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Applying Machine Learning to Support Adults in Educating 0- to 36-Month-Old Children at Home: Theories and Experience from Vietnam

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Abstract

This research presents the theoretical bases and practical experiences in Vietnam in applying machine learning to support adults in educating 0- to 36-month-old children at home. The paper also reports the findings of a scientific research project named "Researching and applying machine learning to support adults to educate young children aged 0-36 months in their families" at Vietnam National University, Hanoi. To be more specific, the authors have designed an AI-driven chatbot which acts as a babysitter to provide information and answer frequently-asked questions regarding at-home education of 0- to 36-month-old children following prevalent scripts or data. For simple questions the AI-driven babysitter chatbot will offer the answers on their own. For more complex ones, the chatbot will send them to teachers for solutions. During the process, the chatbot will do self-learning to enhance its ability to give more accurate and practical answers. Experiments show that the chatbot designed by the authors has successfully addressed limitations of the conventional counterparts. Additionally, it also provides accurate and reliable answers, as well as enhanced user experience thanks to trusted references and parents' coordination in effective child education, ensuring quality and authenticity.

Keywords: *Machine Learning, AI-Driven Babysitter Chatbot, Child Education, 0- To 36-Month-Old Children.*

Introduction

The application of machine learning technology in supporting adults and educating children aged 0-36 months at home is a new and potential issue, especially in Vietnam. Machine learning is a subfield of artificial intelligence (AI), allowing systems to learn from data without being specifically programmed (Le Phuong Truong, Lam Thanh Hien 2020). In the context of child and adult education, machine learning has proved to be useful in various ways.

First, machine learning is personalized. Machine learning systems can monitor the progress of learners in general, and children in particular, then make recommendations or change teaching content to suit the needs and abilities of each individual. For young children, this technology can

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help develop basic skills such as language, logical thinking, or emotions through interactive games.

Second, machine learning allows for learning through interaction and games. For children aged 0-36 months, education applications, integrated with interactive games and learning experiences with images, sounds and feedback from machine learning, may facilitate their cognitive development through simple but effective exercises (Nguyen Trong An, 2015).

Third, machine learning has the capability of tracking developmental progress. To be more specific, machine learning systems can collect data from children's interactions with educational tools, making it easier for parents and teachers to track their child's development over time. For example, apps can help parents see whether their child has reached developmental milestones like talking, walking, or recognizing colors (Nguyen Trong An, 2015).

In Vietnam, the application of technology in children's education, especially in the early stages of life, has been receiving greater focus, although the level of implementation is still limited. Some highlights of the application of machine learning technology in family education can be demonstrated in the following forms:

Vietnamese language learning applications for young children: Some applications use machine learning technology to recognize children's voices, helping children learn to pronounce correctly from the early stages. For example, applications such as "Baby learns letters" or "Baby learns vocabulary" can help children learn vocabulary, recognize images and sounds, and even develop rudimentary thinking skills (Pham Thi Mai Chi, 2015).

Programs to support parents in raising children: Mobile applications can support parents in monitoring their children's development, providing advice on health care, nutrition, and appropriate parenting skills. Through machine learning, the application can customize suggestions based on each family's specific characteristics and needs (Pham Thi Mai Chi, 2015).

Social skills development support system for children: Machine learning technology can develop interactive simulations where children can learn basic social skills, such as greeting, thanking, or getting to know friends through simulated situations (Pham Thi Mai Chi, 2015).

Literature Review

Machine Learning Technology

Research on machine learning technology has shown the superiority of machine learning technology in human life, bringing many conveniences to human life. According to Means and Roschelle (2010), machine learning is a field of artificial intelligence related to the study and construction of techniques that allow systems to "learn" automatically from data to solve specific problems. For example, machines can "learn" how to classify emails as spam or not and automatically put them in the corresponding folder. Machine learning is very close to statistical inference, although there are differences in terminology. Machine learning is closely related to statistics, because both fields study data analysis, but unlike statistics, machine learning focuses on the complexity of algorithms in implementing computations (Hidayat, 2018).

AI-Driven Chatbot and AI-Driven Babysitter Chatbot

According to Sam Altman and his colleagues (2020), AI-driven chatbot is designed to communicate with human through natural conversation using AI to comprehend and respond to

questions or inquiries by users. It aims to offer intelligent and smooth feedback in dialogues instead of giving pre-programmed answers.

AI-driven babysitter chatbot is a system used to support the care and monitoring of children or adults with special needs. AI-driven babysitter chatbot can be integrated with AI to answer questions, provide information and advice, or even monitor a child's health and study conditions, creating easy of mind for parents whenever they cannot be present.

The functions of AI-driven babysitter chatbot include monitoring (i.e. connecting to monitoring device or sensors to monitor a child's activities, health and safety), answering questions (i.e. providing information of child care, nutrition and other health problems), supporting study (i.e. recommending educational games or lessons in line with a child's age), reminding schedules (i.e. notifying meal time, sleeping time or other appointments). Though AI chatbot cannot replace human in child care, it acts as a supporting tool to improve child care and bring ease of mind to parents.

Children Aged 0 to 36 Months

According to Havard University (2015), children at this age have very distinct physical, cognitive, language and social development characteristics. This is an important stage in the development of children. Here are some outstanding characteristics:

Infancy stage (0-12 months): Physically, newborns have low body weight and soft body. During this stage, children will grow rapidly in height and weight. Their primitive motor skills are natural reflexes such as sucking, grasping hands, holding head. In terms of muscle control, children will gradually control the neck and head, then the shoulders and arms. Cognitively and emotionally, children perceive the surrounding environment through the senses (sight, hearing, touch). They begin to recognize the faces of their mother and close relatives, and can respond to sounds and movements, such as turning their heads when hearing their mother's voice or when someone moves. Regarding language, infants begin to make sounds like "uh" or "ah" and respond to adult voices by smiling or crying, but they can only communicate through crying to express emotions like hunger, sleepiness, or discomfort (Nguyen Vo Ky Anh, 2016).

1- to 2-year-olds: Physically, children start to walk with only baby walk at first. Their motor control improves. To be more specific, babies can sit up, crawl, stand up and walk with help. They develops finer motor skills such as using hands to grasp objects or pointing. Cognitively and emotionally, they become more aware of themselves and people around them. Children begin to express emotions more clearly, such as happiness, anger or fear. They also develop the ability to do things on their own, such as feeding themselves or playing. In terms of language, children begin to use simple words such as "mama", "dada" or "no". They learns new words and tries to put words together (i.e. "mommy", "grandma go") (Nguyen Vo Ky Anh, 2016).

2- to 3-year-olds: Physically, children can run, jump, climb and begin to engage in simple active play. Fine motor skills continue to develop, such as building blocks, drawing, and using a spoon and fork to eat. Cognitively and emotionally, children begin to understand simple spatial concepts (in/out, up/down). Children show independence and can refuse or request things more clearly. Children express their emotions through actions and words, and can begin to share toys or play with friends. At this stage, children's language develops rapidly, and they can say short or simple sentences (i.e. "I want to eat", "Mommy, it hurts me"). Children begin to understand and follow simple instructions such as "give me this" or "sit down". Socially, children begin to participate in play activities with friends and learn to interact socially. Children can begin to

learn to share although they may sometimes have difficulty with sharing toys (Nguyen Vo Ky Anh, 2016).

Educating Children Aged 0-36 Months

Educating children aged 0-36 months focuses on developing their emotions and social communication, such as building safe relationships. For instance, at this age, children learn through their relationships with the caregivers (including parents, relatives or babysitter). Such emotional connection serves as an important foundation to ensure that the children feel safe and believe in their surroundings. In terms of their emotions and feedback, the children learn to recognize and express their feelings through interactions with others. Therefore, timely responses and loving are significant in child education.

In terms of language development, although children cannot speak fluently, exposure to language is very important from infancy. Children will begin to develop the ability to listen and understand basic words. Language education at this stage includes talking and reading to children, and encouraging them to imitate sounds. Caregivers can creating opportunities to communicate from a young age through words, music or storytelling which are a great way to stimulate children's language development.

For stimulating cognitive development, children learn mainly through their senses such as sight, hearing, and touch. Games and activities such as building blocks, exploring objects, or listening to sounds will help children develop their cognitive abilities. Caregivers can also encourage children's curiosity. Young children are often very curious and want to explore the world around them. Education at this stage should create opportunities for children to explore and learn through play activities, and at the same time explain to children what they observe be.

In terms of motor skills development, the 0-36-month period is a period of strong motor development. Children learn to roll over, crawl, stand, and walk. Educational activities during this period should include exercises that help children develop body strength, balance, and hand-eye coordination). For fine motor skills, it is necessary to encourage children to grasp objects, use spoons, or doodle also helps develop fine motor skills. Caregivers should create a positive learning environment which is safe and enriching as young children need a safe environment to explore, with age-appropriate toys and materials to stimulate their creativity and learning ability.

Child care is personalized care. To be more specific, each child will have his or her own pace of development, so educating children from 0-36 months old needs to focus on monitoring each child's development and adjusting educational methods accordingly. Caregivers can educate children through fun activities or learning through play. Children aged 0-36 months learn very well through play. Games such as building, puzzles, playing with objects, or simple physical games can help children develop creative thinking and motor skills. It is also essential to encourage children's creativity. Activities such as drawing, coloring, or using shaping tools help develop children's creativity and thinking ability. Caregivers also need to build habits and independence. During this stage, children learn to establish habits and begin to understand basic rules in daily life such as mealtimes, bedtimes, and playtimes. This helps children feel safe and stable in their living environment. Encouraging independence is also important. Although children at this age cannot do everything by themselves, it is possible to encourage them to perform simple tasks such as feeding, dressing, or playing by themselves helps them develop confidence and independence skills.

In terms of self-awareness and awareness of the world, children gradually realize that they are individuals independent of others. Educational activities can include calling children by name and helping them recognize their names, or pointing out body parts through play. They also start to explore the world. Children at this stage are very curious and will explore everything through touching, seeing, and hearing. Educating young children encourages interaction with the surrounding environment, thereby helping them form awareness of the world.

In summary, educating children from 0-36 months old focuses on creating a safe environment that supports the emotional, social, linguistic, and physical development of children. This stage is the foundation for the comprehensive development of children throughout their lives, and education should not only focus on knowledge but also pay attention to the natural, emotional, and creative development of children (Nguyen Vo Ky Anh, 2016).

Research Methodology

The specific research methods used in this particular research are as follows.

Secondary Method: the authors reviewed previous studies (i.e. journal articles, scientific research projects) that are directly or indirectly related to machine learning and AI chatbot supporting adults in educating children aged 0-36 months in their families.

Expert Consultation: the authors consulted with 03 experts with insights into machine learning and AI chatbot, as well as into education of children aged 0-36 months in subject matters in applying machine learning to support adults to educate the children in their families to identify basic concepts and theories to develop an AI-driven babysitter chatbot used for this particular project. The experts agreed on using Retrieval-augmented generation technique (RAG) to develop an AI-driven babysitter chatbot. RAG is a solution combining data retrieval from trusted sources and natural response generation of LLM. RAG is known for its accuracy (for combining data retrieved from trusted sources, i.e. books or medical materials, and flexible text generation), provision of reference (each response involving information sources, allowing users to check for accuracy), and suitability for specialized fields (systems can be optimized for a certain field such as child care thanks to the selection of in-depth materials).

Semi-Structured Interview: the authors interviewed 12 individuals including 03 experts in machine learning and AI chatbot, 04 experts in preschool education (in which 02 experts are currently working in preschool teacher training university and 02 others specializes in preschool education in the Ministry of Education and Training), 03 preschool teachers in Hanoi and 02 parents with children aged 0-36 months in Hanoi. The interview questions are in line with the list of relevant issues in machine learning application in supporting adults to educate 0- to 36-month-old children in their families. The data gathered from interviews were then synthesized, sorted and analyzed.

Quantitative Research Method: the authors utilized questionnaires to gather necessary data regarding the factors affecting the application of machine learning to support adults in educating children aged 0-36 months in their families and statistical methods to analyzed the data.

Findings

Current situation and needs for machine learning to support adults in 0- to 36-month-old child education in their families

Interviews with experts reveal that:

12/12 experts (100%) thought that applying machine learning to support adults to educate children aged 0-36 months in their families in Vietnam is a practical and serious need as it is useful for educators and stakeholders, especially the parents

10/12 experts (83.33%) thought that in Vietnam, the application of machine learning to support adults in educating children aged 0-36 months in their families was at the initial stage of exploration and experiment, while 02/12 (16.67%) shared that machine learning hadn't been adopted in this field yet.

12/12 experts (100%) thought that the application of machine learning to support adults in educating children aged 0-36 months in their families in Vietnam would be highly effective in improving insights and supporting teachers and parents in child care and education.

12/12 experts (100%) thought that it was necessary to design and deploy preschool-dedicated AI chatbot in the education of 0- to 36-month-old children at home.

Development of AI-Driven Babysitter Chatbot

Response Procedure of RAG Technique

The response procedure of the RAG technique is as follows.

Step 1: receive questions from users in the text form

For example: What should children eat to increase iron intake?

Step 2: use the embedding model (further explained in 2.3.1) to transfer the question in the text form into the vector form, allowing the computer to interpret

For example: "What should children eat to increase iron intake?" is transferred into [0.02445, 0.03415, -0.08725, …]

Step 3: compare the vector-form question to search for the most relevant documents in the vector database (further explained in 2.3.1) under the vector form, which is then transferred back into the text form

For example: provided that k=3

[0.02445, 0.03415, -0.08725, …] → [-0.03425, -0.04375, 0.02325,….] :

Question: What should children eat to increase iron intake?

Answer: To ensure sufficient iron intake,

Feed children with lean meat, fish and poultry, which are good sources of iron

Use iron-rich plant-based foods, such as beans, lentils, and dark green leafy vegetables.

Combine with foods rich in vitamin C, such as oranges, strawberries, to increase the absorption of iron from plants.

Consult a doctor. If you have concerns about your child's iron levels, consult a doctor to consider iron supplements.

[0.01875, -0.02706, -0.00875,..]:

Question: Do children need to eat iron-rich food?

Answer: Yes, iron is important for brain development and blood formation. Good sources of iron include red meat, liver, beans, green vegetables, and fortified cereals. If your child does not get enough iron from their diet, an iron supplement may be prescribed by your doctor.

[0.01932, 0.01032, -0.32423, …]:

Question: How to ensure that children take in enough iron?

Answer: To ensure sufficient iron intake:

Feed children with red meat, fish and poultry, which are easily absorbed sources of iron.

Combine iron-rich plant-based foods with foods rich in vitamin C, such as oranges, strawberries, to increase iron absorption.

Consult your doctor. If you have concerns about your child's iron levels, consult your doctor about iron supplements.

Step 4: combine the original question with the k most relevant texts, and give the most appropriate prompt:

Let answer my official question based on the context I have given, if the context does not match with the official question, please use your experience:

Context:

{context}

Official question:

{question}

Step 5: transfer everything into the big language model to generate an answer

(Use API chatGPT/ Gemini by Google/ Claud AI by Anthropic/ Llama 3.2 by Facebook)

Step 6: give a complete response to the user

Development of Vector Database

A vector database is designed to store, manage and search for vector embeddings in an effective way. In RAG, the vector database retrieves information by seeking vectors with a similar meaning from the data which is stored when an input inquiry is received.

The structure of a vector database is as follows:

Embedding model: Transfer data in the form of text or image into vector embeddings (whose height is statistically meaningful).

What infections are common in newborns?

[0.02445, 0.03415, -0.08725, …]

Vector Database:

Store the vector embedding of the source material that needs storing

Search for the closest vector embedding: when an inquiry is received, the vector database searches for the vectors which are the closest to the inquiry one using search algorithms.

Retrieval result: Give relevant materials based on vector concordance.

However, before an inquiry enters the vector database, the authors have processed the materials so that they are long enough and have a complete meaning. Data preprocessing is the process of preparing and cleaning input data to optimize the storage, representation and retrieval of information in a vector database. The major aim of this process is to transfer raw materials (i.e. long texts or documents) into smaller chunks that are possibly presented in the vector embedding form which is suitable for information retrieval. To be more specific, it includes:

Step 1: Data collection. Data is collected from different sources such as texts, PDF files, websites, databases or other raw materials, such as reports, books or trusted websites.

Step 2: Data cleaning. Redundant data is removed by deleting special characters, redundant spaces or unnecessary content. Texts are standardized by removing punctuations, strange characters or unnecessary ones.

Step 3: Data chunking. Texts are divided into smaller chunks.

Step 4: Create vector embeddings. Language model or embedding model is used to turn chunks into vector embeddings, which then present the meaning of the texts in a multidimensional space. For example: Sentence: Learning machine is a subfield of AI → Vector embedding: [0.12, -0.34, 0.56, ...].

Step 5: Vector storage in the vector database. After the vector embedding is created, it will be stored in the vector database with metadata (additional information such as material ID, sources or original contents). The storage structure includes vector – vector embedding type, metadata – content description or material source, and ID – the only identification of each vector.


06:58
VN-GPT
VN-GPT
VN GPT
Thử lại
Hoàn tác
Xóa
Gửi
Examples
Lợi ích của sữa mẹ ?
Sữa non là gì ?
Trẻ sơ sinh cần ngủ bao nhiêu giờ mỗi ngày?


06:59
VN-GPT
Thử lại
Hoàn tác
Xóa
Hoạt động giáo dục phù hợp cho trẻ 12 tháng tuổi là gì?
Gửi
Examples
Lợi ích của sữa mẹ ?
Sữa non là gì ?
Trẻ sơ sinh cần ngủ bao nhiêu giờ mỗi ngày?
Bao lâu nên cho trẻ sơ sinh bú một lần?
Xong
Nhập

Figure 1. Images of a use case of AI-driven babysitter chatbot developed by the authors

Initial Evaluation of AI-Driven Babysitter Chatbot

To initially evaluate the AI-driven babysitter chatbot, the authors have administered a questionnaire with 160 preschool teachers and parents. The valid responses were 145/160 (90.62%). The capability of answer questions of the AI-driven babysitter chatbot is evaluated on a scale of five levels: Excellent, Good, Average, Weak and Poor. The results are presented in Table below.

No.	**Criteria**	**Level of capability**					**Means**	**Rankings**
		Excellent	Good	Average	Weak	Poor		
1	Recognize the question content	13/145, 8.96%	115/145, 79.31%	18/145, 12.41%	10/145, 6.89%	0	3.05	1
2	Analyze the question content, compare with	15/145, 10.34%	111/145, 75.8%	20/145, 13.79%	8/145, 5.51%	0	3.04	2

	those that have been provided in the database							
3	Retrieve an answer that is matched with the question	14/145, 9.65%	112/145, 77.24%	19/145, 13.10%	9/145, 6.20%	0	3.02	3
4	Connect to other data sources apart from the given one	12/145, 8.27 %	114/145, 78.62%	17/145, 11.72%	11/145, 7.58%	0	3.00	4
Total							**3.03**	

Table 1. Evaluation of the capability to answer questions of the AI-driven babysitter chatbot

(Source: Author's analysis)

Table 1 illustrates that the capability to answer questions of the AI-driven babysitter chatbot is highly rated with the means score of 3.03. This means the authors have properly followed the development procedure and established technical standards. Moreover, the authors have developed a database and information system that is in line with the educating content for children aged 0-36 months in their families. Besides, the chatbot is fairly highly capable of retrieving data and connecting to other sources quickly and smoothly. Among the chatbot's capabilities, the capability of recognize the question content is considered the most excellent one with the means score of 3.05. This result is also reflected in other projects. On the other hand, the capability to connect to other data sources apart from the given one is the least excellent with the means score of 3.00. This result is in line with those in other studies and with the experts' opinion that there should be more intelligent AI generations allowing the AI-driven babysitter chatbot to connect to other data sources besides the given one.

Conclusion

Machine learning application in child education in their families, especially for those aged 0-36 months, is highly likely to improve the education quality and support child development. However, to gain higher effectiveness, there should be a strong combination of technology, parents and education experts. Moreover, it is important to enhance technological facilities and technical skill training for the people, especially those in the rural and mountainous areas.

Though the application of machine learning in child education in their families is highly potential, there still exist several challenges including infrastructures and accessibility. Technology is thriving strongly, but in rural areas, access to the Internet and intelligent devices is limited, hindering machine learning application in these areas. Another challenge is privacy and security. The collection and analysis of child data as input for such application have evoked

concerns regarding personal information protection. Therefore, the development of machine learning apps must ensure security and comply with privacy regulations. Moreover, knowledge transfer to parents also encounter obstacles. In many cases, parents do not get sufficient training in technological use. To enhance effectiveness, training courses for parents are highly important.

This particular paper introduces an AI-driven babysitter chatbot which provides support for preschool teachers and parents in caring and educating children aged 0-36 months at home. The initial evaluation reveals that the chatbot is fairly highly capable of providing information and answering questions from preschool teachers and parents. However, the scope and time of chatbot experiment is limited, which means there should be further research projects with more data and higher versions of AI to meet the increasing needs of 0- to 36-month-old child care and education in their families.

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