

Becoming a Smart School: A Holistic View of Technology Integration

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This paper aims to theoretically investigate strategies for successful management of smart schools, in which technology is the key factor to change, not only in the classroom instructions but also overall in school education. First, the authors examine the shift in the educational paradigm that would support the society in future and the changes in the process of teaching and learning. Next, the problems related to existing research on technology utilisation and the range of technologies available in schools are discussed. Third, a systemic plan is suggested for activation of smart school management. The paper concludes with a summary of the strategies needed to establish and run a smart school.

Keywords: *Smart School, School Climate, Technology Integration, Curriculum Management, Technology application.*

Introduction

Development of technology has led to reforms that have created a new digital culture in educational environments. Revolutionary developments that include wireless communication technology, open networks, mobile technology and cloud computing make it possible to offer a customised learning environment at all times. With these developments and the expansion of information, it is important to meet the needs of the learners in a smart way.

As a tremendous amount of accessible information is continuously generated because of the development of information technology (IT), it is more important “to know how to get information when it is needed, in a proper manner” than just “to be able to access the information” (Fischer, 2001). The ability to adeptly handle novel technology and access useful information quickly is known as IT competency. Individuals equipped with IT competency are well-equipped to solve complex problems in today’s diversifying and evolving society. This

ability is essential in the present era (Cheon et al., 2012). While numerous studies report the usefulness of technology integration in school education, few schools actively seek to use technology to improve the quality of education (Chauhan, 2017). One of the problems regarding research on technology effectiveness is that it focuses only on the effectiveness of technology utilisation in teaching and learning, but does not look at its connection with other important factors like the curriculum, school climate and teacher cooperation that can enhance the effectiveness of school education (Toh, 2016). Studies on exceptional schools suggest that the excellence of education in a school depends on complete quality management in all areas of schooling, not just effectiveness of classroom instruction (Rutter & Maughan, 2002; Hargreaves, 1995).

For advanced technologies to contribute toward substantial enhancement of learner competency, a new paradigm is needed that recognises technology as a key factor in changing a school, not only in terms of the classroom instruction but also in reference to other components of education. Research regarding future education has been conducted with a focus on the development of a technology application model based on the new educational paradigm, but this is not enough to prepare institutional strategies that can help in promoting it (Han & Lim, 2013). Further research is required to determine how to effectively apply technology to improve the quality of school education, including classroom instructions and school administration.

Advanced technology that adaptively responds to human needs presents the possibility of various changes in school education. Schools that actively introduce these technologies are called smart schools (Tyler-Wood, Cockerham, & Johnson, 2018; Sheppard & Brown, 2014; Zin, 2003). The concept of a “smart school” is closely related to the advances and needs of modern IT and introduces reformative ideas for every aspect of school education (Zhuang, 2002). We have identified “smart schools” as a system, which implies that various components, including the use of technology, interact with each other to achieve the goal of being a futuristic school that can respond to the individual needs of each student.

The primary goal of this study is to suggest strategies for successful management of a smart school, in which technology is a key factor to change not only the classroom instructions but also the overall educational experience. To reach this goal the study first examines changes in the educational paradigm that the future society is aiming for and the changes that are expected in the process of teaching and learning. Second, it discusses the problems of existing research regarding utilisation of technology and the range of technologies available for schools. Third, it suggests a systemic plan for activation of smart school management. Finally, the study concludes with a summary of the strategies for establishing and managing smart schools.



Educational Paradigm Change and Technology Application

In the industrial society, teaching and learning activities in public education are primarily focused on developing basic skills such as reading, writing, and counting. However, we live “in a highly mobile, globally connected society and learning that can no longer be confined to the years we spend in school or the hours we spend in the classroom” (Bransford et al., 2006, p.9). As there has been a shift from the industrialised society that was based on resources and labour to a knowledge-based society, the role of schools has become more important as they generate, distribute and administer knowledge. The perception about knowledge has changed from the concept of “stock” to that of “flow,” and school education is required to transform the system to raise learners. Future education programs in primary and secondary schools should address these educational needs and related educational policies must be developed for helping students to gain the benefits without any discrimination or failure (Kang, Lee, & Kim, 2012).

Students are now experiencing new forms of social interaction and learning that are supported by information and communication technology. The method of schooling should evolve to accommodate these changes in a smarter way (Ananiadou & Claro, 2009). Thus, for learners who need the skills to function in a society in future that would reflect numerous societal changes, education to develop key competencies is imperative. Using tools interactively, having the ability to interact in heterogeneous groups and acting autonomously are examples of the competencies that would be needed (Rychen & Salganik, 2003). Active interaction between teachers and students and collaborative learning among students is needed to improve these competencies. Therefore, instructional strategies for future education should be directed toward the harmonisation of teacher-centred education with student-centred learning. The student-centred educational model lays emphasis on the role of teachers as facilitators, instructors and organisers, as opposed to their conventional role as the main agents of education in the traditional model. Student-centred education is focused on highlighting the position of the students as agents of learning by increasing their attention and motivating them to learn, so as to help them develop high levels of thinking, self-directed learning and comprehensive problem-solving skills (Wen & Wang, 2006).

In future, learners will seek qualified educational services that are suitable for the changed communication environment that are different from the uniformed, strict and limited traditional educational services. Under these changed educational services, learner-centred teaching and learning methodologies will encourage students to participate in problem solving group activities and collaborate with others (Park et al., 2010; Kim et al., 2006). The focus of school education also needs to shift from the conventional paradigm focused on delivery and acquisition of knowledge to one that cultivates the ability to learn autonomously and creatively solve a variety of problems. The reformation of educational methods will help students acquire rich and diverse learning experiences. Learning activities such as field experiences and



discussions will also encourage students to share their feelings, thoughts, and express their opinions (Kim, Chung, & Kim, 2013). The goal of future education will also include solving intellectual problems and learning practices while transcending interdisciplinary boundaries. Accordingly, education should help students direct and manage their own learning (Zhuang, 2002). It is imperative to identify ways to help students to solve real-life problems and enhance competencies, and not just knowledge and skills. For example, creating a learning atmosphere in which students respect the opinion of others, as the attitude toward those with whom a person is communicating, is a very important part of life.

Our education system attempts to, “leverage technology to create relevant learning experiences that mirror the daily lives of students and the reality of their future” (Plomp, 2013, p.3). Technology can play an important role in implementing student-centred education. In fact, educational application of IT has promoted changes in teaching and learning methods and expansion of learning spaces. According to Ogle and Branch (2002), there are five main categories of technology utilisation in schools. These are: administrative management systems (that is financial accounting, budgeting, operations, and planning); instructional support systems (that is, distance education, testing); communications support systems (that is, electronic mail, satellite links); and security systems (that is, firewall technology, secure transmission systems). These technology applications contribute to the improvement of school education in different ways. Also, the use of appropriate technology can improve the effectiveness of the school administration (Weng & Tang, 2014).

However, school educators do not utilise these properly nor in a systematic manner. If school education is looked at as a system, the performance of each component of the system would be directly related to the overall quality of school education. The components that make up the school system are diverse, and the effective use of the technology should be closely related to these components to improve the quality of education. For instance, use of technology may increase the transparency of the execution of the school budget. If the detailed budget expenditures are stored in an information system, the transparency of the budget would be ensured and efficient management would be possible (Eggers, Baker, Gonzalez, & Vaughn, 2012). As the budget in most schools is limited, proper use of the budget can have a significant impact on the quality of school education.

Another example could be customised assessment using database technology. According to Shirley and Irving (2015), a technology based individualised assessment system will be an important component of schools in the future. If schools use a tailored assessment system that includes specific feedback, students would be able to develop thinking skills and broaden their perspective while investigating problems (Kim, 2011). The assessment system should be able to embrace the differences in learners based on tracking their learning and outcomes. Utilising technology as a part of evaluation will enable schools to diversify the styles and methods of



evaluation, enable them to continuously update the results of evaluation, and will contribute to the establishment of customised databases for each student (Huang & Mao, 2004). Based on the results, teachers and schools will be able to complement the learning of the students, and students will be able to identify their weaknesses and attempt to address these themselves.

Although there are many different ways of applying technology in schools, studies have mostly discussed it in terms of classroom instruction. Not all studies report the benefits of technology in school education. In fact, there is a lot of research on how students could not benefit from specific innovations that characterise the use of technology for teaching and learning (Zielezinski & Darling-Hammond, 2016). Although smart learning concepts promoted by smart schools, which are self-accessed, self-paced and self-directed learning, are highly advanced ideas, it is not easy to put them into practice. Smart schools provide IT and multimedia environments as well as design appropriate multimedia courseware, but cannot guarantee that the students will utilise these to engage in effective learning. It is not possible for multimedia or computer technology to automatically make students learn. While advanced technology is certainly an effective aid for learning, it cannot replace teachers (Huang & Mao, 2004). Although it is not easy to create a smart learning environment, it is even more difficult to foster a smart learning culture. To establish a smart school that meets the needs of future societies, school educators need to expand the use of technology in a slightly different manner. One of the goals of the expansion may be associated with key competencies that students need to acquire for future society, such as creativity and communication skills. There are areas where the use of technology has a direct impact on the student's competencies, while there are some areas in which an indirect effect is seen. Technology can greatly contribute to the enhancement of student competencies. Therefore, we should look at the use of technology from a holistic perspective to develop student competencies.

Curriculum Management

In a knowledge-based society the explicit knowledge that is clearly explained and expressed and the tacit knowledge embedded in the individual are both important. Through knowledge acquisition and creative activities, implicit knowledge can be translated into explicit knowledge and experiences that generate knowledge by themselves (Park et al., 2007). The new educational system requires the reorganisation of curriculum with a focus on explicit knowledge and change in educational methods based on knowledge transfer and acquisition (Lee et al., 2008). This implies that contents of the curriculum and methods should be more varied to develop human resources with creativity. In addition, as the meaning and value of knowledge in a knowledge-based society becomes narrower than in traditional pedagogy or epistemology-based society, there is a need to highlight the importance of fundamental education.

It is not possible to develop the required human resources for meeting the needs of the future society through traditional knowledge-based education. Thus, curriculum that focuses on

developing the skills that are essential for the twenty first century is needed. All contents that are needed for a post-industrial society, network society, and pluralism, should be included in the curriculum. Lee et al. (2009) listed specific core competencies that should be included in the education curriculum such as creativity, communication skills, human relation skills, self-regulation skills, basic learning skills, civic consciousness, understanding international social culture, and career development skills. However, it is not certain how these competencies can be included and reflected in the curriculum. Though the educational system will be quite varied and will include divergent characteristics, the common learning contents should be revised for all learners at the basic levels of primary and secondary education as required. Moreover, once the requirement learning processes are prepared, an official evaluation process should be followed. Further, various processes for developing each essential skill, technique or ability should be provided, so learners can select a more appropriate and interesting curriculum for themselves (Lee et al., 2008).

Future school programs would have to establish a system in which students learn at their pace and level based on a non-graded system. In the educational system, higher level institutions could provide standardised learning objectives and learning resources such as necessary learning materials, but the choice of these materials should depend entirely on each school (Shephard, Kossly, & Hammonds, 2011). The teacher would have to establish a learning plan with the student through counselling and would need to monitor if the student is learning properly according to the plan. Regular classes would have to be organised, but students would not have to attend the class always. They would attend the classes based on their needs or could also learn by themselves at a convenient place. The educational space for this customised learning would be established through educational systems using advanced technology. In future schools, the distinction between schools and informal academies may disappear because learning spaces would be created in various places (Voogt, Ersta, Dede, & Mishra, 2013).

However, there is still a need for an organisation that can manage the learning at the basic and required education level, and the smart schools should take charge of these tasks (Heo, Lee, Kim, Lim, & Kang, 2013). In particular, organising the curriculum linked to a student's life would be the school's primary responsibility. Unlike in the past, many students now question the importance of the educational content that they learn at school. Students should be given the opportunity to explore the topics that they are interested in more deeply. This could include topics that reflect the particularities of their communities and cultures. Digital learning activities associated with the culture and community of the learners are more successful than culturally unrelated ones. (Zielezinski & Darling-Hammond, 2016). Designing the curricula for smart schools involves realising the novel values of the curricula by converging the theoretical principles and methods of modern education with the demands of the developing generation, local culture, social background, and modern educational technologies. More specifically, such a design facilitates complete and balanced development of students while incorporating accurate application of



knowledge, function, values, and language in all curricula (Zhuang, 2002). For example, the design of the smart school curriculum that is being designed in Malaysia is focused on significant learning and social responsibility, diversified cultures, reflective thinking, totality, globalism, openness, goal-centeredness, and technological application (Huang & Mao, 2004).

School Climate

School climate has been recognised as a means to enhance the achievement of students and reduce problematic behaviours and dropout rates. Innovation in school education can be achieved only by the efforts made by teachers. The most important factor in the school climate is the relationship between school members. That is, a positive relationship between teachers and students, students and students, and teachers and teachers, is the foundation for building a better school (Wang & Degol, 2016). When students are respected by teachers and fellow students, they develop a strong sense of community. A student's sense of belonging in a school and emotional ties with the teachers helps him or her to overcome the difficulties that he or she might experience in school life and contributes toward improving his or her academic performance (Hajovsky, Mason, & McCune, 2017). Likewise, if there is a good relationship between teachers and students, and a school climate where teachers can trust and rely on each other, then the effectiveness and efficiency of all activities at the school will increase. In other words, creating a respectful and amicable school atmosphere produces a high-quality learning atmosphere that promotes a good environment in class, which is important for creating the ideal classroom environment. Furthermore, when combined with various teaching and learning strategies, a constructive school atmosphere can have a positive impact.

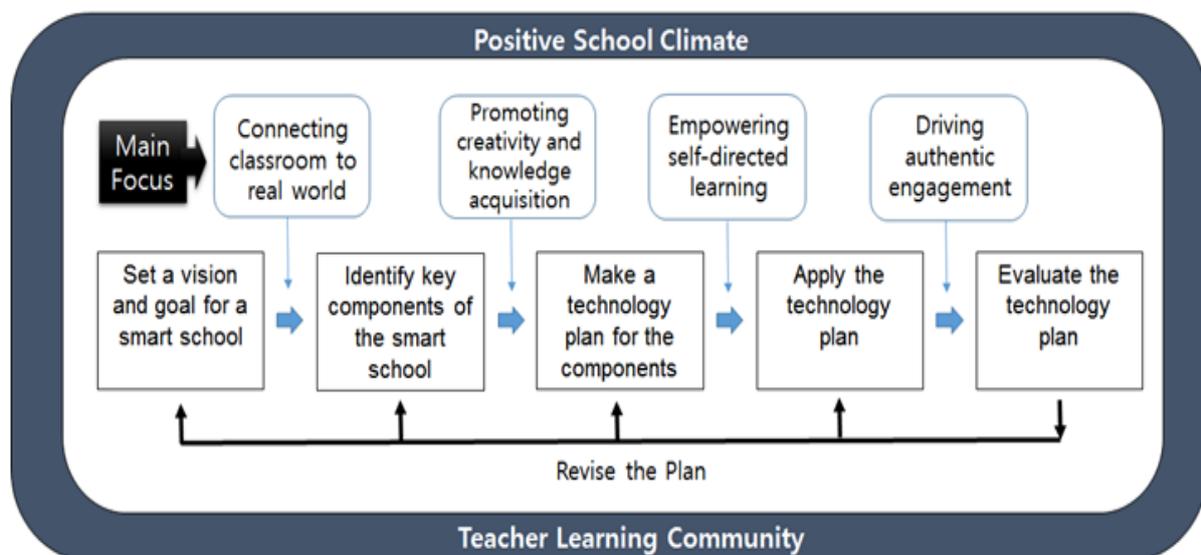
The school climate is initially cultivated through the efforts made by the teachers. It is not possible to change a school with the effort of only one or two teachers. The teachers learning community transforms the school organisation into a learning organisation by encouraging teachers to cooperate with each other without separating learning and practice, resulting in innovation in school education (Seo & Han, 2012). The teachers learning community does not separate the teacher's learning and practice, but makes the school a venue for developing the expertise of teachers. It educates teachers about the various factors that support education (such as IT), provides educational motivation, and helps them to continuously advance in their major courses of study to aid further growth (Huang, 2001). In particular, technological pedagogical content knowledge is now vital for teachers during this time of the fourth industrial revolution (Kim & Kim, 2017). Teachers must strive to develop competencies by learning the effective uses, purposes, and methods of utilising new technologies through a learning community. The capability of a teacher is directly associated with educational efforts. Teachers must completely understand the features and management models of smart schools, as well as the various technologies needed in education that can have a positive influence on students and lead to cultivating their IT competencies.

Utilisation of technology can be significantly integrated into the curriculum only if a healthy school climate is established. The introduction of new technologies has several advantages, but it may challenge the existing school educational practices. Through constant communication based on trust among school members, technology can be employed to improve the quality of education in schools.

Holistic Approach to Technology Integration

Studies regarding smart schools indicate that students actively participate in interactive learner-centred environments with the help of advanced technologies (Mohammadi, Abrizah, Nazari, & Attaran, 2015; Taleb & Hassanzadeh, 2015). However, in many schools, the learning environment was not designed to enhance learner-centred education, but at best to focus on improving test scores. How can a school be smarter through technology application from a holistic perspective? The use of state-of-the-art technologies such as 3D printers and artificial intelligence does not imply that a school is a smart school. An attempt is being made in this study to answer this question by linking effective school research and technology integration. A model will be proposed for running a smart school as a future school, as shown in Figure 1. The model integrates technology use and curriculum, and attempts to meet the demands of the knowledge-driven society. Perhaps the most important aspect of the model is the base that the integration of technology and curriculum should be implemented within a healthy school climate based on the teacher learning community. The model includes five steps.

Figure 1. Holistic Technology Application Model for Smart School Management



First, the vision and goals of smart schools that are defined by the members must be established. In general, a smart school should foster the core competencies of students to respond to changes

in society. Based on the different socio-economic circumstances in each school and the different needs of parents and students, a vision and goal has to be determined that fits in with the school's educational environment. To do this, the opinions of the school members including teachers, students, staff and parents, should be collated. At this stage, school leaders need to abandon their ego and understand what these stakeholders need. If the vision and goals are not supported by school members, it would be difficult to convince them of the need to utilise technology, as well as to make efficient plans later. Smart schools should be able to structure and organise the learning contents and teaching methods in accordance with the life and interests of the students.

Second, smart schools have to be viewed as a system and the components that make up the system have to be identified. The components might include a competency based curriculum, learner centred instruction, remedial education, prosocial education, in-depth student counselling, professional learning community of teachers, efficient budget execution, transparency of accounting, and professionalism of the school staff. The smart school, as a system, should focus more on developing the core competencies of the students rather than on anything else. At this stage, the application of technology should not be considered, but only the relevance of the vision and the goals. In a smart school, the acquisition of knowledge and creativity that is needed for future societies should be considered while setting up the utilisation of technology.

Third, it is necessary to identify the components that can utilise technology in a smart school and to create a plan corresponding to the components. The technology plan has to be implemented by the principal, teachers and staff of the school in accordance with their respective profiles. The contents of the plan must be very specific. The important consideration at this stage is that technology should not be applied to all the components of the smart school. The use of technology may enhance the quality of a person's performance, but in some cases it may not. It should be noted that the use of technology, either directly or indirectly, should contribute toward improving the student's competencies. Although all the teachers and staff can participate in the planning regarding the use of the technology, not all ideas that are generated can be applied. After sufficient discussion among school members, only those suggestions that meet the vision and goals of the smart school should be selected and included in the plan. Specific technology utilisation plans should take into account, among other things, a self-directed learning environment that matches the pace and style of each student's learning.

Fourth, teachers and staff in schools apply the technology utilisation plan to actual education. For instance, in a drama class, students engage in real-time video conversations with professional actors instead of teachers and lectures. Another example is that to utilise the skills of software experts in the local community for coding skill education, a staff member builds a human resource database of these people. Technology use often requires the use of the school

budget and it is necessary to prioritise usage among the various items. It is important to take into consideration if the investment would help students to improve their competencies. When students are actively involved in learning, their motivation to succeed increases along with their level of mastery of learning. Instructional design incorporating the use of technology should include specific educational experiences to facilitate this active engagement.

Finally, school educators periodically evaluate whether the quality of school education is improving by using the technology. The evaluation methods may involve surveys or interviews of teachers, administrative staff, students and parents. Depending on the results of the evaluation, the method of utilising technology should be supported or modified. For example, if a student with low grades in math received supplementary lessons through one-on-one online learning as part of an after-school remedial program, the school teacher should conduct an interview with the student after a certain period of time, which could be after a month or after the semester is over. If it is determined that the online education was unable to lead to an improvement in the student's understanding of math or his or her usage of mathematical concepts in real life setting, the use of technology should be discontinued and other alternative approaches should be developed. This process of continuous evaluation and supplementation enables technology applications to meet the needs of students in a more effective manner.

Conclusion

As information and communication technology develops, many schools are using them as a part of their classes and for administrative purposes. However, the assessment of their impact on the quality of school education or the resulting actions is insufficient. One of the reasons is that it is not clear what the improvement in the quality of school education is ultimately about. The model presented in this study helps school stakeholders to clarify the vision and goal of a smart school and determine the factors that can assist in achieving these. Before making any decision on the use of technology, it is important to clarify the components that make up a smart school and to develop a technology utilisation strategy based on that. Periodic evaluation and, as a result, supplementation or dismissal of the technology application can greatly contribute to ensuring that the limited school budget is utilised efficiently and can also lead to the improvement of the overall quality of education.

When carefully designed and applied, educational technology can accelerate and expand the effectiveness of school education. However, while numerous experimental studies report the effectiveness of use of technology, many teachers are still not fully equipped with the knowledge and skills to integrate technology into their curriculum and are also resistant to the use of technology. The scepticism about technology can only be overcome by enhancing the professionalism of teachers. One of the most useful ways to improve the expertise of teachers is by encouraging them to participate in the professional learning community. In addition, the



integration of technology should be implemented on the basis of a collaborative culture of teacher community.

We should look at the use of technology from a holistic point of view for innovation in school education. Applying advanced technologies from a holistic point of view could accelerate customised and individualised learning in the twenty first century. Schools must be sensitive to the characteristics of their students and actively respond to the needs of future society. Thus, students should be able to open up and manage various opportunities to choose and utilise the appropriate level of educational programs, including technology enabled learning.

Declaration of Conflicting Interests

There are no conflicts of interest to declare.

Ethical Clearance

This study is a policy analysis that does not directly related to any ethical issues.

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