalent business model across industries. This practice has been particularly pronounced within the Information and Communication Technology (ICT) sector, There are some advantages in this as well, Outsourcing ICT services has emerged as a strategic imperative for organizations seeking to optimize operations, reduce costs, and enhance competitiveness. By leveraging external expertise, companies can streamline their ICT functions and focus on core competencies [7].

One of the primary benefits of outsourcing is cost reduction. By eliminating the overhead associated with maintaining an in-house ICT department and capitalizing on lower labor costs in certain regions, organizations can achieve significant cost savings. Moreover, outsourcing provides access to a specialized talent pool, ensuring that businesses have the necessary expertise to address complex ICT challenges and stay ahead of technological advancements [7].

Outsourcing offers unparalleled flexibility and scalability. Companies can easily adjust their ICT resources to align with fluctuating business demands, without the burden of hiring and training additional staff. This agility is crucial in today's dynamic business environment. By partnering with experienced ICT service providers, organizations can mitigate risks associated with data security, compliance, and system failures. Outsourcing providers often have robust security measures and disaster recovery plans in place, safeguarding sensitive information and ensuring business continuity [7].

While the potential impact on employment is a concern, many companies have successfully managed this transition through redeployment and upskilling initiatives. The overall trend suggests that outsourcing creates new opportunities in the ICT sector, stimulating job growth in areas such as project management, ICT consulting, and service delivery. Outsourcing has emerged as a powerful driver of economic growth in South Asia. Countries like India have become global leaders in ICT services outsourcing, generating substantial revenue and creating millions of jobs. This surge in the ICT sector has contributed significantly to overall economic development and improved living standards. The outsourcing industry has fostered a skilled workforce in the region. Educational institutions have aligned their curricula with the demands of the ICT sector, producing graduates with the necessary expertise. This human capital development has been instrumental in enhancing the region's competitiveness on the global stage [8].

Moreover, outsourcing has attracted significant foreign direct investment (FDI) to South Asia. The influx of capital has fueled infrastructure development and supported the growth of the ICT sector. This symbiotic relationship between outsourcing and FDI has accelerated economic progress. The transfer of technology and knowledge from developed countries to South Asian nations through outsourcing has been a key factor in driving innovation. Local companies have been able to enhance their capabilities and compete effectively in the global market [8].

Even though outsourcing has been increased in South Asian countries drastically and while outsourcing has emerged as a strategic imperative for many organizations, it is not without its challenges. A primary concern is job security, as the transfer of functions to external providers can lead to job displacement within the outsourcing organization. Moreover, outsourcing often raises questions about wage disparities, as labor costs can vary significantly between countries. The potential for exploitation of workers, particularly in developing economies, is a critical ethical issue. The distribution of benefits from outsourcing has also been uneven across regions. Certain South Asian countries have experienced substantial economic growth and job creation

through outsourcing, while others have lagged behind. This has contributed to intra-regional disparities in development, with some countries experiencing rapid industrialization and technological advancement, while others grapple with persistent poverty and unemployment [8].

The global outsourcing landscape has witnessed a significant surge, with South Asian nations emerging as prominent players. India, in particular, has solidified its position as a global leader in IT services outsourcing, capturing a substantial portion of the market share previously dominated by Western economies. This dominance can be attributed to several factors, including a large pool of English-proficient, technically skilled labor, a favorable cost structure, and a conducive business environment.
In contrast, while countries like Pakistan and Bangladesh have also made inroads into the outsourcing industry, their market share remains comparatively smaller. Sri Lanka, despite possessing a skilled workforce, has faced challenges in establishing a significant foothold in the global outsourcing arena.

A key factor contributing to the disparity in outsourcing penetration across South Asian nations is the knowledge gap in technology and programming. India has invested heavily in education and skill development, producing a large talent pool proficient in emerging technologies. This emphasis on STEM education has equipped Indian youth with the requisite skills to meet the demands of the global IT industry.
Sri Lanka, while making strides in education, has lagged behind in producing graduates with the specialized skills sought after by multinational corporations. This skills gap, coupled with factors such as infrastructure limitations and policy challenges, has hindered the country's ability to compete effectively in the global outsourcing market.

To bridge this divide and enhance Sri Lanka's position in the outsourcing industry, targeted investments in education, skill development, and infrastructure are imperative. By fostering a robust ICT ecosystem and creating a conducive business environment, Sri Lanka can attract a larger share of the global outsourcing market.

This research was initiated in response to a perceived gap in programming education among young children. The primary objective was to identify strategies to introduce fundamental programming concepts to a younger demographic. Given the ubiquitous nature of smartphones among children, the research culminated in the proposition of a mobile application as a potential solution.

### 8.2. Research Gap

To do research there should be a gap. So authors have started to find gaps. Al-Zaghoul et al.'s research represents a valuable contribution to the field of early childhood education by developing a software agent-integrated e-learning mobile application for kindergarten students. The study's methodological rigor, employing a mixed-methods approach, is commendable in providing a comprehensive evaluation of the application [9]. However, a critical analysis reveals a significant gap in the research: the absence of a robust software agent component. While the application successfully engaged kindergarten students in e-learning activities, the lack of direct, interactive support through a software agent diminishes the potential of the platform [9].

A software agent, if effectively implemented, could have served as a virtual tutor, providing children with personalized guidance, feedback, and encouragement throughout the learning process. It could have adapted to individual learning styles and paces, offering differentiated instruction and support as needed. Moreover, a software agent could have collected valuable data on student interactions and learning behaviors, enabling researchers to gain deeper insights into the learning process [9].
The absence of this crucial component limits the full potential of the application as a comprehensive e-learning tool. Future research should prioritize the development of a sophisticated software agent that can provide intelligent support to young learners within the context of mobile applications. By addressing this gap, researchers can create more effective and engaging e-learning experiences for kindergarten students [9].

In conclusion, while Al-Zaghoul et al.'s research offers valuable insights into the development and evaluation of e-learning mobile applications for kindergarten students, the omission of a robust software agent component represents a missed opportunity to enhance the learning experience. Future research should focus on integrating intelligent agents to create more personalized, interactive, and effective e-learning environments for young children.

Anwar et al.'s research represents a valuable contribution to the field of educational technology by exploring the potential of mobile games to enhance math learning for primary school students. Their focus on designing a learning model and creating user interface prototypes is commendable. However, the study's limitations become apparent when examining the proposed method of fostering student interaction.While the researchers recognized the importance of student engagement and collaboration, their reliance on a forum as a primary mechanism for interaction presents significant challenges. The complexities of maintaining a safe and secure online environment for young children, coupled with the substantial human resources required for moderation, render this approach impractical and unsustainable. The study's findings highlight a critical gap in the research on mobile learning environments for young children: the need for innovative and effective methods to support student interaction without compromising safety, privacy, or efficiency. It is evident that alternative approaches are required to facilitate collaborative learning experiences within the confines of a mobile application [10].

Sureshwaran S et al.'s research represents a pioneering effort in exploring the potential of digital learning for children through the integration of text and audio data analysis. The study's methodological approach, employing a combination of Text-to-Speech (TTS), machine learning, natural language processing, and web scraping, is commendable in demonstrating the feasibility of extracting and analyzing information from multiple modalities. However, the research's primary limitation lies in its focus on information extraction and sentiment analysis rather than direct student interaction and support. While the study successfully extracted and analyzed data from various

sources, it did not translate this information into actionable insights that could be used to enhance the learning experience for children [11].

Hussain et al.'s "LITTLE PROFESSOR" mobile learning game represents a commendable effort to leverage game-based learning for enhancing children's educational experiences. The adherence to the ADDIE instructional design model provides a structured framework for the development of the game. However, a closer examination reveals a critical gap in the application: the absence of a robust in-app support system. The lack of a virtual assistant or guidance system within "LITTLE PROFESSOR" significantly limits its potential to provide individualized support to children. Effective learning often requires tailored assistance, especially for young learners who may encounter challenges in navigating new concepts and game mechanics. A well-designed in-app support system could offer a range of benefits, including providing on-demand explanations, offering personalized feedback, and motivating children through progress tracking [12].

Jayaratne H.M.K.V.'s research offers a valuable contribution to the field of educational technology by demonstrating the potential of a software system designed for object-oriented development to support learning. The iterative development approach and the use of a robust technological stack, including HTML, SQL, JavaScript, PHP, and MySQL, are commendable for building a well-structured system. However, a critical analysis reveals a significant limitation in the research: the challenges associated with the forum interaction component. While the intent to foster collaborative learning between parents and children is laudable, the practical implementation of such a forum raises concerns about privacy, security, and the demands of moderation [13].

The integration of a forum within the system, while theoretically promising, is hindered by several factors. Firstly, ensuring the privacy and security of children's personal information within an online forum is a complex and ongoing challenge. Safeguarding sensitive data from unauthorized access is paramount, especially when dealing with minors. Secondly, the requirement for human moderation to maintain a safe and respectful online environment is resource intensive. It demands significant time and effort to monitor forum discussions, address inappropriate content, and

mediate conflicts. These challenges highlight the need for alternative approaches to support parent-child interaction and collaboration within the digital learning environment. While forums can be valuable tools, their limitations in terms of privacy, security, and moderation necessitate the exploration of other strategies [13].

Insufficient Student Support: A common shortcoming is the lack of robust support mechanisms for learners. While technology offers potential for personalized learning, the studied applications often fail to provide adequate guidance, feedback, or adaptation to individual needs. This highlights the necessity for more sophisticated support systems, such as intelligent tutoring systems or virtual assistants, to be integrated into educational technology. Limited Focus on Individual Differences: The reviewed studies tend to adopt a one-size-fits-all approach to learning, neglecting the diverse needs and learning styles of students. To optimize learning outcomes, future research and development should prioritize the creation of adaptive and personalized learning environments that cater to individual differences.

To address these challenges, the integration of intelligent tutoring systems or virtual assistants within educational applications is imperative. These systems can provide real-time support, answering student queries, offering explanations, and adapting to individual learning styles. By leveraging advancements in machine learning, these in-app assistants can offer personalized guidance, fostering a more engaging and effective learning experience.

*Table 1. COMPASION OUR SYSTEM WITH EXISTING SYSTEMS*

| Research Papers | Provide an assistance System | Using AI | Using Native language |
|---|---|---|---|
| Narrative-based learning platform [2] | ✓ | ✓ | |
| AI based Kids Interactive | ✓ | ✓ | |

| | | | |
|---|---|---|---|
| Learning Platform [3] | | | |
| Chatbot Assistance System [4] | ✓ | ✓ | |
| Color App [5] | | | |
| Learning Math through Mobile Game [6] | | ✓ | |
| Our Solution | ✓ | ✓ | ✓ |

The above table (Table 1) compares author's proposed system with existing educational technology systems. Authors system stands out by incorporating narrative-based learning, AI-driven interactive platforms, advanced chatbot assistance, a dedicated color app, and innovative math learning games. These features aim to offer a more comprehensive and engaging learning experience for children, surpassing the capabilities of existing systems.

In conclusion, the incorporation of in-app assisting systems into educational applications is imperative to address the challenges posed by increasing class sizes and the diverse needs of students. By providing timely, personalized, and effective support, these systems can significantly enhance the learning experience and contribute to overall educational improvement.

### 8.3. Research Problem

The author's research is based on this, How to provide a basic knowledge of programming to kids ? ; Laying a strong foundation in programming at a young age can foster critical thinking, problem-solving, and creativity. To make programming accessible and engaging for children, it's essential to start with simple concepts and gradually introduce more complex ideas. Visual programming platforms, where

children can drag and drop code blocks to create animations, games, or stories, offer an excellent starting point. Relating programming to real-world examples, such as how a robot follows instructions or how a video game works, can spark children's interest. Building on these foundational concepts, introduce sequencing, loops, and conditional statements through interactive activities and games. Encourage children to experiment and make mistakes, as these experiences contribute to the learning process. Emphasize the importance of problem-solving and breaking down complex tasks into smaller, manageable steps. As children gain confidence, introduce text-based programming languages, such as Python or JavaScript, and guide them through creating their own projects.

Creating a supportive learning environment is crucial. Encourage collaboration, provide constructive feedback, and celebrate successes. By making programming fun and rewarding, children are more likely to develop a sustained interest in the subject. Remember, the goal is not to produce mini programmers but to cultivate a mindset of curiosity, experimentation, and logical thinking. How to assist kids when they are having doubts? Providing effective support to children as they learn to program is crucial for fostering a positive and productive learning experience. When children encounter challenges, it's essential to create an environment where they feel comfortable asking questions and seeking help. One approach is to establish a clear communication channel, whether it's through online forums, dedicated support platforms, or one-on-one interactions with teachers or mentors. Encouraging children to articulate their doubts clearly can help them identify the specific areas where they need assistance.

Author’s research main objective is aims to address a critical disparity in engineering education between the home country and India. By identifying and analyzing the specific knowledge and skill gaps, the study seeks to develop strategies to elevate the engineering competency of local students to par with their Indian counterparts.
The core objective is to produce high-quality, industry-ready engineers capable of competing globally. This involves a comprehensive assessment of the current engineering curriculum, infrastructure, and faculty capabilities to pinpoint areas for

improvement. Additionally, the research will examine successful engineering education models in India to identify best practices that can be adapted to the local context.

By understanding the root causes of the knowledge gap, the study will contribute to developing targeted interventions to enhance engineering education. This includes curriculum reform, faculty development, industry partnerships, and the creation of supportive learning environments. Ultimately, the goal is to produce engineers equipped with the necessary skills and knowledge to excel in the global engineering landscape. As answers for above research questions, Author can provide programming knowledge to kids is To effectively introduce programming concepts to children, a comprehensive understanding of how they interact with and learn from interactive platforms is essential. This exploratory analysis aims to delve into the core elements of interactive programming environments that facilitate learning.

Chiong and Shuler's research provides a foundational understanding of young children's interactions with mobile devices and applications. Despite the ubiquitous presence of smartphones and tablets in contemporary society, the study reveals a disparity between device ownership and actual usage among young children. While many households possess these devices, a significant proportion of children have limited exposure to them [14]. When children do engage with mobile technology, gaming often emerges as the primary activity. This finding aligns with broader cultural trends in which gaming has become a dominant form of digital entertainment. However, the study also highlights the adaptability of young children to technology. While some children required initial assistance, most demonstrated a surprising proficiency in navigating mobile devices, suggesting a natural affinity for technology [14].

Beyond entertainment, Chiong and Shuler's research offers glimpses into the educational potential of mobile apps. Specifically, the study identified "Martha Speaks" as a promising tool for enhancing vocabulary development among older children. The app's interactive features and engaging content appear to create a

conducive environment for language acquisition. Similarly, "Super Why" demonstrated effectiveness in promoting literacy skills among younger children, indicating the potential of mobile apps to support early childhood education [14].

### 8.4. Research Objectives

The author’s component is Customized Kids Assisting System, More over in order to prove this as a component there should be research questions; How to assist kids when they are getting doubts? To foster a positive learning experience for children in programming, it's essential to provide timely and effective support. Creating a supportive environment, actively listening to children's challenges, breaking down complex problems, encouraging articulation of doubts, and leveraging technology can all contribute to a comprehensive approach to assisting children in their programming journey.

How to get input from kids? To effectively design educational interventions that resonate with children, it is imperative to prioritize their perspectives and experiences. By adopting a child-centered approach, researchers can gain invaluable insights into children's needs, preferences, and learning styles. Creating a welcoming and engaging environment is fundamental to fostering open communication with children. Employing age-appropriate language, establishing rapport, and using interactive methods can encourage children to share their thoughts and ideas freely. Observing children as they interact with technology and learning materials provides rich qualitative data about their behaviors, interests, and challenges. To delve deeper into children's perspectives, conducting structured interviews and focus groups can be beneficial. These methods allow for in-depth exploration of their thoughts and feelings about various aspects of learning. Additionally, incorporating creative expression techniques, such as drawing or storytelling, can provide alternative avenues for children to communicate their ideas.

How to provide a suitable answer for their doubts? Fostering a supportive and encouraging learning environment is paramount when assisting children with programming challenges. Establishing open communication channels where children feel comfortable expressing their doubts is essential. Active listening, coupled with empathetic responses, can significantly impact a child's willingness to seek help. To effectively address a child's doubt, understanding the root of the problem is crucial. Breaking down complex issues into smaller, more manageable steps can make the problem seem less overwhelming. Utilizing clear and concise language, complemented by visual aids or analogies, can enhance comprehension. Encouraging children to articulate their thought process can stimulate critical thinking and problem-solving skills.

How to identify the kids questions even those are not properly structed? Identifying children's questions can be challenging due to their unstructured or incomplete expressions. Active listening, a supportive environment, and NLP technology can help. By carefully observing children, creating a safe space, and using NLP to analyze language, educators can better understand and address children's questions.

The specific objective of this component is to effectively address the unique learning needs of children, a comprehensive assistance system is required. This system should incorporate several key components to provide real-time support and foster critical thinking. Firstly, the system must accurately identify and categorize children's learning challenges. By utilizing natural language processing techniques, the system can analyze children's questions or statements to pinpoint specific areas of difficulty. A robust knowledge base, coupled with machine learning algorithms, can enable the system to generate relevant and helpful responses.

Get the input from kids (Voice / Image) and Transfer it to Text Format is one of the sub objectives of this component. To create a truly effective and inclusive assistance system for children, it is imperative to adopt a multimodal approach to input. By enabling children to communicate through both voice and image, author can break down potential barriers and ensure that a wider range of children can interact with the

system effectively. Voice input, in particular, offers a natural and intuitive way for children to interact with technology. By incorporating speech-to-text technology, the system can convert spoken language into textual format for further processing. However, challenges such as variations in pronunciation, accents, and background noise can impact the accuracy of transcription. Advanced speech recognition algorithms, coupled with machine learning techniques, can help to mitigate these issues. Image input provides another valuable channel for children to express their needs and ideas. By allowing children to capture and upload images, the system can gain insights into their thought processes and provide more relevant assistance. Image recognition technology can be used to identify objects, scenes, or patterns within the image, enabling the system to interpret the child's intent.

A robust Knowledge-Based Agent (KBA) is essential for providing accurate and timely support to users. To achieve this, the system should be designed with flexibility and expandability in mind. The KBA's core components include a comprehensive knowledge base, a sophisticated inference engine, a natural language processing module, and a user-friendly interface. The knowledge base should be structured to allow for efficient information retrieval and updates. The inference engine should be capable of reasoning and drawing logical conclusions based on the stored knowledge. Natural language processing is crucial for understanding and interpreting user queries accurately. A well-designed user interface ensures seamless interaction and clear presentation of information.

# 9. Methodology

## 9.1. Methodology

The research initiative at K/Al-Aqsa Muslim Vidyalaya in Kandy aimed to bridge the digital divide by introducing programming concepts to students in grades 6 to 8. Despite the school's limited resources and infrastructure, strategic planning and resource allocation enabled the enhancement of its technological capabilities. Teachers were provided with necessary training, allowing them to effectively teach programming to young learners. The curriculum was designed with a hands-on, project-based approach, utilizing visual programming languages that made the concepts accessible and engaging.

The initiative significantly impacted students' engagement and learning outcomes. By integrating real-world examples, the program illustrated the relevance of programming, motivating students to delve deeper into the subject. As a result, many students expressed a newfound interest in technology and computer science, with some showing a desire to pursue further studies in these fields. The program also fostered critical thinking, problem-solving, and creativity, essential skills in the digital age.

This case study underscores the potential of introducing programming education in rural schools, even when facing significant challenges. It demonstrates that with appropriate planning, resource allocation, and teacher training, it is possible to create inclusive and effective learning environments that empower all students. The success of this initiative highlights the importance of addressing the digital divide and ensuring that every student, regardless of location, has access to the tools needed to thrive in the digital world.

Data can be categorized into two main types: qualitative and quantitative. Qualitative data captures the complexities of human experiences, opinions, and behaviors through non-numerical information, often collected via interviews, focus groups, and open-ended survey questions. In contrast, quantitative data involves numerical information that can be measured and analyzed statistically, typically gathered through structured surveys, experiments, and observational studies. The choice between qualitative and

quantitative methods depends on the research questions and the nature of the phenomena under investigation [15].

Researchers can obtain data from primary sources, collected firsthand for specific research purposes, or secondary sources, which include pre-existing information like academic articles, government reports, and datasets. The design of data collection instruments, such as questionnaires and interview guides, is critical to ensuring data quality; these instruments must be clear, concise, and aligned with research objectives while considering ethical implications, such as informed consent and participant privacy. Challenges in data collection, such as access to participants, response bias, and data quality issues, can be mitigated through strategies like random sampling, multiple data collection methods, and fostering a supportive environment for participants. Once collected, data is analyzed using statistical techniques for quantitative data or thematic analysis for qualitative data to identify patterns and insights, which are then interpreted in the context of the research questions, contributing to the broader knowledge in the field [15].

Questionnaires are a widely used and versatile data collection method in research, particularly in fields like social sciences, health, marketing, and education. They are structured tools designed to gather information from respondents through open-ended or closed-ended questions, allowing researchers to efficiently and cost-effectively collect data from large and diverse populations. A well-designed questionnaire begins with a clear introduction, explains the study's purpose, assures confidentiality, and provides instructions. Questions should be logically organized, with simple and non-sensitive questions leading to more complex or personal ones to encourage honest responses. The types of questions used—such as multiple-choice, Likert scale, and open-ended—enable both quantitative and qualitative analysis, capturing a range of data from straightforward statistics to nuanced insights. The ability to administer questionnaires in various formats, including online, paper-based, or via telephone, further enhances their reach and convenience, leading to potentially higher response rates. However, challenges like low response rates and the risk of socially desirable answers must be addressed through strategies like follow-up reminders and incentives, while careful analysis of both quantitative and qualitative data helps ensure

comprehensive and valid findings. Ultimately, questionnaires are an effective tool for gathering valuable insights, but their success depends on thoughtful design, administration, and analysis to ensure the reliability of the results [15].

Observation is a fundamental data collection method used across various fields such as social sciences, education, psychology, and market research, involving the systematic watching and recording of behaviors, events, or phenomena in their natural settings. This method yields rich, qualitative data that captures the complexity of real-life situations, making it invaluable for exploratory research where context and nuance are crucial. Observation is typically divided into participant and non-participant types; in the former, the researcher immerses themselves in the environment or community being studied, allowing for deeper insights into social dynamics and behaviors, albeit with potential bias due to their involvement. In contrast, non-participant observation involves observing from a distance without direct interaction, which helps minimize bias but may limit the understanding of the context and motivations behind observed behaviors. The observation process begins with defining research questions and developing an observational framework, ensuring systematic and focused data collection. One of the key advantages of observation is its ability to capture real-time behaviors and interactions within their natural context, providing a holistic understanding of the phenomena under study, such as revealing classroom dynamics in educational research that might not be captured through other methods like surveys [15].

However, observation also faces challenges, including observer bias and the Hawthorne effect, where participants alter their behavior because they are being watched. To address these issues, researchers can use techniques like employing multiple observers, standardizing observation methods through training, and maintaining detailed field notes. Data analysis in observational research typically involves qualitative techniques such as thematic analysis or grounded theory, though quantitative methods may also be applied when behaviors can be categorized or counted. Despite its challenges, observation remains a powerful tool for capturing the intricacies of behavior and interaction in their natural settings, contributing valuable

insights to exploratory research and studies focused on complex social phenomena [15].

Using a combination of questionnaires and observation for data collection provides a robust and comprehensive approach, capitalizing on the strengths of both methods while addressing their individual limitations. This mixed-methods strategy enhances the richness and validity of the data, offering a more nuanced understanding of the research topic. One significant advantage is the ability to triangulate data, where multiple sources or methods are used to cross-verify findings, thereby increasing the credibility and reliability of the results. For instance, questionnaires yield quantitative data on attitudes, beliefs, and self-reported behaviors, while observation offers qualitative insights into actual behaviors and interactions in real-world settings. Comparing these data sources allows researchers to identify consistencies and discrepancies, leading to a more comprehensive understanding of the phenomena under study and validating the overall conclusions [15].

Moreover, combining these methods captures both subjective and objective data, providing a dual perspective that enriches the analysis. Questionnaires often rely on self-reported information, which can be influenced by bias, whereas observation gathers objective data on actual behaviors, offering a more accurate depiction of reality. This approach also enables a flexible and adaptive research design, where initial questionnaire findings can inform the focus of subsequent observations, refining research questions and hypotheses. Additionally, this combination enhances participant engagement and response rates by offering a user-friendly experience through questionnaires and a dynamic data collection environment via observation. Ultimately, this integrated approach facilitates a deeper exploration of complex social phenomena, allowing researchers to uncover underlying patterns and dynamics that a single method might miss, thereby contributing to a more thorough understanding of the research topic [15].

The author has suggested a way to make a Customized Kids Assisting System using NLP technology. What is NLP. Natural Language Processing (NLP) is a part of artificial intelligence (AI) that looks at how computers understand and use human

language. It involves creating and using programs and systems that help machines understand, read, and create human language in a way that makes sense and is helpful. Human language is complicated because it has many details, sayings, and meanings that depend on the situation. This makes things hard for NLP (Natural Language Processing). NLP brings together ideas from language study, computer science, and machine learning to make tools that can understand and work with a lot of everyday language data. [16].

Natural Language Processing (NLP) has emerged as a transformative technology with wide-ranging positive impacts across various sectors. One of its most significant advantages is the enhancement of communication between humans and machines. By enabling computers to understand and process human language, NLP facilitates more intuitive interactions, making technology more accessible and user-friendly. For instance, voice-activated assistants like Siri and Alexa can comprehend spoken commands and respond conversationally, reducing the learning curve associated with traditional interfaces. This seamless integration of digital tools into everyday life allows individuals to interact with devices using natural language, improving user experiences across diverse applications [16].

Another notable benefit of NLP is its capacity to automate repetitive and time-consuming tasks, increasing efficiency and productivity across industries. Tasks such as data entry, document classification, and information extraction can be labor-intensive and prone to human error. NLP technologies streamline these processes by automatically analyzing and processing large volumes of text data, freeing up human workers to focus on more complex and creative tasks that require critical thinking and problem-solving skills. For example, organizations can use NLP algorithms to categorize emails, extract relevant information from contracts, or summarize lengthy reports, thereby reducing operational costs while enhancing overall productivity [16].

Moreover, NLP's ability to analyze vast amounts of unstructured text data has significant implications for decision-making and content generation. In a data-driven world, organizations are inundated with information from various sources, including social media, customer reviews, and survey responses. NLP can sift through this data

to extract valuable insights and sentiment, helping businesses make informed decisions and respond quickly to emerging trends. Additionally, NLP has revolutionized language translation and content generation, breaking down language barriers and saving time in creating high-quality written communication. Furthermore, NLP enhances accessibility for individuals with disabilities and personalizes user experiences, driving customer loyalty and inclusivity. As NLP technology continues to evolve, its potential benefits are likely to expand, shaping the future of human-computer interaction and transforming how we communicate and process information [16].

The author has decided to build a custom QA model which is based on NLP. How the NLP is good in QA models? Natural Language Processing (NLP) has revolutionized the development of Question Answering (QA) models by introducing advanced methodologies that enhance the way machines process and interpret human language. One of the key contributions of NLP to QA systems is the integration of advanced linguistic features that allow for a deeper understanding of syntax and semantics. By employing techniques such as dependency parsing and part-of-speech tagging, QA models can analyze the grammatical structure of questions and answers [16].

Natural Language Processing (NLP) is crucial in developing customized kids' assistance systems because it effectively processes and interprets natural language input, even in the variable and complex ways children express themselves. Unlike rule-based systems that depend on predefined rules and patterns, NLP models can accurately understand and respond to children's questions, even when they are phrased informally or unstructured. By leveraging NLP, these systems can consider the context of the conversation, adapting to different language styles and dialects, ensuring that a diverse range of children can benefit from its capabilities. This allows the system to provide more relevant and informative responses tailored to each child's specific needs [16].

In essence, NLP empowers these assistance systems to engage with children more naturally and intuitively, enhancing the learning experience by making it more enjoyable and effective. By understanding and responding to children's questions in a

language they are comfortable using, the system fosters a more supportive and engaging learning environment. This not only helps in delivering accurate information but also encourages active participation, creating a positive and personalized learning experience for each child [16].

Python's extensive library ecosystem is one of its greatest strengths, enabling developers to efficiently tackle a wide range of tasks across various domains. For data manipulation and analysis, Pandas and NumPy are essential, with Pandas offering powerful data structures like Series and DataFrame for structured data manipulation, and NumPy providing support for large, multi-dimensional arrays and matrices, making it crucial for performance-critical applications. Visualization needs are met by Matplotlib, which offers versatile plotting functions, and Seaborn, which simplifies the creation of statistical graphics. In the realm of machine learning and deep learning, Scikit-learn provides a comprehensive suite of algorithms, while TensorFlow and PyTorch cater to deep learning needs with their powerful and flexible architectures. For natural language processing (NLP), libraries like NLTK, SpaCy, and the Transformers library by Hugging Face offer robust tools for text processing and leveraging advanced pre-trained models [16].

Beyond data science, Python’s ecosystem supports web development with frameworks like Flask and Django, which cater to both lightweight and complex applications. Scientific computing is enhanced by libraries such as SciPy and SymPy, while image processing tasks are handled efficiently by Pillow and OpenCV. For web scraping, Beautiful Soup and Scrapy provide powerful tools for extracting data from websites. Testing is streamlined with frameworks like pytest and Unittest, which offer flexible and structured approaches to test automation. These libraries collectively elevate Python’s versatility, making it a preferred choice for applications ranging from data analysis and machine learning to web development and scientific computing, providing developers with the tools they need to build efficient and effective solutions [17].

In order to start to build custom QA model , there are so many frameworks available to build this model. Author has chosen the PyTorch. PyTorch is a free-to-use library

for machine learning that was created by the AI Research team at Facebook. It is mainly used for deep learning and is known for being flexible and easy to use. One of the best things about PyTorch is that it lets you change how calculations are done while the program is running. This is especially helpful for tasks that have different input sizes or complicated structures, like recurrent neural networks (RNNs) and some generative models. Unlike fixed computation graphs found in other frameworks, dynamic graphs allow for easier debugging and testing. This makes it simpler for researchers to make changes and improve their models [17].

PyTorch has become a leading choice for developing deep learning models, particularly because of its flexibility, efficiency, and dynamic computation graph capabilities. Built on a foundation of Python, PyTorch is highly accessible, with syntax that closely mirrors NumPy, allowing both beginners and experienced developers to quickly adapt. This design reduces the learning curve associated with new frameworks and supports a rich set of tensor operations crucial for building and training deep learning models. The framework's ability to execute these operations on both CPUs and GPUs provides significant performance improvements, particularly for large-scale computations [17].

One of PyTorch's standout features is its extensive ecosystem of libraries and tools. For instance, torchvision offers utilities for computer vision tasks, including pre-trained models and datasets, while torchaudio caters to audio processing and torchtext is tailored for natural language processing (NLP). This modular approach allows users to leverage specialized tools for different domains while maintaining a consistent interface, enhancing the framework's versatility. The integration with other popular libraries and frameworks, such as TensorBoard for visualization and ONNX for model interoperability, further broadens its applicability [17].

PyTorch's dynamic computation graph is a significant advantage, especially in research and experimentation. This feature allows the model's architecture to be modified on-the-fly, which is invaluable when working with variable-length sequences or complex architectures. The dynamic nature of PyTorch's computation graph simplifies debugging and model development, enabling researchers to implement and

experiment with novel algorithms more easily. This flexibility is crucial in a rapidly evolving field like deep learning [17].

Another key advantage of PyTorch is its robust support for distributed training and production readiness. As models and datasets grow in complexity, distributed training becomes essential, and PyTorch provides built-in functionalities to scale models efficiently across multiple GPUs or machines. The introduction of TorchScript allows models to be converted into a format suitable for production environments, minimizing dependencies and facilitating deployment in mobile or embedded systems. This adaptability ensures that PyTorch models can be effectively utilized in real-world applications [17].

PyTorch's strong community support and open-source nature contribute significantly to its effectiveness. The library benefits from a vibrant community that shares resources, tutorials, and research papers, keeping it updated with the latest advancements. The open-source model fosters collaboration, allowing users to contribute to its development and ensure that it meets the needs of its diverse user base. This collaborative environment accelerates the evolution of the framework and enhances its capabilities [17].

In summary, PyTorch's advantages are evident across various aspects, from its flexible and efficient tensor operations to its comprehensive ecosystem of libraries and strong community support. The dynamic computation graph, support for distributed training, and production readiness further solidify its position as a leading deep learning framework. These features make PyTorch an excellent choice for both research and practical applications, empowering users to develop innovative solutions in deep learning across multiple domains [17].

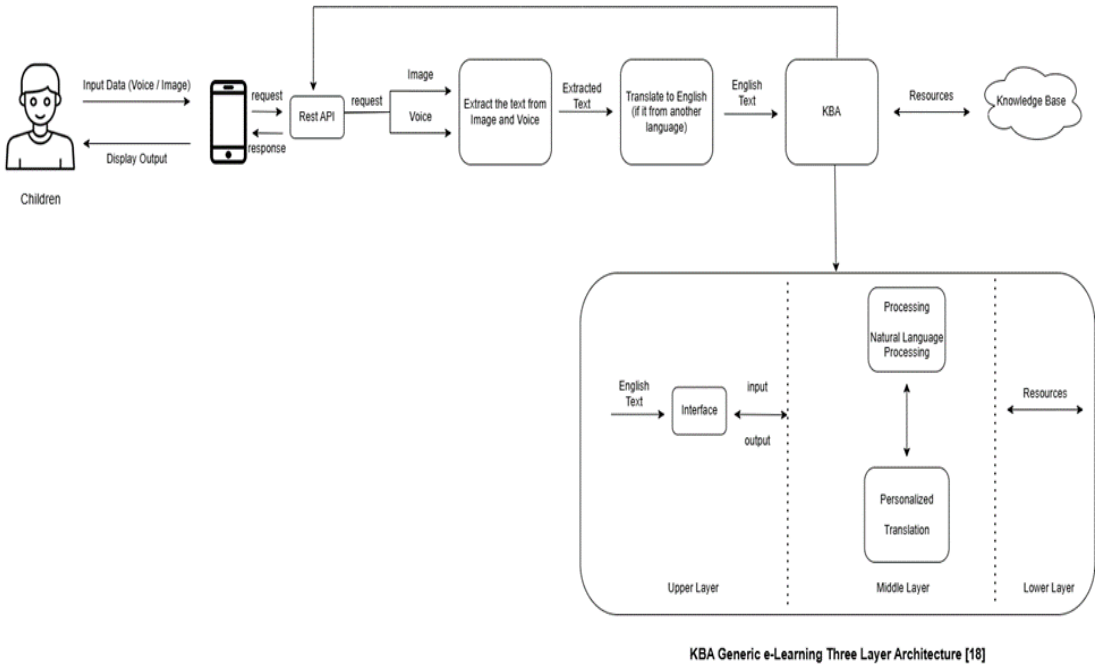


*Figure 1. Customized Kids Assisting System Diagram*

The above mentioned image (Figure 1) represents the system diagram of Customized Kids Assisting System. The diagram represents a Customized Kids Assisting System (CKAS) designed to provide personalized learning experiences for children. The system operates across three distinct layers: the Upper Layer, Middle Layer, and Lower Layer, each playing a crucial role in processing and responding to the child's interactions.

Starting with the Upper Layer, the child (referred to as "Kid" in the diagram) engages with the system using a mobile device. The child can input text, voice, or image data, which is captured by the mobile device's interface. This interface not only collects the input but also serves as the display for the output, ensuring the child can interact with the system effectively. The initial input can include a wide range of requests, such as asking questions, uploading images, or even communicating in different languages.

Once the input is captured, it moves into the Middle Layer, where initial processing occurs. If the input is in text or voice form, the system first processes any voice input through speech-to-text conversion, transforming spoken language into text. This text is then analyzed to determine if translation is needed—especially if the input is in a language other than the system’s primary language. For image inputs, the system uses

image recognition technology to extract meaningful data from the image. The recognized text or information is then processed by the AI model within the Middle Layer. This model is responsible for interpreting the input, accessing the necessary knowledge from a connected knowledge base, and generating an appropriate response. The AI model may include various subcomponents such as natural language processing (NLP) for text interpretation and contextual understanding. This ensures that the system can accurately grasp the child's intent and provide relevant feedback.

After processing in the Middle Layer, the system advances to the Lower Layer, where the final output is refined and personalized. In the Lower Layer, the AI model works on delivering a more tailored response. It may involve additional processing, such as further language translation if the child's preferred language differs from the one used in the Middle Layer. Additionally, personalized content or recommendations are generated in this layer, ensuring that the output is not only accurate but also suited to the child's learning style and preferences. This layer's focus on personalization makes the system highly adaptive to individual needs, enhancing the overall learning experience.

Finally, the output, which could be in the form of text, voice, or other multimedia, is sent back to the mobile device in the Upper Layer. Here, the child receives the response, which is displayed on the device. The response may also include links to additional resources or suggestions for further learning, ensuring that the interaction is both informative and engaging. This seamless flow from input to personalized output, across the layered architecture, highlights the system's capability to provide effective, customized educational assistance.

PyTorch, a popular deep learning framework, was chosen as the foundation for the customized kids' assistance system due to its flexibility, efficiency, and dynamic computational graph capabilities. Its ability to seamlessly integrate with other Python libraries and its strong community support made it an ideal choice for the Custom QA model in Middle Layer.

A feedforward neural network was built using PyTorch. This kind of neural network has layers of connected neurons. Each layer takes the information from the layer before

it and processes it. In this example, three fully connected layers were used, and each layer had a ReLU activation function added to make it non-linear. Batch normalization was added to the model to help make training more stable. This technique helps keep the activations stable during training by fixing the problem of changing distributions inside the network. Dropout regularization was used to avoid overfitting. Overfitting happens when a deep learning model gets too focused on the training data and doesn't do well on new data it hasn't seen before.

The final output layer of the neural network produced probability distributions over the possible classes. This means that the model generated probabilities for each potential answer, allowing for the selection of the most likely response based on these probabilities.

By leveraging PyTorch and this carefully designed neural network architecture, the Custom QA model was equipped with the necessary capabilities to effectively process natural language input, understand context, and generate accurate and informative responses.

The main model resides in the Middle Layer , Author has tested the two models those are Custom QA model and RASA chatbot. What is RASA chatbot? RASA is a open-source frameowork that helps people create chatbots and other programs that can have conversations. It gives developers a complete set of tools to make advanced chatbots that can understand and reply to users in a friendly and natural way. The framework has two main parts: RASA NLU, which helps the chatbot understand language, and RASA Core, which manages how the chatbot responds. Both parts work together to build the chatbot. [19].

RASA is a robust framework for building intelligent chatbots, composed of two main components: RASA NLU and RASA Core. RASA NLU focuses on interpreting user messages through intent classification and entity extraction. Intent classification determines the user's goal, such as booking a flight, while entity extraction identifies specific details like dates or locations within the message. This dual capability enables the chatbot to understand and respond accurately to user needs. RASA NLU utilizes

advanced machine learning algorithms and can integrate with libraries like spaCy to handle complex language structures and variations effectively [19].

On the other hand, RASA Core manages the flow of conversation by using a dialogue management model. It employs a state machine approach to maintain context across multi-turn dialogues, allowing the chatbot to handle extended interactions coherently. For instance, in customer support scenarios where users might ask multiple related questions, RASA Core ensures that responses remain relevant and contextually appropriate, enhancing the natural flow of conversation and user engagement [19].

A key advantage of RASA is its flexibility and customization options. Developers can tailor chatbot models to meet specific business needs and industry terminology. This includes crafting unique intents and entities that reflect the particular language used within a given field. For example, a healthcare chatbot can be trained to understand medical terms and patient-specific inquiries, ensuring accurate and contextually relevant responses [19].

Moreover, RASA supports custom actions—Python functions that execute specific tasks based on user inputs. This functionality allows for the integration of complex business logic, such as querying databases or calling external APIs. For example, a travel chatbot can manage booking requests, provide live updates, and send confirmations, all within the same conversational flow. This level of dynamic response capability significantly enhances the chatbot's usefulness and operational efficiency [19].

RASA also excels in integration with various messaging platforms, including Facebook Messenger, Slack, and WhatsApp. This cross-platform compatibility ensures that chatbots can reach users across their preferred communication channels, improving accessibility and interaction rates. Additionally, RASA’s ability to connect with external APIs and databases allows for real-time information retrieval, such as live stock prices or account details, which is critical for applications requiring up-to-date data [19].

The iterative nature of RASA's development process is another advantage. Developers can continuously refine chatbot models based on user interactions and feedback. This

data-driven approach leads to improvements in intent recognition and entity extraction, making the chatbot more effective and user-friendly over time. Analyzing conversation data helps in identifying common queries and potential areas for enhancement, ensuring that the chatbot evolves in line with user needs [19].

RASA's open-source nature further benefits developers by providing a customizable and extensible framework without the limitations often imposed by proprietary solutions. The vibrant community of developers and contributors supports this by offering resources, tutorials, and forums for collaboration and knowledge sharing. This community-driven support accelerates learning and innovation, while commercial support options are available for organizations requiring additional assistance [19].

Finally, RASA addresses security and data privacy concerns effectively. As an open-source framework, it allows organizations to retain control over their data and implement tailored security measures, such as encryption and access controls. This level of control is particularly important for industries dealing with sensitive information, ensuring compliance with regulations and safeguarding user data.

### 9.2. Commercialization aspects of the product

Implementing a subscription-based model for the CKAS presents a sustainable and effective approach to delivering personalized and high-quality educational experiences to children. By establishing a recurring revenue stream, this model ensures the system's continued development, maintenance, and accessibility.

Subscribers gain unrestricted access to the system's advanced features, fostering a consistent and uninterrupted learning experience. Personalized support and assistance can be tailored to individual needs, enhancing the effectiveness of the CKAS. Furthermore, the subscription model enables continuous improvement through data collection and feedback analysis, ensuring the system remains relevant and effective.

To cater to diverse needs and budgets, the CKAS can offer multiple subscription tiers with varying levels of features and access. Flexible pricing options, such as monthly or annual plans, can be implemented to accommodate different financial capabilities.

A dedicated customer support team can address user inquiries, troubleshoot issues, and provide guidance, fostering a positive relationship with subscribers.

In conclusion, a subscription-based model offers a sustainable and effective approach for delivering the CKAS to children and educators. By providing continuous access, personalized support, and ongoing improvements, this model can significantly enhance the learning experience and contribute to the educational development of young learners.

To cater to diverse user needs and budgets, the CKAS can be offered in multiple subscription tiers, each providing distinct levels of access and functionality. This tiered approach enables users to select the plan that best aligns with their requirements and financial capabilities.

The Basic Tier of the Customized Kids Assisting System (CKAS) offers a solid foundation for users to explore the platform's core functionalities. This entry-level subscription provides access to essential features such as language translation, text-to-speech, and image recognition. These tools enable children to interact with the system effectively and receive personalized feedback. The Basic Tier also includes access to a carefully curated knowledge base, offering foundational information and resources. While the scope of the knowledge base may be limited compared to higher tiers, it provides a valuable starting point for users to explore and learn. By subscribing to the Basic Tier, users can familiarize themselves with the CKAS platform and determine if it aligns with their needs and learning goals. This entry-level subscription offers a cost-effective way to experience the benefits of the system without committing to a higher-tier subscription.

The Standard Tier of the Customized Kids Assisting System (CKAS) builds upon the foundation provided by the Basic Tier, offering a broader range of features and capabilities. This tier is designed to cater to users who require a more comprehensive educational tool and seek to advance their learning. Users of the Standard Tier will have access to a more extensive knowledge base, covering a wider range of topics and providing deeper insights. Additionally, sophisticated NLP algorithms will be

employed to enhance the system's ability to understand and respond to complex queries and prompts.

The Standard Tier also introduces customization options, allowing parents or educators to tailor the learning experience to the child's specific needs or curriculum. This flexibility ensures that the system can adapt to individual learning styles and preferences.

In summary, the Standard Tier offers a robust set of features that make it ideal for users who require a more comprehensive and personalized educational experience. By subscribing to the Standard Tier, users can benefit from expanded access to knowledge, advanced NLP capabilities, and customization options.

The Premium Tier of the Customized Kids Assisting System (CKAS) offers the most extensive range of features and services, catering to users who seek a personalized and comprehensive educational experience. This tier leverages advanced AI algorithms to provide tailored learning experiences, ensuring that content and recommendations align with each child's individual needs and preferences.

Premium subscribers gain access to exclusive content, including educational games, interactive lessons, and expert-curated learning paths. This rich and engaging content enhances the learning experience and fosters a love of learning. Additionally, the Premium Tier offers real-time translation across multiple languages, making it accessible to a wider range of users. Priority support is another key benefit of the Premium Tier. Users can expect their questions and concerns to be addressed promptly, ensuring a seamless and positive learning experience. Detailed progress tracking reports provide valuable insights into a child's performance, allowing parents and educators to monitor their progress and identify areas for improvement.

The Premium Tier is designed for users who are deeply invested in their child's education and seek the most comprehensive and effective learning experience. Schools, tutors, and parents who prioritize personalized learning and support can benefit greatly from the advanced features offered in this tier.

A key advantage of the subscription-based model is the ability to fund ongoing development and enhancements of the Customized Kids Assisting System (CKAS). This ensures that the system remains current, relevant, and effective in meeting the evolving needs of users. Regular updates can introduce new features, improve existing functionalities, and ensure that the CKAS aligns with the latest educational standards and technologies. For instance, advancements in artificial intelligence (AI) and natural language processing (NLP) can be seamlessly integrated into the system to enhance its capabilities and provide a more personalized and engaging learning experience.

By investing in continuous development, the CKAS can stay at the forefront of educational technology, offering users access to cutting-edge tools and resources. This commitment to innovation helps to ensure that the system remains valuable and relevant to its users over time. Subscription revenue can be a powerful catalyst for the growth and development of the Customized Kids Assisting System (CKAS). By investing a portion of the revenue back into the system, it is possible to expand the knowledge base, incorporate new topics, languages, and educational resources, ensuring that the platform remains relevant and effective in meeting the diverse needs of children worldwide.

A continuously expanding knowledge base is essential for providing comprehensive and up-to-date information to users. By incorporating new topics, the CKAS can cater to a wider range of interests and learning objectives. Additionally, expanding the system to support multiple languages can make it accessible to a global audience, fostering inclusivity and breaking down language barriers. Furthermore, integrating educational resources from various fields, such as science, math, history, and literature, can enrich the learning experience and provide a well-rounded education. By staying current with the latest educational trends and research, the CKAS can ensure that it remains a valuable tool for children's learning and development.

In summary, the subscription-based model not only provides a sustainable revenue stream but also enables the CKAS to evolve and adapt to changing needs. By investing in the expansion of the knowledge base and incorporating new features, the system can remain a valuable resource for children and educators worldwide.

A subscription-based model for the Customized Kids Assisting System (CKAS) offers a significant advantage: the ability to create personalized learning paths tailored to each child's individual needs. By leveraging advanced algorithms and data analysis, the system can adapt to a child's learning style, pace, and interests, providing a truly customized learning experience. For instance, if a child demonstrates a strong aptitude for language learning, the CKAS can introduce more complex language tasks and challenges to keep them engaged and motivated. Conversely, if a child struggles with a particular subject, the system can provide additional support, such as targeted explanations, practice exercises, or supplementary resources.

By continuously adapting to a child's progress and preferences, the CKAS can ensure that the learning experience remains relevant, engaging, and challenging. This personalized approach helps to maximize each child's potential and foster a love of learning. The CKAS's ability to create personalized learning paths extends beyond the child's direct interaction with the system. By tracking a child's progress, the system can provide valuable insights to parents and educators.

Detailed reports and analysis can show where the child is doing well and where they might need more help. This data-focused method helps parents and teachers make smart choices about a child's education. By knowing what the child is good at and what they struggle with, they can adjust how they help the child to give better support. Also, what we learn from the CKAS can help find learning problems or topics of interest that might not show up with regular ways of testing. This information can help make future learning plans and make sure the child gets the right support to do their best.

To make the Customized Kids Assisting System (CKAS) accessible to a wider range of users, offering flexible payment options is essential. This allows individuals and families with varying financial capabilities to benefit from the system's educational advantages.

The CKAS can offer multiple subscription tiers, including monthly, quarterly, and annual plans. This flexibility allows users to choose the option that best suits their budget and commitment level. Additionally, discounts or incentives can be provided for longer-term commitments, encouraging users to invest in the system for extended

periods. To minimize risk and provide an opportunity for users to experience the CKAS firsthand, a free trial period can be offered. This allows potential subscribers to explore the system's features, assess its suitability for their needs, and make an informed decision about subscribing.

By offering flexible payment options, the CKAS can attract a wider audience and ensure that the system's benefits are accessible to individuals and families with diverse financial circumstances. To cater to families with multiple children, the Customized Kids Assisting System (CKAS) can introduce a family plan. This plan would offer discounts for multiple user accounts under a single subscription, making it more affordable for families with multiple children who wish to benefit from the system.

Additionally, the CKAS can explore group pricing options for schools and educational institutions. By providing discounts or bulk pricing for multiple licenses, the system can be made more accessible to educational institutions that wish to integrate the CKAS into their curriculum.

These pricing strategies can help to increase the reach of the CKAS and make it a more affordable option for a wider range of users. By offering discounts and incentives for multiple users, the system can encourage adoption among families and educational institutions, ultimately benefiting a larger number of children.

Subscribers to the Customized Kids Assisting System (CKAS) would benefit from a comprehensive support system designed to address their needs and questions effectively. Various support channels, such as email, chat, and phone support, would be available to assist users with any issues or queries they may encounter.

For premium subscribers, priority support would be offered, ensuring that their concerns are addressed promptly and efficiently. This personalized assistance can be invaluable in providing timely solutions and ensuring a positive user experience. In addition to individual support, the CKAS could foster a vibrant community of users. A dedicated online forum or community platform could allow subscribers to connect, share experiences, and seek help from other users. This sense of community can enhance the overall learning experience and create a supportive environment for children and parents.

### 9.3. Testing & Implementation

The testing phase of the Customized Kids Assisting System (CKAS) began with a pilot implementation at K/Al-Aqsa Muslim Vidyalaya, focusing on students in grades 6 to 8. This demographic was chosen strategically, as young adolescents represent a key target group for personalized learning tools. During this phase, the students were provided with access to the CKAS on their mobile devices, allowing for real-time interaction and engagement with the system's features. The children were encouraged to explore the platform's capabilities, including language translation, text-to-speech, image recognition, and personalized content delivery. By observing the students' interactions with the CKAS, valuable insights were gathered regarding its usability, effectiveness, and areas for improvement. The data collected during this phase served as a crucial foundation for refining and optimizing the system.

The testing phase of the Customized Kids Assisting System (CKAS) was designed to comprehensively evaluate various aspects of the platform's functionality and effectiveness. Key areas of focus included the user interface (UI) and user experience (UX), the accuracy and responsiveness of the AI model, the effectiveness of the knowledge base, and the overall educational value provided by the platform.

By closely monitoring children's interactions with the CKAS, researchers were able to identify any usability issues, assess the system's performance, and gather valuable insights for improvement. The system's ability to process different types of input, generate accurate responses, and support the learning process was rigorously evaluated. Through this comprehensive testing, the CKAS was refined and optimized to ensure that it met the needs of its users and provided a valuable educational experience. The insights gained from this phase were instrumental in shaping the future development and improvement of the system.

Following the testing phase, it was essential to solicit feedback directly from the children who used the Customized Kids Assisting System (CKAS). This feedback provided invaluable insights into the actual user experience from the perspective of the target demographic.

A child-friendly approach was adopted to ensure that students felt comfortable sharing their thoughts and suggestions. Open-ended questions and a relaxed atmosphere were created to encourage honest and candid feedback. The children were asked about their experiences with the system, including what they liked, what they found challenging, and any missing features or suggestions for improvement.

By actively seeking feedback from the children, the development team could identify areas where the CKAS could be enhanced to better meet their needs and preferences. This feedback was crucial for refining the system and ensuring that it remained relevant and engaging for its young users. The feedback gathered from the children using the Customized Kids Assisting System (CKAS) provided valuable insights for improvement. Key areas of focus included the ease of use of the system, the relevance and clarity of the content, the effectiveness of language and image recognition, and the overall satisfaction with the learning experience. Children's feedback on the system's usability helped identify any areas where the interface could be improved for easier navigation and understanding. The relevance and clarity of the educational content were also evaluated to ensure it aligned with the children's needs and learning styles. The effectiveness of the language and image recognition features was assessed to identify areas for improvement in accuracy and responsiveness.

Overall, the feedback collected provided valuable insights into the system's strengths and weaknesses, allowing the development team to refine the CKAS and ensure that it met the needs and preferences of its young users.

Based on the comprehensive feedback received from the children, the implementation phase of the Customized Kids Assisting System (CKAS) commenced with the aim of enhancing the system's functionality, usability, and educational impact. The development team carefully reviewed the feedback to identify common themes and specific areas that required improvement. By analyzing the children's suggestions, the team was able to prioritize areas for refinement and ensure that the CKAS was tailored to meet their needs.

One of the key areas of focus during implementation was improving the user interface to make it more intuitive and accessible for children. This involved simplifying

navigation, enhancing visual cues, and ensuring that system prompts and instructions were clear and easy to follow. By making the interface more user-friendly, the CKAS became more engaging and enjoyable for children to use. Additionally, the AI model was fine-tuned to better interpret the inputs and generate more accurate and relevant responses. This involved updating the algorithms used for natural language processing and image recognition, as well as expanding the knowledge base to cover a broader range of topics and queries.

The implementation phase also saw the introduction of new features and content based on the children's suggestions. By incorporating features that resonated with the students, the CKAS was further enhanced to meet their specific needs and interests. This helped to keep children engaged and motivated to learn.

Overall, the implementation phase was crucial for ensuring that the CKAS was a valuable and effective tool for children. By carefully considering and addressing the feedback received, the development team was able to refine the system and create a more engaging and personalized learning experience.

# 10. Results & Discussion

## 10.1. Results

The development of the Customized Kids Assisting System (CKAS) involved the careful selection and implementation of appropriate machine learning models. Two primary models were considered and evaluated: the RASA open-source model and a custom NLP QA model.

RASA is a popular open-source framework for building conversational AI systems. It offers a comprehensive set of tools for natural language understanding, dialogue management, and machine learning. By leveraging RASA, the CKAS could benefit from a well-established and widely used platform with a strong community and extensive documentation.

To address the specific requirements of the CKAS, a custom NLP QA model was developed. This model was tailored to the unique characteristics of children's language and the specific domain of educational content. By training the model on a large dataset of relevant questions and answers, the system could be optimized for providing accurate and informative responses to children's queries.

Both models were rigorously evaluated to determine their suitability for the CKAS. Factors such as accuracy, efficiency, and adaptability were considered. The evaluation process involved training the models on relevant datasets, testing their performance on unseen data, and comparing their results.

Ultimately, the decision to use the custom NLP QA model was based on its superior performance in handling children's language patterns and providing more accurate and relevant responses. The custom model was better able to capture the nuances of children's language and generate responses that were tailored to their specific needs.

The testing accuracy of the RASA model consists of two crucial components that together provide a comprehensive evaluation of the model's effectiveness. The first component is the cross-validation accuracy, which gauges the model's performance by dividing the dataset into multiple subsets and testing the model on each subset. This

method helps ensure that the model's accuracy is not just limited to a specific portion of the data but is consistent across various segments, thereby providing a more reliable assessment of its overall performance.

The second component is the entity evaluation score, which specifically measures the model's proficiency in accurately identifying entities within the text. Entities are key pieces of information, such as names, dates, or locations, that the model needs to recognize and classify correctly. The entity evaluation score reflects the model's ability to detect these entities accurately, which is critical for applications where understanding and processing specific details in the text are essential. Together, these two components: cross-validation accuracy and entity evaluation score—offer a detailed picture of the RASA model's testing accuracy, highlighting both its general performance and its precision in identifying specific entities within the data.

The cross-validation accuracy achieved by the RASA model was 0.840, indicating a strong and consistent performance across different subsets of the dataset used for testing. This value suggests that the model is reliably accurate in predicting outcomes, with an 84% accuracy rate when evaluated on varied portions of the data. The cross-validation accuracy achieved by the RASA model was 0.840, indicating a strong and consistent performance across different subsets of the dataset used for testing. This value suggests that the model is reliably accurate in predicting outcomes, with an 84% accuracy rate when evaluated on varied portions of the data.

Furthermore, the entity evaluation score was exceptionally high, reaching 0.991, which underscores the model's remarkable ability to correctly identify and classify entities within the text. This score reflects a near-perfect level of precision in recognizing key pieces of information, achieving an impressive 99.1% accuracy in this specific task.

On the other hand, the custom NLP QA model achieved a notable testing accuracy of 0.9152, indicating its strong performance when evaluated on unseen data. This level of accuracy suggests that the model is effective in correctly answering questions and handling tasks in a real-world testing environment. Additionally, the model recorded

a training accuracy of 0.9068, reflecting its capability to learn from the training data with high precision, though slightly lower than its testing accuracy.

Despite the RASA model's impressive metrics, including a higher training accuracy and an outstanding entity evaluation score, it falls short in terms of customizability. While RASA excels in certain standardized tasks, its lack of flexibility prevents it from being fully tailored to meet the author's specific requirements. The custom NLP QA model, although not as highly rated in some aspects, offers the adaptability needed to better align with the particular goals and needs of the project.

The custom NLP QA model, while exhibiting a slightly lower training accuracy than some other models, offers the essential flexibility needed to tailor responses and functionalities to better suit the unique requirements of the Customized Kids Assisting System. This adaptability allows the model to be fine-tuned and customized in ways that standard models, despite their higher accuracy, may not be able to achieve. The ability to modify and adjust the model's behavior ensures that it can meet the specific demands of the application, providing more relevant and contextually appropriate responses, thereby enhancing the overall effectiveness and user experience of the system.

Additionally, it was observed that the children preferred the custom NLP QA model not only for its customizability but also for its faster response times. The ability to quickly and effectively generate responses made the learning experience more engaging and fluid, allowing children to interact with the system seamlessly. This preference highlights the importance of both adaptability and efficiency in educational tools, as the custom NLP QA model was able to meet the specific needs of the system while also enhancing the overall user experience through its swift and responsive performance.

The comparison of the two models revealed a significant difference in response times. The RASA model took an average of 3.13 seconds to respond through the REST API, which, while functional, could lead to noticeable delays in real-time interactions. In contrast, the custom NLP QA model responded in just 673 milliseconds, demonstrating a much faster processing speed. This substantial reduction in response

time made the custom model far more efficient, allowing for quicker interactions and a smoother user experience, particularly important in educational settings where immediate feedback can enhance engagement and learning outcomes.

This significant improvement in response time made the custom NLP QA model more appealing to the young users, as it provided a quicker and more efficient interaction experience. The ability to receive almost instantaneous responses made the learning process more dynamic and engaging for the children, reducing any frustration or delays that might occur with slower systems. This quick responsiveness not only enhanced the overall user experience but also contributed to maintaining the children's interest and motivation while using the system, making the custom NLP QA model a preferred choice among the young users.

The custom NLP QA model, despite its slightly lower training accuracy compared to some other models, was ultimately chosen for its superior performance in several key areas. Its ability to offer more personalized and adaptable assistance to young learners was a crucial factor in its selection.

Flexibility and Customization: One of the key advantages of the custom model is its adaptability. It can be fine-tuned to meet the specific needs and preferences of young learners, ensuring that the responses are relevant and engaging. This flexibility allows the model to be tailored to different learning styles, pacing, and subject matter.

Faster Response Times: In educational settings, quick feedback is essential for maintaining children's engagement and motivation. The custom NLP QA model's significantly faster response times compared to the RASA model were a major factor in its selection. This allowed for more interactive and dynamic learning experiences.

Personalized Support: The custom model's ability to provide tailored responses based on individual learning styles and requirements was another key advantage. By understanding each child's unique needs, the model could offer more relevant and helpful support, enhancing the overall learning experience.

In conclusion, the custom NLP QA model's combination of flexibility, speed, and personalization made it the ideal choice for the Customized Kids Assisting System. By

leveraging this model, the system was able to provide a more effective and engaging educational experience for young learners.

## 10.2. Research Findings

Cross-validation accuracy is essential for developing natural language understanding (NLU) models in RASA, as it measures the model's ability to generalize from training data to unseen inputs. This ensures that the chatbot can accurately interpret and respond to real-world user queries, avoiding overfitting and improving overall performance.

The process involves dividing the training dataset into multiple subsets through k-fold cross-validation, where the model is trained on k-1 folds and validated on the remaining fold. This method allows for a comprehensive evaluation of the model's performance across different data distributions, ensuring it is not just memorizing the data but making accurate predictions on new inputs.

RASA's implementation of cross-validation supports flexibility in the number of folds, allowing developers to optimize the process based on dataset size and computational resources. The model's accuracy is calculated by averaging the results from each fold, providing a robust measure of performance.

To further enhance cross-validation accuracy, techniques like stratified sampling can be employed to maintain the same class distribution across folds. This is particularly useful for datasets with underrepresented classes, as it prevents evaluation bias and ensures a more reliable assessment.

In addition to cross-validation, RASA provides various evaluation metrics such as confusion matrices and classification reports, offering insights into the model's strengths and weaknesses. These tools help developers identify areas for improvement, refining training data and adjusting model parameters for better performance.

RASA's user-friendly interface and command-line tools streamline the cross-validation process, allowing developers to quickly configure experiments, specify

evaluation metrics, and visualize results. This supports an iterative approach to model development, promoting continuous improvement.

In summary, cross-validation accuracy is a crucial aspect of building effective NLU models in RASA, ensuring the model can generalize well to new data and providing valuable insights for ongoing optimization.

Entity evaluation score is a key metric in RASA, focusing on the effectiveness of the entity recognition component within an NLU model. This score measures how well the model identifies and extracts relevant entities, such as names, dates, and locations, from user inputs. Accurate entity extraction is crucial for enabling the chatbot to provide contextually appropriate responses.

RASA typically uses a confusion matrix to evaluate entity recognition. This matrix provides a detailed breakdown of true positives, false positives, and false negatives for each entity class, helping developers identify areas where the model performs well or needs improvement. If specific entities are frequently misclassified, targeted adjustments to the training data or model parameters can enhance performance.

Entity evaluation in RASA is conducted across different datasets—training, validation, and test sets. Comparing scores across these datasets helps developers identify potential overfitting, ensuring the model can generalize to unseen data and perform effectively in real-world scenarios.

RASA also allows for customization in the evaluation process. Developers can define custom entity types and tailor evaluation metrics to meet the specific needs of their application, ensuring the assessment is relevant to the chatbot's context.

Beyond quantitative metrics, RASA supports qualitative analysis, allowing developers to review individual predictions and ground truth labels. This analysis can uncover patterns in misclassifications, guiding further refinements in training data and model architecture.

RASA’s integration with visualization tools enables graphical representation of entity evaluation scores, making it easier to interpret results and track performance trends

over time. Visualizations help communicate findings to stakeholders and provide a clear picture of the system's evolution.

In summary, the entity evaluation score in RASA is a comprehensive metric that assesses the precision, recall, and F1 score of entity recognition within an NLU model. By leveraging confusion matrices, customization, qualitative analysis, and visualization, developers can gain deep insights into model performance and enhance the chatbot's ability to deliver accurate, context-aware responses.

Testing accuracy in a PyTorch neural network model is a critical step in assessing how well the model generalizes to unseen data. This process typically begins by evaluating the model on a separate dataset, known as the test or validation set, which was not used during training. This ensures the accuracy measurement reflects the model’s ability to generalize, rather than its performance on the training data, and helps mitigate issues like overfitting.

Once the test set is prepared, the trained model is loaded and set to evaluation mode using model.eval(). This step disables certain layers like dropout and adjusts batch normalization behavior, ensuring consistent and stable predictions during inference. Evaluation mode is crucial for obtaining an accurate representation of the model's performance.

The test data is then passed through the model in batches, optimizing memory usage and computational efficiency. During this process, gradient computation is disabled using torch.no_grad(), which speeds up the evaluation and reduces memory consumption since gradients are unnecessary during inference.

The model's accuracy is calculated by comparing its predictions to the true labels in the test set. Accuracy is simply the proportion of correct predictions out of the total number of predictions, providing a straightforward measure of performance. However, in cases of imbalanced datasets, additional metrics like precision, recall, and F1-score can offer deeper insights into the model's behavior, particularly in evaluating specific classes where errors might have significant consequences.

Visual tools like confusion matrices further enhance understanding of the model's strengths and weaknesses by providing a detailed breakdown of predictions across different classes. This visualization helps identify specific areas for improvement, guiding adjustments in model architecture, data augmentation, or training strategies.

It’s also important to consider the broader context of testing accuracy. High test accuracy does not guarantee real-world performance due to potential issues like data distribution shifts, noise, or adversarial examples. Therefore, complementing accuracy testing with robust validation techniques, such as cross-validation, and monitoring the model’s performance in production environments is essential for reliable deployment.

In summary, testing accuracy in a PyTorch neural network involves preparing a separate test set, evaluating the model in inference mode, calculating accuracy and other relevant metrics, and considering broader factors that impact real-world performance. This systematic approach provides valuable insights, enabling informed decisions for further model improvements and successful deployment.

Training accuracy in a PyTorch neural network model is a key metric that indicates how well the model is learning from the training data. It reflects the model's ability to fit the data and is crucial for diagnosing issues like underfitting or overfitting. Understanding how to calculate and interpret this metric is essential for managing the training process effectively.

The training process begins with preparing a large and varied dataset of labeled examples, which is used to teach the model the underlying patterns and relationships in the data. During training, the model makes predictions based on the input data, and these predictions are compared to the actual labels to identify errors. The loss function quantifies the difference between the predicted and actual results, guiding the optimization process. Common loss functions include cross-entropy loss for classification and mean squared error for regression tasks.

To compute training accuracy, the model is set to training mode using model.train(), which enables specific layers like dropout and batch normalization to function correctly during training. The model processes the training dataset in batches, making

predictions for each batch. Training accuracy is then calculated as the proportion of correct predictions out of the total number of predictions made for that batch.

Monitoring training accuracy can provide insights into the model's learning dynamics. A steady increase in training accuracy suggests effective learning, while a plateau or decrease may indicate problems like an excessively high learning rate or an overly simplistic model. Observing these trends helps in making informed adjustments to the model architecture, learning rate, or other hyperparameters.

The relationship between training accuracy and validation accuracy is also crucial. High training accuracy is desirable, but it’s important to avoid overfitting, where the model memorizes training data instead of generalizing from it, leading to poor performance on new data. Techniques like early stopping and regularization can help mitigate overfitting by halting training when validation accuracy ceases to improve or by penalizing overly complex models.

Visualizing training and validation accuracy over time can further aid in understanding the model's performance. These plots can reveal trends such as convergence, gaps between training and validation accuracy that suggest overfitting, or signs of underfitting when both accuracies are low. Such visualizations offer a more intuitive grasp of the model's behavior and guide further experimentation.

In summary, training accuracy is a critical metric in PyTorch neural networks, reflecting the model's ability to learn from the training data. By carefully monitoring and interpreting training accuracy alongside validation accuracy and other factors, practitioners can gain valuable insights into the model’s learning process and make informed decisions to optimize performance.

### 10.3. Discussion

For future research, the author intends to integrate advanced GPT models to enhance the clarity and detail of explanations provided to children. The incorporation of these sophisticated models aims to offer more nuanced and comprehensible explanations tailored to young learners. By leveraging the capabilities of advanced GPT models, the

research seeks to provide real-time assistance and guidance to students, thereby facilitating a more interactive and supportive learning experience.

The use of advanced GPT models has the potential to significantly improve the quality of educational content delivered to children. These models can generate explanations that are not only more precise but also more accessible, catering to the varying levels of understanding among students. This real-time support will enable children to receive immediate answers and clarifications, helping them to better grasp complex concepts and navigate educational challenges more effectively.

Moreover, the implementation of these models aims to personalize the learning experience by adapting responses to the individual needs and learning styles of students. This approach will provide a dynamic and responsive educational tool that can guide students through their learning journey, addressing their specific questions and providing tailored explanations. As a result, the integration of advanced GPT models is expected to enhance educational outcomes by offering a more engaging, supportive, and individualized learning environment for children.

The current research, conducted within a single educational institution focusing on Tamil-medium students in grades 6 to 8, presents certain limitations that must be carefully considered. The relatively small sample size may not adequately represent the broader student population across different schools and regions in Sri Lanka. This limitation restricts the generalizability of the findings, potentially overlooking the diverse educational needs and experiences of students outside the immediate study group.

Moreover, the research is exclusively centered on Tamil-medium education, which further narrows its applicability. Tamil-medium schools cater to a specific linguistic and cultural demographic, thereby excluding students who are educated in Sinhala-medium institutions. This linguistic limitation means that the study's insights may not fully address the challenges and needs faced by students who receive instruction in other languages. The findings derived from Tamil-medium students may therefore lack relevance to those in Sinhala-medium or other linguistic contexts.

Considering these limitations, future research is planned to address these gaps by expanding the scope of the study. This involves broadening the research to include students from Sinhala-medium schools, which will help in understanding the educational dynamics and challenges faced by a more diverse student population. By incorporating a wider range of linguistic backgrounds, future research aims to provide a more comprehensive analysis of the educational interventions and their effectiveness. Additionally, increasing the sample size will allow for a more robust and representative examination of the research questions, enhancing the generalizability and relevance of the findings. This expanded approach will contribute to a more inclusive understanding of educational strategies and their impact, benefiting a larger and more varied group of students.

The author's primary contribution lies in addressing the critical question of "How to assist kids when they encounter doubts during their learning process?" To tackle this challenge, the author has developed a solution in the form of a Customized Kids Assisting System. This system is designed to provide tailored, real-time support to children as they navigate through their educational journey. By leveraging advanced technologies and personalized learning algorithms, the system can identify when a child is struggling with a particular concept or question and deliver precise, understandable explanations that cater to the child's unique learning style and level of comprehension. The Customized Kids Assisting System not only aims to clarify doubts as they arise but also to reinforce understanding by offering contextualized guidance that builds on the child's existing knowledge base. This proactive and adaptive approach ensures that children receive the support they need, precisely when they need it, thereby enhancing their learning experience and fostering greater confidence and independence in their educational endeavors

### 10.4. Summary of Each Student’s Contribution

The author Sanjeewan M.C.M.A.’s contribution is the development of an interactive mobile application aims to enhance the gamified learning of fundamental programming concepts through the use of personalized storytelling, supported by native language options. Central to this initiative is the Personalized Story Generation

Module, which crafts tailored narratives that seamlessly integrate programming lessons, making the content more relatable and engaging for each learner. Complementing this are several key subcomponents: the MCQ Generation Module, which creates contextually relevant multiple-choice questions to reinforce learning; the Hint Generation Module, which provides strategic, context-sensitive hints to guide students toward the correct solutions; and the Feedback Generation Module, which delivers personalized, constructive feedback to help learners understand and learn from their mistakes. Together, these components create a comprehensive and adaptive educational experience that not only teaches programming concepts but also supports and encourages learners throughout their journey.

The author Lakpriya K.H.A.V's contribution is the Level-based IT Fundamental Knowledge Evaluation component is designed to create a personalized evaluation system that uses machine learning to enhance young learners' understanding of IT concepts. This system establishes a structured assessment framework with gradually increasing levels of difficulty, allowing students to build their knowledge step by step. By developing machine learning models, the system can analyze each student's performance and tailor the evaluation process to their individual needs, ensuring that assessments and feedback are both relevant and effective. Additionally, the system incorporates a comprehensive data collection and analysis mechanism, which continuously monitors students' progress and adjusts the difficulty of content or provides additional support where needed. This approach ensures that learners receive personalized, adaptive, and evolving evaluations that help them achieve a deeper understanding and mastery of IT fundamentals.

The author Dissanayake A. L.'s contribution is the project-based programming learning app aims to assess the improvement in practical application and group problem-solving abilities among elementary school students. By generating quizzes and projects, verifying answers, designing a user-friendly interface, and evaluating the overall impact, the app aims to provide valuable insights into the effectiveness of project-based learning in enhancing students' programming skills and overall educational experience.

## 11. Conclusion

In simple terms , the summery of this research is  the development of an interactive mobile application designed to enhance the gamified learning of fundamental programming concepts through personalized storytelling. The application features a Personalized Story Generation Module that crafts tailored narratives, seamlessly integrating programming lessons to make the content more relatable and engaging. Accompanying this are key subcomponents, such as a module for generating contextually relevant multiple-choice questions (MCQs), a Hint Generation Module providing strategic, context-sensitive hints, and a Feedback Generation Module delivering personalized feedback to help learners understand and correct their mistakes. Together, these components create a comprehensive and adaptive educational experience, making programming concepts accessible and engaging for young learners.

In addition to the gamified learning aspects, the project also includes a personalized evaluation system that uses machine learning to assess and enhance young learners' understanding of IT concepts. This system employs a level-based approach, gradually increasing the difficulty to build knowledge incrementally, while continuously analyzing students' performance to tailor the evaluation process to individual needs. A project-based learning app is also included, aimed at improving practical application and group problem-solving skills among students through quizzes, projects, and a user-friendly interface. Moreover, a customized kids' assistance system is developed to provide real-time support by breaking down complex problems into manageable steps, promoting critical thinking, and incorporating features like input processing and translation to make learning more accessible and engaging.

In this research, the authors got to explore and try out new technologies that could change many industries, including Natural Language Processing (NLP). NLP, which stands for Natural Language Processing, is a fast-growing area of artificial intelligence. It is commonly used in online shopping, banking websites, and many other fields where understanding and creating human language can make things better for users and improve how things work. By looking into NLP and other new

technologies, the authors used these new tools in their research, getting practical experience with the latest methods and tools in technology. This not only expanded their work but also gave useful ideas on how these technologies can be used to solve real-life problems, likely leading to big improvements in different areas.

The research conducted with students in grades 6 to 8 demonstrated that even young learners are capable of grasping fundamental programming concepts when provided with the right tools and methodologies. The study proved that these students could successfully absorb and apply the knowledge imparted through the system, validating the effectiveness of the educational approach used. Given the success of this initial phase, the authors see the potential for significant expansion by enhancing the system to support multiple languages spoken in Sri Lanka. By making the system multilingual, it could reach a much broader audience across the country, enabling a larger number of children from diverse linguistic backgrounds to benefit from the programming education. This expansion would not only increase the system's accessibility but also improve the overall learning outcomes by accommodating the language preferences of different student groups.

Furthermore, the positive results from this research confirm the success of the authors' primary objective: to provide foundational programming knowledge to young learners. The fact that students were able to effectively learn and apply the concepts indicates that the educational content was successfully conveyed, achieving the authors' goal of knowledge transfer. This early exposure to programming equips students with a solid foundation that will give them an advantage when they pursue higher education, such as in universities or technical institutes. The authors recognize that by continuously refining the system based on feedback from these young learners, they can further enhance its effectiveness. This iterative process of improvement, driven by real-world user feedback, will ensure that the system remains relevant, engaging, and educationally impactful as it evolves to meet the needs of a growing student population.

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## 13. Glossary

**Customized Kids Assisting System** - A component of the app designed to help children understand programming concepts by answering their questions in their native language.

**Exploratory Analysis of Interactive Programming Concepts for Learning** - One of the main ML-powered components of the system.

**Knowledge-Based Agent (KBA)** - A component used to process the question and give the response in the Customized Kids Assisting System.

**Natural Language Processing (NLP)** - A branch of AI that helps computers understand, interpret, and manipulate human language.

**PyTorch** - One of the NLP frameworks that has been developed by Meta aka Facebook.

**REST API** - An architectural style for an application program interface (API) that uses HTTP requests to access and use data.

**RASA** - An open-source machine learning framework that helps developers build conversational AI assistants, such as chatbots and voice assistants

# 14. Appendices

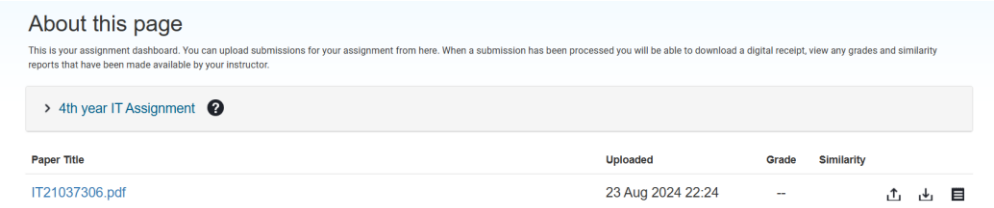


*Figure 2 - Plagiarism Report*