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A Review of Smart Education and Lessons Learned for An Effective Application in Binh Duong Province, Vietnam

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Abstract

Regarding educational opportunities in the era of information technology, smart education is no longer a novel concept, especially in the world's developed nations. This study examines previous research on smart education and the successful implementation in the Vietnamese province of Binh Duong. We have examined both international and Vietnamese research on smart education. According to the findings, Smart education is gaining popularity among students. Vietnam has adopted it, and according to the government, the results have been overwhelmingly positive. This article aims to evaluate previous studies on smart education and the current state of smart schools in Vietnam, as well as to critique research frameworks for smart education and provide recommendations. The report concludes with suggestions for the implementation and evaluation of smart educational programs throughout Vietnam, with a focus on Binh Duong Province. In recent years, research into the transition processes of other nations has yielded suggestions and references for the development of smart education in Vietnam, particularly in the province of Binh Duong, and in other nations.

Keywords: elementary school, digital transformation, smart education, smart school, smart teaching and learning

Introduction

Smart education is a new trend of education in the globe. In order to build a smart nation, many countries have aimed to build smart education to train generations of smart citizens. As an advanced school model, smart schools create opportunities and conditions for schools to enhance their adaptive capacity and sustainable development in the face of rapid changes in society. With smart education, learners are able to discover and construct knowledge, develop self-control and adaptive capacity, think creatively through personalized pedagogical instruction which is suitable to individual characteristics and needs. Smart education model also increases the importance, credibility, usefulness, flexibility of the curriculum content. The application of smart technology to education system has reshaped the educational landscape by transforming the content and mode of receiving knowledge as well as instruction methods, supporting services, organization, school administration (Demir, 2021).

In Vietnam, smart education model has just appeared in the past few years. Since it is quite a new topic, related studies about smart education in Vietnam is still scant. There is a need for a study to clarify the definitions, characteristics of the smart school model, its theoretical and practical significance in order to improve the adaptive capacity and quality of education system. This study also draws lessons for the development of smart education in Vietnam nowadays.

In the following sections, the related research topics of smart education development are reviewed; The definition of smart education is clarified; Also a research framework on smart education is depicted. Furthermore, the challenges facing during implementing smart education into school systems are pointed out. Finally, this study make some suggestions for applying smart education in Binh Duong province, Vietnam and evaluating its effectiveness (Nguyen, 2021).

Noh, Joo, and Jung (2011) defined smart learning as a human-centered and self-directed learning method which integrates the smart technology into the learning environment. According to Kwak (2010), smart learning is intelligent and adaptable learning that takes into account a variety of learning styles and abilities and allows learners to improve their thinking, communication, and problem-solving skills via the use of various smart equipment. Over the past two decades in the 4.0 revolution era, the concept of Smart Education (SMART Education/ Learning) is known as the transition from traditional education to a new educational paradigm, embodied in five interrelated components: (1) self-directed; (2) motivated; (3) adaptive; (4) resource-enriched; (5) technology-embedded (MEST, 2011).

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The self-directed feature indicates the change in the role of the student from a consumer to a producer of knowledge and the change of the teacher from a transmitter of knowledge to a facilitator. It also implies the extension of educational time from a fixed schedule to flexible learning time. The motivated feature highlights how smart education will encourage students to be interested in learning. Smart education emphasizes teaching and learning methods that promote collaborative learning, problem solving and process-focused individual assessment. Student learning experiences will be transformed from typical textbook-based to experience-based which encourage students to develop communication skills. The adaptive feature is the pursuit of education through a customized education system and a customized teaching and learning system. Smart education strengthens the flexibility of the education system and facilitates on-demand learning that aligns with individual interests and future career aspirations. It also helps schools grow from a hub of knowledge to a place that supports learning that is personalized to students' levels and aptitudes. The resource-enriched characteristic extends the education content by supporting rich teaching-learning materials. From a cloud-based learning service, smart education provides free access to rich content developed by public and private organizations and individuals in the education sector, expanding share learning resources at home and abroad, and promote collaborative learning through content delivery platforms. Lastly, technology-embedded characteristic illustrates the use of the latest information and communication technologies. Smart education allows students to learn anytime, anywhere using information technology. By building an educational environment that promotes student-centered learning, students are provided with a variety of learning methods tailored to their chosen fields of interest (Jang, 2014). Studies on the effectiveness of smart education according to the model of MEST (2011) can improve the equality of the educational process in the following directions: (1) Changes in learners' expectations and school' ability to cater for the demand (adaptability, employability and self-employment after graduation; ability to maintain and develop professional expertise; lifelong learning opportunities, etc.); (2) The diversification of educational products, the process of ensuring and improving the quality of education thanks to big databases, artificial intelligence, value chains in education; (3) Changes in the relationship, role and position of teachers and learners in the teaching process, and in the educational ecosystem; (4) The change of the teaching environment, the learning campus with multi-functional learning materials; (5) The change of management and administration models in education and teaching on a new digital platform (Nguyen & Ton, 2019).

Literature Review

In Russia, research by Konovalova et al. (2018) mentions the effectiveness of Smart Education in the curriculum of educational institutions. Teachers who apply smart education have succeeded in activity-based and learner-centered approaches such as effectively expanding students' knowledge, building individual educational trajectories, successfully expanding their learning experience, which determines the achievement of the educational goal - the cultural formation of the student. Research results also show that the technologies of smart education are compatible with traditional teaching and learning methods.

In the United States, since the 1990s, the smart education program has emphasized the role of integrating digital technology in classroom context. In 2014, the New York Board of Education issued seven criteria for smart schools, including: Providing and expanding online learning; Using technology to personalize learning; Broadband, high-speed school internet connections and technology applications; Connecting the classroom with open sources outside the school; Teachers apply technology to teaching and continuous professional development; Focusing on developing STEM skills for learners; Smart leadership and management based on technology foundation and technology capabilities.

In Korea, a study by Han, Kim, and Heo (2014) using a meta-analysis method to analyze twenty articles published in Korea from 2006 to 2013 for investigating the effectiveness of Smart Education as defined by MEST (2011) showed that (a) Smart education is statistically more effective than traditional education; (b) All effect sizes of dependent variables such as academic achievement, academic satisfaction, learning attitudes are also effective through adaptation to smart education; (c) the moderated variables such as learner characteristics, learning content, and interaction are highly effective.

A meta-analysis from 112 articles about Smart Education published in Korea from 2009 to 2016 by Heo, Gu, and Han (2017) for general education as well as for fisheries and marine vocational education also found that (a) Smart education is statistically more effective than traditional education; (b) There is no significant difference in the effects of smart education on general education and fisheries and island education; (c) Smart education is most effective for high school students, followed by university students; elementary school students and finally middle school students.

Ha and Lee (2019) studied the perception of primary school teachers about smart education issues to propose a better future teacher training program to support students in smart learning in classrooms. A total of 438 Korean elementary school teachers took part in a survey on smart education-related topics such as teachers' educational beliefs, technology support systems in schools, teachers' efficiency in technology-based teaching and learning, teachers' perceptions on computer-based learning, and smart learning. The results showed that teachers' educational beliefs directly affect teachers' IT-related

knowledge and use of Information Technology (IT) in the classroom. Teachers' educational beliefs also directly affect teachers' perceptions of computer-based learning methods and smart education methods. In other words, teachers with more student-centered learning beliefs and higher levels of IT knowledge seem to have a more positive view of smart education. Finally, the more technology-enabled systems a school provides, the more positive teachers will be about smart education.

In Japan, the digital textbook was first developed in 2005 until the end of 2010, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) proposed implementing digital textbooks for all elementary and middle school students. In 2013, MEXT proposed "21st century competencies", and to fulfill this mission, MEXT budgeted to build a smarter school, spending 131 billion yen during the period of 2014-2017 on IT equipment, e-learning and teaching materials. To accomplish this mission, educators pointed out that two main things need to be considered: (1) How to use the e-learning system and control IT equipment; (2) Online learning with active educational methods (Jang, 2014). The effectiveness of smart education in Japan was shown by MEXT to be very effective with more than 91% of students catching up with the lesson content, over 90% remembering the learned content, over 86% of students deepening their thinking and having deeper understanding of the lesson content (Thuy, 2017).

In Malaysia, since 1997, the project of Smart Education began to be implemented with four main foundations, including a flexible learning program, helping students to develop comprehensively; flexible teaching methods, combining many approaches in teaching and learning, helping students discover knowledge and develop sustainably; the learning materials promote cognitive ability, create motivation through the combination of technology, teachers and open learning materials; the flexible and comprehensive assessment in terms of skills, knowledge, abilities and aptitudes through activities and regular tests. Smart education in Malaysia underwent four stages: Experimentation; Post-testing; Mass adoption; Consolidation and stabilization (Ho, 2021).

According to a study by Omidinia, Masrom, and Selamat (2012), data collected from teachers and students at 14 schools in Selangor state showed that the smart education system has been successful in Malaysia. Most schools use computer-based tools to impart knowledge to students. Schools have Internet facilities and students are provided with exercises on the Internet to improve their interaction skills with computers and online learning. However, smart education needs to be updated with IT infrastructure including software and computer labs. Board of Management in other schools should also follow the standards of smart education to enhance students' competence through interactive learning.

In Singapore, a research by Kong, Chan, Huang, and Cheah (2014) was conducted with the view that IT would support learners with the opportunity to self-study at any place and time. The country has carried out four master plans for smart schools: The first planning phase is called "Building the foundation" (1997 – 2002). The second phase is "Sowing the seeds of innovation" (2003 – 2008). The third phase is "Strengthening and scaling up" (2009 - 2014), and the fourth phase is "Strengthening learning, sharp practice" (2015 to present). Since 2007, Singapore has implemented the program "Future schools" for eight schools. These schools were funded to cooperate with universities and companies to promote research in IT and media in teaching and learning. The master plan after 2015, focused on quality learning, nurturing and developing "responsible and future-ready digital learners". Singapore identifies smart education as an important part of a smart country (Ho, 2021; Kong et al., 2014). Accordingly, to effectively achieve smart education in Singapore schools, it is very important to develop teachers' careers related to smart education in a sustainable and scalable manner (Kong et al., 2014).

An overview of the research situation in the world shows that the issue of smart education has received a lot of research attention in developed countries. However, the research problem on improving the effectiveness of smart education for schools is still quite limited.

It can be said that smart education has been applied in Vietnam since 2013 (Tuan Hung, 2013). The resolution No. 950/QD TTg of the Prime Minister approving the "Project on sustainable smart city development in Vietnam for the period of 2018 - 2025 and orientation to 2030", of which three cities including Hanoi, Da Nang and Ho Chi Minh City are supported to build the first smart cities. Currently, many provinces and cities such as Ba Ria - Vung Tau, Binh Duong, etc. also have a roadmap to deploy smart cities and smart education (Ho, 2021).

Particularly in Hanoi, Vietnam's first smart classroom was inaugurated at Hoang Hoa Tham primary school in 2013 with all technology, software and hardware solutions produced and financed by Samsung Company that went by the name of Samsung Smart School (Tuan Hung, 2013). In 2015, the first smart class at Tran Phu High School, Hanoi was equipped with 50 sets of Galaxy Tab S tablets, two sets of LFD screens, computers for teachers, internet connection sets, and charging cabinets with a total value of nearly one billion Vietnam Dong which were also sponsored by Samsung Company (Quynh, 2015). In 2018, five more smart classrooms were applied in Archimedes Primary School (Hoang, 2015). The smart classroom model using Smart Edu solution introduced by the Vietnam Posts and Telecommunications Group (VNPT) was used for trial in three semesters, from January 21, 2018 to May 10, 2019 at Archimedes primary school. During the trial

period, 19 teachers and nearly 700 students in grades 3, 4 and 5 were practicing teaching and learning Math, Science, Nature & Society with more than 500 lessons on the Smart Edu model (Thanh, 2017; Thuy Ha, 2017).

The effectiveness of smart education, initially assessed from teachers and students using Smart Edu solutions, showed that 100% of teachers were assured with the support of VNPT's information technology staff in the classroom; 87% of teachers said that the lesson brought good and positive effects to students and wanted to continue using it in the coming semesters. 92.6% of students surveyed said that smart lessons were easier to understand than regular classes, easier as well as more convenient to present their opinions to friends; and nearly 98% of students expected to continue using the platform in the next semester. Thanks to the use of this model, each lesson becomes more exciting, interesting and understandable for the students, giving them excitement in learning, stimulating inquisitive and creative thinking (Thanh, 2017).

In Ho Chi Minh City, during the period of 2018-2020 with a vision to 2025, the Education sector will build a Smart Education Operations Center at the Department and pilot smart schools at five high schools including Le Hong Phong, Tran Dai Nghia, Le Quy Don, Nguyen Hien and Nguyen Du. Smart school is built with five criteria including online exam, online career guidance, maximum application of IT in teaching; teachers are equipped with international office informatics; high-speed Internet coverage; deploying smart libraries and electronic school records; students are allowed to use smart handheld devices during class time as well as in testing and assessment (Ho Sy Anh, 2021).

In 2018, the Department of Education and Training collaborated with other units to survey the implementation of the card scheme in 12 schools, with six functional modules including checking student attendance; checking teacher attendance; vending machines; school interaction; canteen management; payment of fees and tuition. Pilot installation of equipment was carried out at two schools namely Ly Thanh Tong Middle School in District 8, and Nguyen Gia Thieu Middle School in Tan Binh District. After two years, the smart school card made school management simpler, more economical and smarter; ensure safety and quickly notify students' situation to parents and teachers; create a habit of non-cash payment, help children form a mindset about spending, support parents in life skills education, etc.

Specifically, from the data of the trails at two schools, there were more than 120,000 students/ month checking attendance; 1,270 students/month using smart cards to take the shuttle bus; an average supply of 15,337 meals/month for part-boarding students, with detailed menus and meal times immediately notified to parents; 3,730 transactions/month for cashless payment via vending; perform timekeeping for 100% of teachers using access cards; nearly 130,000 school interactions per month, of which over 50% of parents and 100% of teachers have been activated to use the interactive channel (Thao, 2020).

Ba Ria - Vung Tau province implemented the project "Building and deploying smart education management services and utilities (phase 1)" from 2019, with a focus on perfecting office software systems administrative documents, online administrative procedures, digitization of educational management information; building the Smart Education operating center in the Department; investing in modern equipment and technology for teaching and learning for five schools (one kindergarten, one primary school, one middle school and one high school); fostering skills in IT and communication applications for teachers (Nguyen, 2019).

In Binh Duong, a smart educational solution has been tested for elementary school students of Ngo Thoi Nhiem elementary school, Ngo Thoi Nhiem middle school, Ngo Thoi Nhiem high school and Phu Tan primary school. All these school are equipped with tablets, projectors and pre-designed software systems for visual education programs invested by NTT Vietnam Company, Japanese FDI, and Vietnam Technology and Communication Cashless payment via vending Joint Stock Company telecommunications (VNTT). Smart education solution is a project in the cooperation program between NTT Group, Japan, and Becamex IDC Corporation, Vietnam in order to research and deploy solutions to implement the project "Smart city" Binh Duong" which was approved by the People's Committee of Binh Duong province in 2016 (Ba, 2019).

In summary, in terms of theoretical research, due to the implementation time, smart educational projects and projects related to smart schools, smart classrooms have only taken place within the past few years, of which there are some prominent studies belong to Nguyen and Ton (2019), and Ho (2021). Regarding practical research, there is a research by Duong et al. (2021) on factors affecting smart school leadership of 295 high school principals in Vietnam by qualitative and quantitative research methods. The results show that smart school leadership capacity depends on individual factors, school-level factors and educational community-level factors. Smart school development policy and smart school infrastructure and facilities innovation were identified as the most important factors.

There has been no research on improving the effectiveness of smart education for schools in Vietnam as well as in Binh Duong province, and thus this study absorbs existing research data and establishes new a systematic research orientation.

Zhu et al. (2016) proposed a framework for Smart Education including three essential elements: smart environments, smart pedagogy, and smart learner. Smart education places great importance on achieving better education. Smart

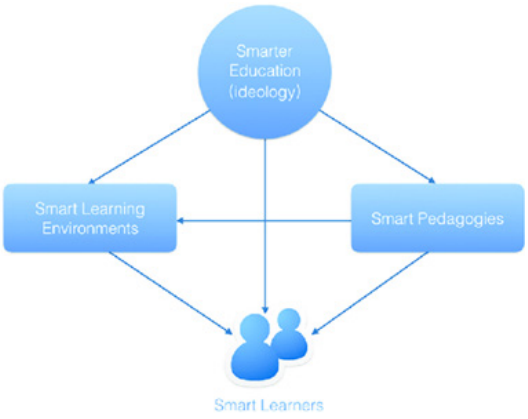

Fig. 1: Smart education framework (Zhu et al., 2016)

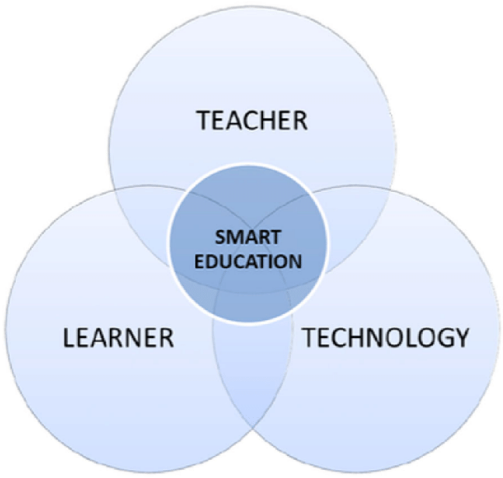

Fig. 2: Zhu et al.'s smart education framework (2016)

education addresses the demands for smart pedagogies as a methodological issue and smart learning environments as a technical issue and advances the educational aims to nurture smart learners as a consequence. Smart pedagogy has the potential to have a big impact on the smart environment. The development of smart learners is aided by smart pedagogies and smart environments.

Figure 2 illustrates smart education framework with combination of the teaching presence, learner presence and technological presence. The smart education paradigm emerges when these three core elements interact with each other in educational environment.

Liu et al.'s (2017) smart learning approach is depicted in Figure 3. The learner is in the center of the model, which is divided into four levels (learning experience, support technologies, learning scenarios, and basic principles of teaching learning). Four types of support technologies for smart learning consists of awareness and adaptive technologies, assessment and support technologies, tracking and analytic technologies, and lastly organization and reconstruction technologies.

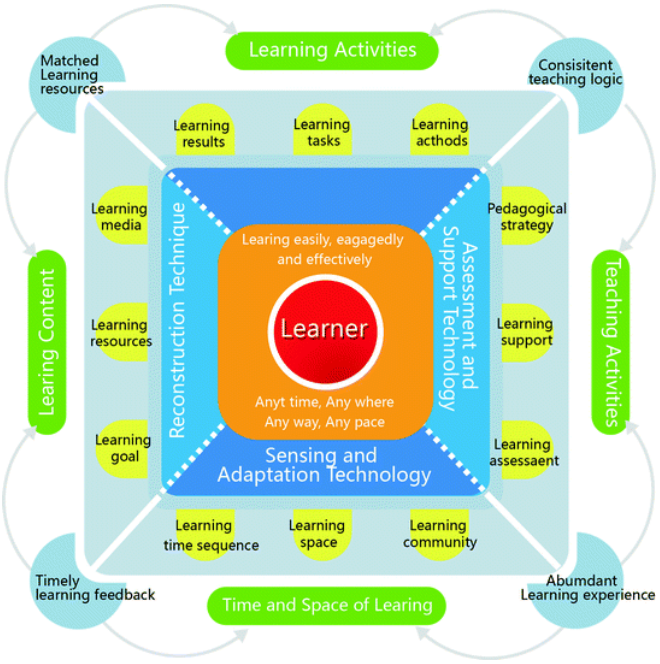

Fig. 3: Liu et al.'s framework of smart learning (2017)

Discussion

Deploying theoretical and practical research to develop strategies for developing smart classroom models in Vietnam.

In order fulfill this mission, state management agencies in education play an important role. Researches on smart education in terms of theory and practice need to be invested and implemented in order to properly identify the nature, characteristics and requirements to develop smart education. The research and analysis on the current school model helps to determine the gap between the conditions and qualifications of Vietnam and the requirements and characteristics of smart schools, thereby looking for feasible methods of implementation for Vietnam situation.

Developing a strategy to develop a smart school model.

The smart school development strategy is an important basis for orienting the education system and encouraging the community to take an active interest in this model. That is also the basis for financial investment, preparing necessary pedagogical conditions for smart education. Consequently, it helps to unify the will, beliefs, orientation and behavior for managers, teachers, students, parents and the community towards the smart school model. Therefore, in order to develop the smart school model in Vietnam, it is necessary to have the consensus and participation of all levels and sectors from the central to local levels to work together to make this advanced school model possible.

Fostering a team of teachers with professional qualifications to meet the requirements of building and deploying smart classroom models.

A team of well-qualified teachers is a decisive factor for the success of smart education. The problem of training and developing a strong team of teachers to meet the requirements of smart school is critical. Therefore, schools need to conduct training, retraining and professional development for teachers in successive stages taking into account the characteristics of teachers' qualifications and local culture. It is necessary to assess the current situation of teachers in terms of quantity and quality according to the standards and criteria of teachers in smart classrooms. It is necessary to determine the needs and methods of training and retraining in accordance with the current conditions and circumstances of each region.

Developing policies to support the development of smart classroom models.

The policy to support the development of smart education is useful for the process of converting, maintaining and developing sustainably the elements of smart schools. The transition to smart education is the process of preparing human, material and financial resources to meet new requirements. Therefore, there should be legal support policies to encourage the development of smart schools, policies to support the development of smart school technology, policies to support professional development for teachers of smart schools, policies to motivate the community to support smart schools, policies to develop smart school management.

Building and designing curriculum for smart schools.

In order to create a smart interactive environment for learners, smart schools need a smart curriculum that is highly integrated, flexible and open. The content of the program meets the requirements of providing background knowledge, developing learners' capacity to meet the requirements of workers in modern society with the context of extensive application of modern technology. The program must be built in the direction of increasing the interest in learning, enhancing the learning ability for learners, and fostering the effectiveness of the program. On that basis, smart education creates a positive learning environment, in which learners can learn with diverse and rich forms designed suitably for individual needs and pace.

Developing an excellent leadership team to manage smart schools.

School leaders and managers have an pivotal role in inspiring, implementing, vision sharing, leading and supporting school members in the transition process from traditional pedagogy to smart pedagogy. Leaders and managers of smart schools need to develop a system of competencies such as: 1) The ability to plan strategic school development according to the stages of the smart school model; 2) The eadership and management capacity for teachers to access resources for continuous professional development; 3) The ability to connect and create relationships between members and organizations inside and outside the school; 4) The capacity to support and advise teachers and school officials; 5) The ability to adapt and use modern technology in school management and leadership; 6) The capacity to effectively mobilize resources for the development of smart shopping malls; 7) The ability to analyze and solve problems, promptly resolve difficulties arising in the school's activities; 8) The ability to share, create motivation to participate in intelligent pedagogical activities for school members. School leaders and administrators need to have the right awareness and develop appropriate self-improvement plans.

Investing in facilities, equipment and smart technology.

Facilities, equipment and technology are important factors which directly affects the implementation of smart pedagogical activities, the quality and effectiveness of teaching and learning as well as the management of schools. The investment in infrastructure, smart technology equipment to serve smart pedagogical activities of the school needs to be researched, planned in details, identified and selected investment items to ensure the elements of synchronization, quality, efficiency and sustainability. Computer system with Internet connection, interactive whiteboard, smart podium, personal tablet for students, high quality broadband system, system of teaching and learning software, system of software management, camera system to monitor and control the school's activities, etc. are items that need to be considered for investment in the school.

Conclusion

Smart education has become an inevitable trend in the era of the 4.0 technology revolution. Smart school models and smart classrooms have shown good effects not only on student learning outcomes but also on the school's management quality. Smart classrooms with the help of information technology give teachers the opportunity to create more interesting, engaging, and effective classrooms. Smart school is a school model that adapts to the strong development of all aspects of social life and meets the requirements of training smart citizens to build a smart nation and start a business. Transition to smart school is a process of thorough preparation which goes through many stages corresponding to investments in infrastructure, qualifications of managers, qualifications of teachers, social awareness and socio-economic circumstances. Lessons learned

through studying the transition process of some countries are suggestions and references for the development of smart education in Vietnam as well as in Binh Duong province today.

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