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ICT-based Elementary School in Indonesia: Curriculum Content, Strategies, and Challenges

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Abstract

Along with the rapid growth of ICT, many schools offer ICT-based courses or programs. This study aimed to investigate the implementation of ICT-based elementary school in Indonesia focusing on the curriculum content, the strategies for integrating ICT curriculum into national curriculum, and the challenges they faced in running the school. Taking the case at SD ICT Al Abidin Surakarta, Indonesia, this study employed a descriptive qualitative method by conducting interview, observation, and document analysis. The result showed that the ICT curriculum included coding as the main skill by using several applications namely Code.org, Scratch Jr., Kodular, and Tinkercad.com. There were also several supporting skills taught namely rapid typing, hardware knowledge, basic Microsoft Office, graphic design, and ICT unplugged. They arranged the national curriculum content first and then added ICT content into daily learning activities. The challenges in running ICT school were the difficulty in convincing parents about the benefits of learning ICT skills, the absence of ICT school as a model in Indonesian context, and the limitedness of ICT teachers in the school. To solve it, they regularly conducted socialization to parents about ICT through seminar and social media campaign. The limitedness of ICT teachers was solved by providing regular training for class teachers to learn about ICT so they could teach ICT as well whenever needed. This study implies that ICT skills can be taught since early age and it can be integrated into formal education. For that purpose, it requires adequate learning facilities, skilled teachers, and mutual coordination with parents.

Keywords: ICT-based School, Curriculum, Coding, Elementary School

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Abstrak

Seiring dengan pertumbuhan pesat TIK, banyak sekolah menawarkan kursus atau program berbasis TIK. Penelitian ini bertujuan untuk mengetahui implementasi sekolah dasar berbasis TIK di Indonesia yang berfokus pada isi kurikulum, strategi mengintegrasikan kurikulum TIK ke dalam kurikulum nasional, dan tantangan yang mereka hadapi dalam menjalankan sekolah tersebut. Mengambil kasus di SD ICT Al Abidin Surakarta, Indonesia, penelitian ini menggunakan metode deskriptif kualitatif dengan melakukan wawancara, observasi, dan analisis dokumen. Hasil penelitian menunjukkan bahwa kurikulum TIK memasukkan coding sebagai keterampilan utama dengan menggunakan beberapa aplikasi yaitu Code.org, Scratch Jr., Kodular, dan Tinkercad.com. Ada juga beberapa keterampilan pendukung yang diajarkan yaitu mengetik cepat, pengetahuan perangkat keras, Microsoft Office dasar, desain grafis, dan ICT unplugged. Mereka menyusun konten kurikulum nasional terlebih dahulu, kemudian konten TIK ditambahkan ke dalam kegiatan pembelajaran sehari-hari. Tantangan dalam menjalankan sekolah TIK antara lain sulitnya meyakinkan orang tua tentang manfaat mempelajari keterampilan TIK, tidak adanya sekolah TIK sebagai model dalam konteks Indonesia, dan keterbatasan guru TIK di sekolah. Untuk mengatasinya, mereka rutin melakukan sosialisasi kepada orang tua tentang TIK melalui seminar dan kampanye media sosial. Keterbatasan guru TIK diselesaikan dengan memberikan pelatihan secara berkala kepada guru kelas untuk mempelajari TIK sehingga mereka dapat mengajar TIK dengan baik kapan pun dibutuhkan. Studi ini menyiratkan bahwa keterampilan TIK dapat diajarkan sejak usia dini dan dapat diintegrasikan ke dalam pendidikan formal. Untuk itu diperlukan fasilitas belajar yang memadai, guru yang terampil, dan saling koordinasi dengan orang tua.

Kata Kunci: Sekolah Berbasis TIK, Kurikulum, Coding, Sekolah Dasar

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INTRODUCTION

Information and communication technology (ICT) has played an important role in human life. Since the era of internet and smartphones, this kind of technology has grawn more rapidly than before and is used by most people over different ages, from children, teenagers, to the elderly. Many activities can be done if they have the device as well as internet connection. Children who were born in the 2000s are computer and smartphones-literate and even they are able to operate those devices before they can write or read, for example, to watch videos and play games. This condition, unfortunately, tends to make them the user of ICT products, especially for entertainment purposes, not the creator who might lead the technology development. It has become an important issue in recent years for parents and schools that the children are being 'addicted' to ICT products on their hands. They prefer spending time with their mobile phones to studying school subjects. However, every change must have both positive and negative sides. What people need to do is to deal with those sides and take the benefits for a better life.

The rapid growth of information and communication technology cannot be avoided in our daily life and interaction. With smartphones on their hands, people can do many things such as reading news, playing games, watching videos, making payments, ordering food, shopping, having a conference, listening to music, etc. In fact, information and communication bring good things to people. If it is used properly, people can take many benefits.

Children are now active users of ICT as well, for either educational purposes or entertainment. Many educational applications are available and continually developed through which children might learn simple to complex activities across various topics and genres. Along with the growth in ICT industries, several providers offer courses that allow someone to create his own program or application (Staubitz et al., 2015). Eventually, the kinds of courses are also provided for children. It's such a good idea and widely accepted. It lets the children know how the technology really works so that they can be a creator, not merely a user (Kaplancali & Demirkol, 2017). In addition, learning programming for kids is beneficial for their development (Arfé et al., 2019; Çiftci & Bildiren, 2020; Coravu et al., 2015).

One of the basic skills to be learned in dealing with information and communication technology is coding. This idea has been well-managed by European countries by implementing coding in the school curriculum in 2015 and the United States of America in 2016. In those countries, coding is taught since elementary school level. Coding itself is the very basic skill to develop application, software, and any other digital products (Kaplancali & Demirkol, 2017).

There are several studies about teaching ICT skill for children. Kaplancali & Demirkol, (2017) conducted a study about the methodology to teach coding to children. They believed that teaching coding to children would give them a skill for life. They argued that effective coding teaching ought to follow seven fundamental concepts of coding. Those are algorithm, loops, if statements, functional and procedures, graphics, variables, and finally list and indexes. They built CiK, an independent coding library platform that supports Turkish with its editor. It was developed based on seven fundamental concepts in coding.

Coravu et al. (2015) conducted a study about Scratch and recreational coding for kids. This study evolved the direction of teaching computer programming concepts to young students of primary and secondary schools. They believed that involvement in this work field could prove beneficial for the national educational policy, and consequently, for turning the interest of young generations to STEM-oriented careers. Arfé et al. (2019) investigated the correlation between coding in primary grades and children's executive function. By conducting a longitudinal study involving coding activities and standard STEM activities, they found that children exposed to coding improved significantly more in planning and inhibition tasks. The longitudinal data showed that improvements in planning and inhibition skills after 1 month of coding activities (eight lessons) were equivalent to or greater than the improvement attained after 7 months of standard activities.

These findings support the hypothesis that learning CT *via* coding can significantly boost children's spontaneous development of EFs.

Teaching coding for kids has become a trend globally. There are many online courses and open sources which provide coding activities. Learning coding at a young age is believed to bring benefits for the future. Between the ages of 5 and 7, in the transition period from preschool to primary school, children undergo rapid changes in their cognitive functioning. The product of these changes known as executive functioning (EF), has long-lasting effects on their future academic achievements and self-regulation skills, and coding has been proved as a positive intervention (Arfé et al., 2019).

The development and evolution of telecommunications and technology facilitate the rapid transmission of information, including in the education sector (Setiawan, et al., 2019). ICT has been utilized for school and learning management purposes (Giarti, 2016). It is also included in the curriculum content as an additional subject, especially for junior high school and senior high school levels. Even so, it is still a lack of infrastructure and teacher competency in the implementation at the national level. (Hermawan et al., 2018). Unfortunately, ICT is still rarely taught in public elementary schools in Indonesia since it does not belong to the compulsory national curriculum content whereas the other countries have massively taught ICT and programming at early age both at school and at home context (Kaplancali & Demirkol, 2017; Unahalekhaka & Bers, 2021).

This gap was well-managed by an elementary school in Surakarta, Indonesia which saw the emergence issue in the growth of ICT. Children of elementary school age nowadays have become active users of technology, where actually they can do more if they have adequate ICT skills. ICT skill will become a fundamental skill in the upcoming digital era of the 21st century (Papadakis, 2022; Popat & Starkey, 2019). Therefore, the school integrates coding and other ICT skills into its curriculum and implements ICT-based activities in its daily learning. This is SD Information and Communication Technology (SD ICT) Al Abidin Surakarta. As the first ICT-based elementary school in Indonesia which was legally declared as an ICT school at elementary school level, there are many challenges at the beginning to translate the idea of an ICT-based school. However, realizing the benefits of ICT skills for future life, they struggled to provide coding and other ICT skill for their students.

This study investigated the implementation ICT curriculum and its integration into national curriculum in elementary school. This study focused on the contents of ICT skills taught to the students, the strategies to integrate the ICT content into the national curriculum, and the challenges in running an ICT-based elementary school. The novelty of this study lies in the newly explored topic of the integration of ICT curriculum into the national curriculum for elementary school level in Indonesian context. Several implications of this study are also elaborated to provide insightful information for schools, teachers, and stakeholders in managing ICT-based school, especially for the elementary level of education.

METHODS

This study employed a descriptive qualitative method. It was conducted at SD ICT Al Abidin Surakarta from April to May 2021. The data were collected by interview, document analysis, and observation. The interview was done to collect information from the school principal, the vice principal for curriculum affairs, and the teacher about the content of ICT skills, the challenges, and the strategies in implementing the ICT curriculum. The document analysis of student handouts and school profile was done to see the integration of the ICT curriculum into the national curriculum. The observation was done to see the school facilities which supported the implementation of ICT-based school.

The data were analyzed using a thematic method to formulate the findings based on the research focuses, namely the contents of ICT skills taught to the students, the strategies to integrate the ICT content into the national curriculum, and the challenges in running an ICT-based elementary school. The data were read and examined several times and unnecessary information was omitted. After that, the data related to the focus of this study

were critically analyzed, and eventually, the conclusion was drawn. For data validation purposes, the information has been confirmed for different periods of time to check the consistency.

RESULTS AND DISCUSSION

The Content of ICT Skill

This school believed that comprehensive ICT skills didn't depend on coding skill only. Therefore, they created a curriculum that contained both coding and general ICT skill (supporting skill) to build comprehensive skills for the students. For the coding skill, they used different platforms depending on the types of activity and the consideration of the students' readiness. This school used Code.org for students in grade 1. Students in grade 2 used Scratch Jr. Students in grade 3 used Scratch Jr and Kodular. Code.org and Scratch Jr are coding platforms for kids provided free by the Massachuset Institute of Technology (MIT). Those platforms provide game-based coding that grows the students' computational thinking. Even though those platforms are open access and can be accessed freely at any time, this school believed that the school environment would bring a better atmosphere in learning coding such as guiding the students step-by-step in learning coding as well as supporting skills, building the students' characters, and integrating coding to the national curriculum that ensures the students follows the national standard of Indonesian education.

> "The benefits of learning coding at school compared to an online course is that at school we arrange the materials on daily basis, make it step by step from simpler to more difficult ones. Students are also guided by a teacher, and here we also provide supporting skill to develop the students' skill comprehensively." (Interview with Vice Principal of Curriculum Affairs).

Higher grade students learned coding using different applications and platforms providing more complex skills. Students in grade 4 used Tinkercad.com which employed higher logical and step-by-step thinking. The rapid ICT development has led many providers to provide an open-source platform that enables kids to learn coding online.

> "Coding is the core of all ICT skills. It is presented in a block game which is fun like playing a game. This is the way to teach about logic, step by step in solving problems. This is very beneficial for the kids, whatever they will be in the future, not only for computer programming." (Interview with the Principal).

> "Nowadays, there are many online coding sites that we can use online. Previously we have to install the application, but it caused some problems such as the compatibility with the device. Now we prefer using online sources which have more features than the offline one." (Interview with Vice Principal of Curriculum Affairs).

Visual programming tools based on blocks are the most common way of introducing children to coding at an early age. Furthermore, the use of a coding platform is also suited to children's ages. For example, Code.org provides online coding programs since the age of 4 by combining plugged and unplugged activities. In this stage, children learn about digital citizenship, sequencing, loops, and events (Kaplancali & Demirkol, 2017). The coding activities are getting more complex as it is designed for older ages, such as Minecraft coding which is designed for middle school students (Kutay & Oner, 2022). Even though Code.org has designed the activity based on the ages and logical development, it can be taught based on the students' conditions in Indonesia. The school can modify the programs as long as it follows the learning path.

Strategies to Involve the ICT Curriculum into National Curriculum

SD ICT Al Abidin Surakarta implemented KTSP (Unit-Based Curriculum). This curriculum allowed schools to develop curriculum according to their needs (Permendiknas No.24/2006). This school implemented full-day learning activities, six days per week. Therefore, it had more time allotment for additional content. The standard curriculum based on national education law was prioritized in the learning activities. After all the national curriculum contents were

arranged in the schedule, then the ICT curriculum and other additional materials were added, including extracurricular activities.

> "Of course, we have to make sure that all national curriculum contents are well arranged and scheduled. After that, we can add coding lessons and others. We consider the time availability and if there is enough time, we can make more extracurricular activities." (Interview with the Vice Principal of Curriculum Affairs).

For lower grades (grade 1 and 2), the school time allotment was 40 sessions/ week, while higher grades (grade 4, 5, and 6) have 50 sessions in a week. Within the time allotment, the school allocated 10 sessions per week for ICT lesson which was spread on an everyday basis.

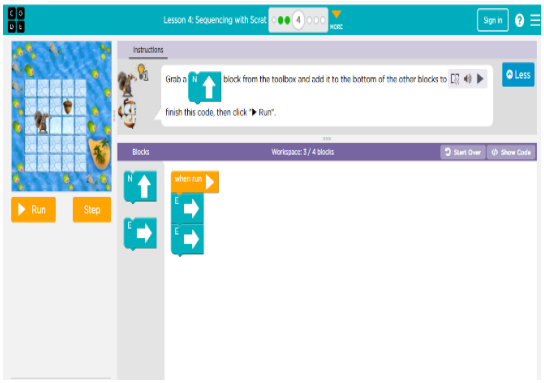

Figure 1. One of Coding Activities Taken from Code.Org

Other than the ICT curriculum, this school also included English lessons and Islamic content i.e *tahfid* Alquran and mentoring *adab*. On certain occasions, the school management also provided activities that encouraged the students' creativity in ICT, such as vlog competition after mid-test or semester test.

> "Other than ICT, we also include English and Islamic teaching. We choose English because it is the language used in general communication and information worldwide. Later, many (ICT) references are also available in English, so it will help the students in the future. Then, because we are an Islamic foundation so we include mentoring *adab* (Islamic character building) and *tahfid*. We hope whatever they will be in the future, as programmers or else, they will have a good personality and strong character." (Interview with the School Principal)

After the time allotment was fixed for the national curriculum and ICT curriculum, then they arranged the topics to teach, including coding materials and supporting materials. The teaching and learning activities were planned from the semester program. Once the semester program was fixed then the teachers arranged weekly learning materials.

As it is stated by Wong et al. (2015), the success of integrating coding curriculum into school curriculum depends on the perceptions of teachers and headmasters in schools, how well they believe in coding education, and prepare for the innovative teaching and learning. The arrangement in this school has considered several aspects such as the time allotment, the national curriculum content, types of coding activity, and the students' development. In fact, coding is not merely about working in front of a computer. It also can be implemented through mathematical problem solving, social skills, self-management, and other academic skills (Popat & Starkey, 2019). Therefore, schools can modify various learning experiences that can support coding learning.

Challenges in Running ICT-based Elementary School

As the first school which implemented ICT curriculum, there were several challenges faced by the management.

Educating Parents about the Importance of ICT Skill

Based on the interview, it was revealed that this school still faced a challenge in convincing the parents to enroll their children in this school as not many parents had realized the function of ICT skills for their kids in the future. The stigma in our society shows that ICT skills for children may result in gadget addiction which is not good for their children's development. Meanwhile, this school believes that it is impossible to separate our children from technology, so the solution is to guide them to use the technology wisely and develop the mindset to be the creator of ICT content.

> "Most parents are afraid that their children will be addicted to smartphones. But, we in SD ICT Al Abidin believe that smartphone is very beneficial if we can teach them what to do with smartphone properly. So, they don't use it for playing games only, but they can create the game, especially for educational purposes. Here, we teach them about logic, ICT skill, coding, etc." (Interview with the Vice Principal of Curriculum Affairs).

To solve this problem, this school regularly conducts socialization with parents concerning the role of ICT skills in life and its benefits for children, strategies to overcome gadget addiction, and similar topics. They also produced digital content to promote the importance of coding skill for children. They usually cooperate with kindergartens and other institutions such as government offices as it is stated by the school principal.

> "We make much socialization through social media and offline meetings before the pandemic. During the pandemic, we make it online through a virtual seminar or WhatsApp group. We try to give a new point of view to parents about ICT skills. Some parents who have already known are so interested in this school program. However, more parents do not know yet, and that still becomes our homework." (Interview with the School Principal).

This kind of socialization with parents was considered as an effective way to convince them about the importance of ICT skills for their children. It was in line with research by Maruyama (2019) which investigated the impact of conducting programming seminars for parents. The study revealed that participation in programming seminar boosts parents' expectations and decreases anxieties about introducing programming education to primary schools. It also suggests that parents' attitudes and confidence in involvement in supplementary instruction at home improved.

The Absence of Role Model of ICT school

The second challenge of this school in running the ICT curriculum is the fact that they are the pioneer of the ICT school itself. In fact, Indonesia still is one of the countries that have less development of ICT in education (Hermawan et al., 2018). This condition forces them to arrange the curriculum themselves. Helped by an ICT consultant, they developed the curriculum content by researching several coding providers and arranged them into the school curriculum based on the students' level.

> "Because we are the first school which implements ICT curriculum, we really arranged the content by ourselves. Yes, we have an ICT consultant working with us, but then how we translate it into a school curriculum is very challenging." (Interview with the School Principal).

There are some aspects they consider in arranging the ICT contents, namely the recent development of ICT, the future needs, and the coding skill complexity. To deal with the students' and curriculum needs, they always try to keep up-to-date about coding activities and coding applications/providers. Should it meet their requirement, this school can use it for daily school content.

Preparing Teachers to Teach ICT Content

Another problem faced by this school in running ICT curriculum was the teachers' capability to move to digital learning since not all teachers have adequate ICT skills.

> "The challenge I found was when we have to move to digital content. We struggled to develop the content and made several revisions until it was ready to use in daily learning activities. We learned to make videos, make quizzes, and other contents in a relatively short time. It also needed effort to help the students adapt to electronic device and digital content." (Interview with the School's Teacher).

Figure 2. Classroom Layout, One Student One Computer

This school divided the teachers into two categories, namely class teachers who teach national curriculum content and ICT teachers who are responsible to teach coding and supporting ICT skills. The class teachers should be also responsible about the digital learning content. Due to the limitedness of the ICT teachers, the class teachers were also asked to learn ICT so they could teach coding and other ICT skills. This is very important because teachers play a very important role in any initiative aimed at the integration of information and communication technology in education and they are the key component for learning using ICT in schools (Yusri & Goodwin, 2013). In addition, it can not be denied that education in the 21st-century era demands teachers and learners to be digital literate or tech-savvy, and able to use ICT applications and procedures as teaching and learning tools (Hafifah & Sulistyo, 2020).

The limitedness of ICT teachers to teach coding in primary schools was because computer science graduates are more likely to take technology jobs than teaching jobs (Kundukulam in Mason & Rich, 2019). Therefore, in some other cases, school principals are relying on existing teachers to teach computer science, instead of hiring specialists to teach coding and computing (Rich et al., 2019). Unfortunately, most elementary school teachers have not been trained in the content and pedagogy of computer science.

For this reason, the school provides training for the teachers. The training depended on the need. It could be weekly or daily. The ICT consultant hired by the foundation helped a lot in providing the training for the teachers in this school. They also invited other professionals to work with. The training included several topics such as coding, learning media and application, and creating digital content. It is in line with Hockly (2012) who defines that digital literacy covering information, media, and technology skills is needed to face the 21st-century education era. By developing the teachers' competence and IT-supported by their attitude toward information and communication technology, this school believed that it could grow fast in a couple of years. Teachers' attitude and competence are both important factors in integrating ICT into teaching and learning activities.

To gain the competence and confidence to teach computing, elementary school teachers need effective preservice and in-service training. For teachers to teach with technology, there are several aspects they must understand, namely the content they are teaching, the technology they are using, and pedagogy related to the content, technology, and students (Mishra & Koehler, 2006). This is also in line with the values of professional teachers, namely (1) committed to students and their learning; (2) in-depth mastering the subject that they teach and how to teach to students; (3) responsible to monitor student learning outcomes through various means of evaluation; (4) able to think systematically about what he does and learn from experience; and (5) be a part of the learning community within the profession (Tanang et al., 2015).

CONCLUSION

Teaching coding and ICT skill in elementary school is a new trend in Indonesia. It has been implemented by a private school in Surakarta, Indonesia. SD ICT Al Abidin integrated the national curriculum and ICT curriculum. The ICT curriculum included coding as the main skill by using several applications namely Code.org, Scratch Jr., Kodular, and Tinkercad.com. There were also several supporting skills namely rapid typing, hardware knowledge, basic Microsoft Office, graphic design, and ICT unplugged. They arranged the national curriculum content and ICT content into daily basis learning activities. The national curriculum was scheduled first, then ICT content was added. There were several challenges in running ICT school, namely the difficulty in convincing parents about the benefits of learning ICT skills, the absence of previous ICT school as a model, and the limitedness of ICT teachers in elementary school. To solve it, they regularly conducted socialization with parents about ICT through online seminars and social media campaigns. As the first school to integrate the ICT curriculum, this school always tried to keep up-to-date with ICT and coding development so they could always provide the newest technology. The limitedness of ICT

teachers was solved by providing regular training for class teachers to learn about ICT so they could teach ICT as well whenever needed.

This study implies that ICT skills can be taught from an early age and supported by various learning platforms that enable children to learn coding or programming from simpler to complex activities. ICT skills can also be integrated into formal education by combining national curriculum and ICT materials and implementing coding practices in other learning experiences. For that purpose, it requires adequate infrastructure, skilled teachers, and mutual coordination with parents since ICT skills learning experiences are practiced in school and home contexts. Further studies may address students' perceptions of attending ICT-based schools to explore their learning experiences as well as the impacts they feel.

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