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DEVELOPMENT OF A SMART DOLL PROTOTYPE FOR EARLY AGE CHILDREN COLOURS LEARNING IN THREE LANGUAGES

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Abstract
Early childhood is a golden age to learn a language, not only the mother tongue but also a second or third language. However, learning media that can be used to attract children's interest in learning multi-language is still limited. Therefore, this study aims to develop a smart doll that attracts children to learn Javanese, English, and Indonesian. In particular, this media is intended to help children recognise colours in three languages. This research is developmental research with the following steps: First, collecting information about the product being developed, conducting a literature review and interviewing teachers and parents. Second, planning product design in accordance with the results of the needs analysis. Third, developing the initial product form. Fourth, conducting a preliminary field test on 3 children. Fifth, revising the main product. Sixth, field testing on eight children. Seventh, evaluate the testing result for the next development plan. The result of this research is a prototype of a smart doll that is able to recognize colours in 3 languages. Based on the field trials results, the prototype of this smart doll can attract children's enthusiasm for learning colours and improve their ability to recognise colours in three languages. Some things that need to be improved will be discussed further.

Keywords: colour, multilingual, smart doll

Introduction

Mother tongue is defined as the language used by children when they first learn to speak. Mother tongue is not always associated with a person's place of residence. If an Indonesian live abroad but accustomed to speaking in Bahasa Indonesia from the beginning he learned to speak, then the person's mother tongue is Bahasa Indonesia although he does not live in Indonesia (Rahmadi, 2021). Likewise, children living in Yogyakarta, where Javanese language is the local language, do not necessarily have Javanese as their mother tongue. The determination of the mother tongue depends on the environment speech habits in which the child grows up and first gets to know the language.

Mother tongue is important to consider because based on research, children find it easier to learn new language (second language or third language) if it is paired with their mother tongue (Kurniawan, Reliubun, & Fandasari, 2022; Rahmadi, 2021). Based on an interview conducted by the researcher with a kindergarten teacher in Yogyakarta showed that children almost never use Javanese language at school and in everyday life. Children are accustomed to using Bahasa Indonesia in daily conversations and learning in class. In this case, the children's mother tongue is Bahasa Indonesia.

It is a concern that the use of local languages is getting less and less, especially the shifting of Javanese language usage to Bahasa Indonesia within the family communication in Yogyakarta which has become a phenomenon. Research conducted by Bhakti in Sleman (2020), showed that the shifting of Javanese language usage to Bahasa Indonesia was due to the desire to choose a more straightforward language, the lack of Javanese language learning in families, residential areas consisting of various regions of origin, family social stratification, and level of education and family attitudes towards local languages.

On the other hand, it is necessary to introduce children to international languages, to enable them to communicate globally in this 21st century. Children also need to be introduced to international languages so that they have a strong interest in mastering this language, in this case, English mastery. In accordance with the children development achievement level standard (STPPA), children aged 4-5 years have begun to be able to listen to other people's words, both in their mother tongue and in other languages. So, it is appropriate if we begin to introduce the children to a second or third language at an early age.

Derived from the concerns above, the author was moved to develop an appropriate learning media to attract children's interest in learning multi-language. Based on research conducted by Swastyastu (2020) it is known that acquiring a second language will be more effective when using media. Media can be in the form of visual media, audio media, or audio-visual media. In addition, it is also possible to use animated learning media that incorporates elements of motion and sound in teaching a second language (Sun, Loh, & Roberts, 2019). Children who listened to stories from these animated storybooks were also reported to have a higher level of attention listening to stories. These media show that the use of children's senses of sight and hearing is believed to facilitate the acquisition of a second language. Therefore, it is necessary to develop media that accommodates various senses.

As the initial project of this research, the researcher developed a media to recognize colours in three languages. The selected media is a "smart doll". The doll was chosen because it utilizes sound and visual elements from concrete objects. The smart doll referred to in this study is a doll that is able to recognize colours in Javanese language, Bahasa Indonesia, and English. This doll uses an ATmega328 microcontroller and an Arduino TCS3200 colour sensor. The doll's body is wrapped in cloth forming a child-friendly doll. This doll is equipped with a colour recognition sensor and is able to make a sound according to the detected colour and thus named a smart doll. The term smart doll is taken from a term that is usually used to refer to smart toys, namely toys that have been added with digital features such as software or digital materials such as sensors (Komis, et al., 2021).

The design of the doll shape is based on the development of the children's mindset. Children up to the age of 4-5 years still have animistic thoughts, which is having the belief that all objects including inanimate objects have life and the ability to act. This is in line with the stages of playing according to Hurlock (Ardini & Lestariningrum, 2018) that at the peak of the age of 5-6 years, children still often observe their playing toys and talk to them or play with them like their playmates. Dolls are one of the toys that children often talk to.

Next, as one of the initial projects of this research, colour learning for children is chosen as the theme. As part of developing cognitive and language skills, the introduction of colour to children is a must. Colour recognition is a necessary skill in everyday life because many things in this world are symbolized by colours or categorized by certain colours. Therefore, children need to recognize colours before knowing the meanings that are symbolized.

In Permendikbud number 137 of 2014 concerning STPPA, at the age of 3-4 years, children will be able to understand the meaning of colours, such as the meaning of the colour of a traffic light. At the age of 4-5 years, children will start to develop the ability to think logically, for example classifying objects based on function, shape or colour or size. Usually, children are able to sort objects based on 5 series of sizes or colours. At the age of 5-6 years, children will be fully able to classify objects based on colour, shape, and size.

Children's ability to recognize colours is also a part of children's development in developing problem-solving abilities. This is because many problems in everyday life use colour as a symbol. For example: when we ask a child to get a red stuffed bunny, the child needs to know the red colour to solve the problem (Santrock, 2011).

According to their level of development, the easiest way to teach early age children learning is to use concrete objects and direct experience. Children learn through seeing, hearing, and experiencing first-hand (Seldin, 2021). Learning with the colour doll provides an opportunity for children to experience learning directly through concrete objects and fun game activities.

In this development research, colour recognition is given using Javanese language, English, and Bahasa Indonesia with a total of 12 colours introduced. Colour recognition is done through the activity of playing with the doll. This play activity is intended to create a sense of fun and joy in children (Pasek, Golinkoff, & Eyer, 2003) because children need to have fun in learning (Pitamic, 2013).

Method

This research is developmental research conducted in seven steps: First, the researcher collects information about the product to be developed, conducts a literature review, and performs needs analysis by interviewing teachers and parents. Second, the researcher designs products according to the results of the needs analysis. The third step is developing the initial product which begins with analysing the test results of the prototype doll to see the performance of the prototype doll developed based on the algorithm used and the validity of the developed system. The fourth step is to validate. Validation of project results consists of two validation classifications, namely validation from the content side and validation from the application side. Fifth, revising the main product. Sixth,

field testing on eight early age children. Seventh, evaluate results for the next development plan.



Figure 1. Research methodology

Findings and Discussion

This research is developmental research conducted in the following steps: First, the researcher collects information about the product to be developed, conducts a review of various literature, and performs needs analysis by interviewing teachers and parents. There are various studies on colour recognition efforts for early-age children. For example, Syukur, Djahimo, & Leba (2020) introduced puzzles as a learning medium for colour concept learning. Hardiyanti, Husain, and Nurabdiansyah (2018) designed a rubik's media to introduce colour to early age children. Ariona (2014) developed a colour recognition educational game as an Android-based learning medium for pre-schoolers. This media is proven to be worthy of making children interested in learning about colours and increasing their creativity and activities. Realizing the importance of basic colour recognition in early childhood, Yudha, Ardhiyanta, Haris, and Widiarti (2016) began to develop applications that were able to recognize basic colours. Their application succeeded in detecting the basic colour using a sensor. This research was then further developed to be able to detect more colours.

The four studies above showed that colour recognition is indeed a basic thing that needs to be understood by early age children. A further needs analysis was carried out by the researcher by conducting interviews with teachers and parents of students. The result showed that many children do not understand colours in Javanese language although they live in Java because they do not use Javanese language in their daily conversations. On the other hand, they were also introduced to English as an international language. It is triggering a concern that the interest in using Javanese language will decrease among children. Therefore, it is necessary to design a media that is able to attract children to learn Javanese language in addition to Bahasa Indonesia and English.

This various language media design is also driven by the belief that mastering a second language other than the mother tongue has its own advantages. This is also believed by Ambarini, Indrariani, and Zahraini (2019) who taught early childhood teachers the importance of preparing lesson plans and teaching children various health learning topics in two languages, namely the mother tongue, which was Bahasa Indonesia, and a foreign language, which was English. The analysis result conducted by Annisa (2021) showed that various language mastery has a positive impact, one of which is to support children in mastering one of the 21st-century skills that need to be mastered by children, namely the communication skills. The ability of children to master more than one language can make children easily adapt to their social environment. In addition, mastering more than one language will give children a sense of pride.

The second step is planning the product's design according to the results of the needs analysis. The design stage is aimed at obtaining colour recognition algorithms, designing data streams, designing hardware and puppet shapes, and designing the sound that will come out as the output of the dolls. Some of the design provisions that need to be considered when developing the tool consist of what objects to use, what background of the object will be, how will the lighting be when capturing objects, how many colour components are in the object and how wide it will be, what is the distance from the object to the camera and what is the slope of the object, what kind of sound will come out of the speakers, what will the doll look like, and what tools will be used to build the doll's primary machine. In developing a software system with an algorithm chosen to recognize colour, the steps taken for system development are designing a system using a colour classification algorithm, analysing the test data candidates by studying the data and researching the representation of the test data in its digital format. Afterwards, implementing the system design by making a prototype of the colour recognition system, and carrying out trials with a prototype of the colour recognition system that has been completed using data that has been prepared previously (Widiarti, Nugroho, Pinaryanto, & Kurniastuti, 2020).

The third step is to develop the initial product starting with analysing the test results of the prototype system to see the performance of the prototype developed based on the algorithm used and the validation of the developed system. The next big step is to make the doll machine. In this case, using the Arduino Uno ATmega328 board which is relatively cheap and easy to obtain. In general, there are only three tools used, namely the board, colour sensor, and speaker to produce a sound which will be the learning source for the early-age children. The next step in developing the tool is to make the body and clothes of the doll with Arduino as the hardware inside the body. The following is the initial appearance of the developed product.



Figure 2. Initial product design

The fourth step is to validate. Validation of project results consists of two validation classifications, which are the validation from the content side and validation from the application side. The validation of the content side means the validation of the Javanese language learning materials that will be taught. The validation from the application side means the validation of the black blox application system produced and the effectiveness and efficiency of the tool. Three children are involved in this trial. From the test results, the doll incorrectly detected some colours. This indicates that the colour spectrum used in machine calibration needs to be reviewed. From the application side, children seem

enthusiastic and interested in using dolls to recognize colours. The other thing to be improved is the user-friendliness. The doll needs to be used by children on a mobile basis so it requires a battery instead of electricity from an adapter to make it more flexible for mobility.

The fifth step is to revise the main product. Based on the test results, various improvements were made. From the hardware, the power source of the doll is changed from an adapter to a battery to make it more mobile and flexible. From the display, the appearance of the doll has been changed to make it more attractive for children and resembles a character that is more comfortable to talk to. In accordance with the initial goal that this doll will introduce children to three languages, the software of this doll is equipped with three languages, namely English, Bahasa Indonesia, and Javanese language (the application developed only has Javanese language in the previous experiment). Next, a guidebook was added to make it easier for the companions who would assist the child in using the doll to recognize colours.



Picture 3. Product design after revision

After several revisions were made, the next step was to conduct another test with a limited group consisting of eight children. The results of this trial showed that the doll could help children learn colours. Of the three languages introduced, eight students found it difficult to recognize colours in Javanese language. Colour recognition in Bahasa Indonesia and English was much easier for children to master. All students seemed enthusiastic to try using this doll's assistance to identify colours. They were amazed because the doll could speak in three languages according to the coloured papers that were shown to the doll. The obstacle faced in this trial was that the doll had difficulty recognizing colours other than the coloured papers that had been prepared by the developer. Children tend to be driven to use the doll for further exploration, picking up a variety of colourful objects. Unfortunately, not all of them could be detected by the doll due to the difference in the colour spectrum that could be detected. The colours that can be detected by the doll are according to table 1.

Table 1. List of Colours the Doll Can Detect

Bahasa Indonesia	Javanese Language	English
Merah	Abrit	Red
Putih	Pethak	White
Kuning	Jene	Yellow
Hitam	Cemeng	Black
Hijau	Ijem	Green
Biru	Biru	Blue
Ungu	Wungu	Purple
Coklat	Coklat	Brown

Jingga	Oranye	Orange
Merah muda	Ping	Pink
Biru muda	Biru enem	Light blue
Hijau muda	Ijem enem	Light green

In addition to the colours above, when the doll's sensor detected an unprogrammed colour spectrum, it would produce an additional sound of "undetected". From the testing results with children, this sound became a separate learning tool for them because it showed that this smart doll was not a living thing that knew everything. The doll sounds based on the program that had been designed. If the command had not been programmed, the doll would not understand it. With this experience, children could be motivated to learn more about various colours. The honesty of "undetected" also motivated children because it encouraged children to keep looking for information by interacting with adults or teachers.

In the principle of developing educational media, the auto-correction principle was indeed a criterion that must be met, namely, learning media should be designed to help children learn independently because they have error control (Kurniastuti, Mbawo, 2019). As in this smart doll, when the sensor worked properly, all objects that matched the colour list in table 1 could be identified properly. The sound of this doll regarding colour was a manifestation of error control. Students knew that an object is red because the doll sounds red.

The interesting thing from the results of this limited field trial was that there was an increase in mastery of recognizing colours in three languages. Before colour recognizing smart doll was given to the children, the highest score they got was in recognizing colours in Bahasa Indonesia, followed by English and Javanese language. Here it appears that Javanese was indeed the language they rarely heard although they live in Java. One of the advantages of this smart doll was that it produced sounds according to the object brought to the sensor in three languages at once. For example: when a red object was brought near to the sensor, the doll would make sounds: "*merah"*, red, and "*abrit"*. By knowing the pronunciation of colours in Bahasa Indonesia first, it helped they were helped to understand the other language of "*merah*" in English, namely red, and in Javanese language, namely "*abrit"*. This is in accordance with research from Kurniawan, Reliubun, & Fandasari, (2022) and the opinion of Rahmadi (2021) that in learning something new in a foreign language (second language or third language), children will find it easier to learn if paired with their mother tongue.

In further observation, children who were amazed by the doll that was able to make sounds in three languages, slowly understood that this doll taught them to learn something, which was colour. The word "*abrit*" which was previously unfamiliar to their ears became familiar because the doll provided ample opportunity for children to repeat it until they were able to master what they were learning. This is in accordance with the natural tendency of children in the learning process, they like a repetition of something that is considered interesting and makes them learn new things until they really master it (Seldin, 2017). This smart doll is practical for kids to use if they want to do repetition.

The seventh step is to evaluate the product for an improvement plan. From the trial results, it was necessary to have an improvement to enable the doll

recognizing colours from various spectrums considering the characteristics of children who like to explore with objects around them.

Children have their own pleasure when invited to see the natural surroundings together. Watch various insects on the leaves, the drops of water on the leaves, the colour of the sunset, the view from the mountains, the silence or ripples in the lake, the movement of the sea, the wind in the trees, or simply enjoy the beauty of flowers and bees in the neighbour's garden. Children enjoy taking a magnifying glass to explore up close, touching things with their hands, listening to the movement of trees and grass, and smelling rain or flowers (Davies, 2019). Children are active learners. Children move in search of stimulation that can increase their opportunities to learn. Children use their whole body as a tool to learn and engage all their senses. Children are energetically looking for their own experiences and looking for ways to produce maximum potential (Sutrisni & Marisa, 2018).

Of course, this developed media cannot represent all children's activities in this world. However, it is expected that this colour doll can be used by children for natural exploration in the future. For example, a child could bring the doll to nature, take objects such as leaves of various colours to the sensor and the doll would identify the colour. Afterwards, the child could try the objects around with various colours. Thus, the child will have the experience of moving in nature, touching various objects, and learning colours from the sound made by the doll. Further development of this doll is certainly highly expected.

Learning in nature to find various kinds of coloured objects as mentioned above is an example of a discovery learning strategy. This learning is effective and fun because it requires active participation from children and an environment that encourages children's curiosity. If there are obstacles in the field related to the doll's sensor that cannot recognize all the colour spectrums, students will be invited to identify what objects can be detected by this smart doll. This actually becomes a new discovery because it is based on problems that occur in the field that stimulates inquiry learning where students are invited to think further to find new discoveries (Mulyasa, 2017).

The next development is to add a song feature that can be played like the one on Ami-chan doll from Japan (Larasati, 2021). Researchers have developed songs related to colour recognition in three languages, but they have not yet been integrated with the software of the dolls.

Conclusion

The results of the development of a smart doll prototype to recognize colours in three languages for early-age children show good results in terms of increasing children's enthusiasm in learning to recognize colours in three languages. The voice features in the dolls make children more enthusiastic to learn because the smart doll can help them learn independently although they are not assisted by parents or teachers. However, in terms of development, the doll still needs to be improved, such as expanding the colour spectrum that can be recognized by the doll so that children can learn to explore colours in the natural environment.

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