INTRODUCING STEM AND DIGITAL SKILLS IN ARCHITECTURES IN EARLY CHILDHOOD EDUCATION

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Abstract
To attract the children to science, technology, engineering and mathematics, known as STEM, should start from their early lives in order that the subjects were in the minds and souls of the children since they start knowing the shapes, sizes, spaces, changes, movements, and others around them. Technology is the application of scientific concepts and with these concepts, a human can create technology that we now live with. Children have high curiosity on the phenomena that occur around them. The parents and teachers should appropriately use their concerns on the environment to develop their future interests on STEM and one of them is architecture. The children can be given many kinds of architectural shapes, sizes, and spaces and when they are shown an architectural design, their minds will be working on questioning that their previous knowledge on these architectural forms is useful in creating an architectural design. Their eagerness to know can be geared to knowing more and higher on architectural products by showing the architectural megastructures, such as the Borobudur in Indonesia, the Taj-Mahal in India, The Great Wall in China, The Twin-Tower in Malaysia, The Eifel Tower in Paris and other world monumental buildings. All of these were created by engineers by using shapes, sizes, and spaces in designing the structures. When children are having basic knowledge on architectural structures and designs and combine them with digital skills, that is the time they lay down their professional KSAs (knowledge, skills, and attitudes) in architectures and create perfect mega designs for their community the decades to come.

Keywords: STEM, Curiosity, Digital Skills, Design

INTRODUCTION
Early Childhood Age
When designing an educational program, it is important that we determine the age of this phase of education. What is the cultural age of early childhood in Aceh? According to Islam and the culture of the Acehnese, childhood age is culturally and religiously, from the time they start to speak to the age of "aqil baliq" or about nine years old. Syaikh Salim Bin Sumair Al-Hadhromiy in his book entitled Safinah An-Najjah (Munandar, 2018) said that there are three indications for baliq: (1) boy at around 15 and girl at around 9, (2) when a girl starts having their period and (3) when both experiencing a “dream” and the semen is produced. Since the word “about” is used for limiting the age by Al-Hadhromiy, it can be concluded that the end of a “childhood” is nine for a girl and may be the same or a little bit older for a boy. This age limit is “vague” and not formal in Islam and also for other religions. It’s more of a
religious and cultural rather than biological age. The teaching approach for this age is “early childhood education”. Early Childhood Education (ECE; also nursery education) is a branch of educational theory which relates to the teaching of little children (formally and informally) from birth up to the age of eight which is traditionally about the 3rd grade (Eddy, 2016).

The approach that we use for teaching this group is “pedagogy”, an approach for the early ages of childhood and the pedagogy for children” prior to entering the adolescence, that is from the age of 4 to the age of 17 years old. When we teach adult groups we use "andragogy" and for the elderly, we use "gerontology" (Meyer, 20017).

Laying Down Architectural Interests
Culturally, parents, caregivers, siblings and other extended family members are the first individuals that may shape the children’s views on Science, Technology, Engineering and Mathematics (STEM) in their lives. Most children have a high curiosity towards their environment since they are eager to know anything around them by using their senses. The task of the parents is to stimulate their eagerness to understand stages of STEM development. Each child would use all of their senses to observe, to touch, to taste and to manipulate the objects given to them. The results of a project conducted by IKEA Foundation can be concluded that children are born as a curious human being and their curiosity will assist them in developing their confidence. Once they have had confidence, they will be highly motivated to learn (Sousa, 2016).

When a set of LEGO is given to the children, they will naturally and instinctually take them apart after notifying various shapes, sizes, forms, and spaces. Later on, they will put them back together by placing back the shapes, sizes, spaces, and forms of the Legos into its original design and construction. The children will do it again and again for many, many times until they have acquired “technical and architectural skills” on how to deconstruct and how to reconstruct them properly. Shah and Frith (1993) in the study on the ability of the children to construct “blocks” found that autistic subjects, regardless of age and ability, performed better than the controls when presented without segmented designs. It can be concluded that when the children are having a better understanding of how to design and deconstruct constructions blocks, that is the beginning of their interests on the architectures.

After having their interests and skills on architecture and when electronic and digital devices, such as computers, laptops, tablets, gadgets, and others are known to the children, the children will be able to manipulate the architectural designs digitally. This is the time when all stake-holders of early childhood education, from early childhood to the middle part of primary schools, to lay down architectural interests and develop their imaginations on architecture, especially those who have higher interests on the science of architecture. World wonder buildings should be frequently shown and illustrated to develop their ad-miring, curiosity and higher interests on architectural designs, such as by showing the picture of the Borobudur in Indonesia, the Taj Mahal in India, the Pyramid in Egypt, other great wonders of the world and famous sculptures that can be found around the world. Should there be “Legos” on these wonders, it will help the children to observe, imagine and have dreams of becoming great architects, at least for his or her own community.
Digital Culture and Digital Skills
Many of the parents who are financially “capable” will be providing their children with computation tools using digital transmissions into all kinds of electronic gadgets that they are provided with. These gadgets are so attuned to them from the time their eyes are opened in the morning up to the time that is about to sleep at nights. Many parents are fighting with their children nowadays due to their so much focus on the gadgets. Many of the children of “the haves” start using their computers, laptops, tablets, gadget, smartphones and other kinds of digital cultural products that we are now familiar with are more than ever. The teachers should use this momenta stage to combine the IT and the STEM that are relevant to architecture, to mathematics and other sciences of their interests. They may be more literate in the skills of using gadgets than adults.

These digital devices are now endemic and the skills are permeating into the minds and souls of almost all children from all walks of life of our society. This is the era of “digital culture” where digital skills are the forefront for almost all kinds of engineering and innovation in our modern world, the culture that has brought about by the emergence of digital, networked and personalized media that uses digital compressing and processing capacities at their cores (Rowles & Brown, 2017).

We are now surrounded by the devices and the innovations that are created by the digital culture that makes our life easier and more convenience. However, without proper “management” from parents and teachers, this culture may also disturb the proper growth of our children. The task of the parents and other responsible persons at home is to guide them on how to use this 21st century technology positively that garnered the children to enable them to ignite their senses towards STEM, in this case to the sciences on how to plan, design, and engineer the styles of all kinds of human shelters, space for works, places for worships, space for trades and other kinds of architectural designs. Digital culture, not only influence the architect in architectural designs for the city but also the urban landscape (Picon, 2010).

In fact, understanding shapes, sizes, and spaces are the first among all areas of STEM in the early life of human being. Earp (2018) said that shapes, sizes, forms, and spaces are not only making the children happy with but also indirectly inspire them to create technology. These inspirations will lead the children to use digital skills in manipulating shapes, sizes, forms and spaces to improve their interests and invest their imagination in architectural designs, especially when the 3D or 4D are taught to the later stages of early childhood at about the ages of nine or ten years old. The 3D Studio Max, is a professional 3D computer graphics program for making 3D (three dimensions) animations, models (architecture), games and images. It was developed and produced by Autodesk Media and Entertainment.

The next question for the teachers is “How early should parents and teachers introduce the basics of science, technology, engineering, and mathematics?” How to involve the children in the programs or activities that are related to STEM that is focusing on architecture? Many educators suggest that the teachers not only involving the pupils but also the parents in their spare times that they have, at home and at any of their
family time. Bridging the parents at home and the teachers at school will speed up the minds and souls of the children in the understanding of STEM and its applications to architectural designs and innovations. Marcus Vitruvius, one of the earliest architects in the early Roman Empire described architecture as a passion, a vocation, a calling – as well as a science and a business (Milenkovic, 2014). It has been described as a social art and also an artful science. Architecture must be of the highest quality of design. The architecture provides, in the words of Marcus Vitruvius, “firmness, commodity and delight” (Milenkovic, 2014). He further stated that Architecture provides a sense of place and support of all types of human activity. Architecture helps the man-made fit in harmony with the environment while promoting health and well-being, enriching lives aesthetically and spiritually, providing economic opportunities, and creating a legacy that reflects and symbolizes culture and traditions.

All of us know that in the early years of development, either at schools or home, there are not specific STEM curricula provided by the Ministry of National Education of Indonesia. The teachers who are interested in arousing children's interests in architecture should create their own curricula that lead to opening the children's horizons on how to use shapes, sizes, forms and spaces in architectures. Basically teachers, in any given situation at school and the parents at any situation home, both, need to be thinking of methods to be selected, values to be taught, norms to be maintained and ideas to be developed to enable the children to widen their horizons on architectural insights.

The society provides a cultural basis for design and interpretation. The culture within a given society is often not a simply categorized element, being entwined on differing levels through many social instances. The practice of architectural design captures the cultural and societal influences relative to the specific design problem and translates these influences into a structure which embodies the culture (Erdogan, 2018). The task of the teachers is to combine the STEM development with the development of digital cultures.

**Digital Skills on 3Ds and 4Ds**

The teachers should develop programs that are fun to play, thoughtful to experiment and skillful to investigate, which later on familiarize the children with KSAs (Knowledge, Skills and Attitudes) in using digital skills, cognitively, motorically and affectively (Bloom, et al., 1956; Krathwohl, 2002). The children should be taught the methods to be used, the ideas to be developed and the values of architectural designs and innovations to be included in the digital cultures. They should be facilitated with these skills at school and later on develop further at home with the help of parents and peers. Having parents engaged in the "bridging programs between the school and home" will give motivations to the children and they are being appreciated for such collaboration.

Earp (2016) said that the pedagogical model that can be used for this collaboration is ERA: Experiences (children undertake experience before they get used to the Apps; Representation (the Apps representation of those experiences); and Application (children applying those experiences through play-based engagement beyond the app). The first app, according to Earp (2016) is to engage the children with patterns and the relationships between the patterns. The second is based on the surrounding location
and arrangement to engage children’s spatial reasoning. Architecture, according to Gardner (1993) is a science that mainly focuses on “the use of spaces” by applying “spatial Intelligent” and "reasons for using the spaces". Spatial is one of nine bits of intelligence possessed by a human being (Gardner, 2000).

The procedures that were proposed by Earp (2016) were by giving the children explicit verbal language on the names of every shape, size, form and space, followed by explaining them explicitly the contextual language to be used (terms as used in the science of architecture) and connect them with what they are asked to do by the teachers, such as to construct or to design a bedroom.

After experiencing the above activities, Lowrie (2017) suggests that the children are taught to conduct an investigation using logical reasoning by interpreting pieces of evidence based on the facts that they have observed in their experiment. When the children are able to use the digital skills in modifying the designs or spaces, sizes, shapes, and forms, either by using the 3Ds or 4Ds, they can flexibly change them and they can see the evidence right before their own eyes.

Lowie said that it was a really good way of introducing to them some really important STEM values – that was, that the children could make an informed decision based on the evidence that they had. When they have more evidence on their experiences, they will have the flexibility of being able to change that way of their thinking once the extra evidence is coming to their very bare eyes using computerized images. Such a project experiment was developed in Australia, sponsored by the Australian Government's National Innovation and Science Agenda, and it worked in promoting digital skills among the children in Australia. The research was taken place at the University of Canberra STEM Education Research Centre. We do believe that it will work well if a similar project is developed here in Aceh.

**Skills Needed for Teachers**

Not all children have interests in architecture. This paper is presented and aimed at informing the teachers of PAUD (Pendidikan Anak Usia Dini, or Early Childhood Education) that this is the time for them to develop a new literacy program in order to develop the 21st-century children in the 21st-century classroom. Once they have had these skills, the teaching will be easier for the teachers to teach and for the children to learn as well as for the parents in bridging the school programs and related activities at home. To make it even better and easier, the parents should also be trained with some basic skills of this new literacy program that is the literacy in digital skills in this digital culture. Sadly, according to the surveys conducted by the writers to several kindergartens in Banda Aceh, and found that only 5% of the teachers are capable of using digital skills in teaching and combining the STEM with the IT in transferring the KSA (Knowledge, Skills, and Attitudes) to the learners.

In this case, architecture is a combination of skills, attitudes and the loves of the STEM-related to the arts of designs and structure. The Encyclopedia Britannica (2017) stated that “architecture is both the process and the product of planning, designing, and constructing buildings or any other structures. Architectural works, in the material form of buildings, are often perceived as cultural symbols and as works of art. Historical civilizations are often identified with their surviving architectural achievements”. Showing the magnificent designs of the Borobudur and Taj Mahal, for
instances, will develop their inquiries on how two different cultural heritages are blended into architectural designs.

CONCLUSIONS
Teachers will be left behind should such skills are ignored by the teachers themselves and by the institutions where they are working with, either the institutions operated by the state or private foundations. The government should also pay more attention to improving the know-how among the teachers at the primary levels, starting from the playgrounds, the kindergarten, and the primary schools. The existing data at the Banda Aceh Municipality suggests that there are no STEM and IT training as yet provided by the Department of Education of Banda Aceh, except the ones designed and conducted by the PKK of Aceh and Syiah Kuala University in collaboration with the IMT-GT Uninet in Kuala Lumpur and the Stem Movement Center of Malaysia and the Thai STEM Movement in 2018. This is the foundation where interests on STEM and IT are to be laid down. Laying down their interests from the early stages of cognitive development will help them improve their "integrated inquiry" on science, mathematics and IT. Having higher inquiry on STEM and digital cultures will drive them to search for more as they grow and study.

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