Education and Information Technologies (2020) 25:4211–4230
https://doi.org/10.1007/s10639-020-10173-9

Smart school project in Iran: Potentials and barriers

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Received: 25 November 2019 / Accepted: 24 March 2020 / Published online: 31 March 2020

Abstract

The study was aimed at identifying the potentials of and barriers to the Smart School Project (SSP). Through the use of a mixed methods design, data were garnered from 746 school teachers, principals, and information technology experts, semi-structured interviews with 21 key informants and two researcher-designed questionnaires on the potentials of and barriers to SSP. The qualitative data were analyzed using three-stage coding and quantitative data were analyzed using exploratory factor analysis. The findings from the three data collection tools indicate 8 potentials and 9 barriers. SSP potentials include improving teachers', principals', and students' knowledge, skills and attitudes toward using information and communication technology (ICT), access to quality e-content, increasing school facilities, potentials available in the social environment, developing curriculum beyond schools, student participation in the learning process, enhancing school and parent relationship, and social supports and enacted laws. Further, SSP development barriers are comprised of 9 themes including teachers', principals' and students' lack of access to ICT and using it, vagueness in policies, missions, and goals of ICT integration into school curriculum, lack of support system and supervision, lack of specialized training for principals and teachers, barriers concerned with the nature of ICT, incompatibility of curriculum structure with ICT, structural and organizational barriers, cultural conditions and barriers, and lack of space and equipment.

Keywords Smart school project · ICT · Barriers · Potentials · School curriculum

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1 Introduction

The emergence of new horizons on a stage of international competition and the impact of new technologies in all aspects of humans' life indicate that the requirements of today's education are not the same as those of the past. The advancement of information and communication technology (*ICT*) and its consequent impacts have provided opportunities for the establishment of learner-centered, interactive, flexible, meaningful and facilitated learning environments (Zamani et al. 2016; Gülbahar 2007). Therefore, educational systems in information societies attempt to integrate the curriculum of public education courses with ICT and its capabilities in three main ways. The first is the provision of diverse educational resources and facilitation of the interaction between learners through the network and the technological capabilities that are employed as complementary to on-the-face to face learning (Goldhammer et al. 2016; Gil-Flores et al. 2017). This method is implemented in the European Union countries via a project called Euro net (Mee, 2007; Admiraal et al. 2017), in China via CER net (Huang and Price 2016), in England via School+ (Wu, Yu, Rao & Yu, 2016) and in Iran through a project called 'Roshd Network (Seraji and Attaran 2011, p,22). The second is the development of 'virtual schools', which is common in Canada and the United States (Barbour and Reeves 2009). In Canada, virtual school is employed to facilitate access to education in remote and rural areas in secondary school. In some states in the United States, this approach has also been adopted to meet the diverse needs of students and parents (Serdyukov 2017). The third form of ICT integration with the curriculum is to establish 'smart schools', a method that, although initially used in Harvard-supervised schools in 1984, is commonly used in countries like Taiwan, and particularly Malaysia and Iran. A smart school is a face to face learning environment where management is based on computer and network technology; content of most courses are electronic; evaluation and monitoring system is intelligent; and attention is given to the difference in the student's talents and abilities during education (Sivagami and Samundeeswari 2015). Likewise, the priority in smart school project (SSP) is given to enhancing the quality of teaching-learning process.

In 1998, to develop the information society, the Malaysian government designed a project for the 2020 horizon. In this project, the education department was required to provide a technological education program to educate the new generation in order to enter the information society. The Malaysian Department of Education dubbed it the Smart Schools project (Ali, Nor, Hamzeh, & Alwi, 2009; Hamzah et al. 2010). The experience of setting up and running smart schools in Iran is based on the Malaysian educational system and it started in 2003. The first smart nonprofit high school (Shahid Aghaie) was established in Tehran in 2003. Accordingly, the Education Organization of Tehran, in charge of implementing the pilot SSP proposed the 'Smart School Sample Project' document to implement them at four schools targeted for implementing the Smart School Pilot Project including Absal School in District 4, Doctor Masa'eb School in District 5, Nedaye Azadi School in District 7 and Shohadaye Kargarin District 15 in Tehran) at the beginning of 2004.In this document, school requirements were determined for starting and implementing projects in the infrastructure sectors (local area network, internet connection, hardware, software, website, management system, e-content and other e-learning software, school office automation, and e-mail), training (for the four groups of learners including: management personnel, teaching staff, students, and parents) and human resource.

Information and Communication Technology (ICT), and in particular SSP, can assist school principals in their educational and administrative missions and tasks. The use of school management systems allows school principals to break free from their current affairs and spend more time planning, monitoring, and making more intelligent decisions for their schools. Additionally, smart school teachers need to learn the skills they need for such schools. Teachers should be able to present their plan for using electronic content in the syllabus and compose the content. They need to acquire the skill of designing an electronic curriculum and of selecting the content components to use them in the curriculum (Tondeur et al. 2017). Thus, smart schools need to interact more and share successful and superior experiences with each other. In integrated communications, smart school teachers can share their latest experiences with others and share theirs. Sharing educational content and resources is another element of SSP (Baek et al. 2008). Moreover, one of the goals of SSP is to familiarize students with the dimensions, features and capabilities of ICT in various areas of personal and social life.

Nevertheless, for implementation of SSP, there are always potentials and barriers, attention to which can play a significant role in advancing SSP. In this context, various studies have examined the issue of SSP aspects such as barriers and limitations. Eshkali (2018) indicated that inappropriate school culture, teachers' negative attitude and computer literacy were the most important barriers to SSP, respectively. In their research on the weaknesses and threats facing SSP, Zamani et al. (2016) reported factors including insufficient attention to the role of ICT integration in the development of educational systems, lack of the world's latest knowledge and technology in the country, lack of access to Databases, teachers' lack of information literacy, and their inadequate ability and motivation to work with this type of education. Mohajeran et al. (2013) attribute failure of SSP in Mazandaran Province to the lack of guidelines and rules, lack of required infrastructure, lack of teachers' skills and scattered programs. Sanchez and Salinas (2008) examined the use of ICTs in Chile's secondary schools. They examined the extent of technology integration into the classroom from the four aspects of policymaking, technological facilities, learning conditions, and digital literacy of curriculum stakeholders, i.e. teachers, students, and practitioners. Findings demonstrated that despite major changes in policy making, equipping schools with technology, and introducing teachers to technology dimensions and characteristics, there have not been significant changes in classroom and learning conditions yet. In another study, Lim (2007) found that for reasons such as lack of time, teacher skills, positive attitude in teachers, and lack of support from the Officials, and school-based learning culture in applying technology to achieve high-level curriculum goals, schools are not very successful.

The Iranian educational system also emphasizes the development of SSP in line with the Fundamental Evolution of Education Document and the overwhelming need for the emergence of the information society; in the light of these emphases, SSP in all provinces is on the agenda. In the province of Hamadan, like other provinces, there have been many efforts to develop SSP. Among the education department districts in Hamadan, the education department in District Two has been more active than other districts in developing its smart schools. Accordingly, assessing the potentials and identifying the existing barriers to developing this project can be considered a necessary step. In this study, the potentials and barriers were examined with respect to the five dimensions highlighted in the SSP (2011) including processes, management, education (teaching-learning practices), content and infrastructure.

2 Research question

The main research question formulated for the present study can be stated as follows:

What are the potentials of and barriers to SSP in Iranian education system?

3 Methodology

The research method employed in this research was exploratory, chosen from among mixed-method designs. In the exploratory method, the researcher first uses qualitative methodology to probe into the research problem in depth, and then in the next stage, using quantitative methodology, further explores the findings and describes them (Creswell et al. 2003). In the present study, initially through interviews with school principals, teachers, and practitioners involved with the SSP, the necessary data were collected and analyzed; then, a quantitative methodology (via researcher-designed questionnaire) was used to further describe the findings.

4 Data collection

According to statistics available in the education department of District Two in Hamadan, there are 192 schools for various age groups in the education department of District Two in Hamadan, with 94 schools in this district having varying degrees of integrating SSP (including the five semi-electronic, electronic, semi-smart, smart, and advanced-smart phases) developed. In this study, to conduct interviews and administer the questionnaire, school principals, teachers, and knowledgeable experts in the education department of District Two in Hamadan were considered as the statistical population.

Snowball sampling was used to determine the participants for conducting the interviews. In this method, to identify the sample, first a number of key informants were identified and interviewed. At the end of the interview, they were asked to introduce two or three key informants. It is impossible to precisely determine the sample size beforehand in this method and for this reason the theoretical saturation method was used. In this section, 21 key informants were interviewed via a semi-structured interview, and due to the saturation of the data, the researcher did not conduct further interviews. Four school principals, two technology experts, and 15 teachers participated in the interviews Interview questions were categorized into two sections including the potentials of and barriers to SSP, and in each section the interviewers were asked based on the five dimensions of SSP including educational processes, school structure and management, teaching-learning activities, electronic and multimedia content and infrastructures. Moreover, the validity of the interview questions was confirmed by five experts in the field of e-learning and smart schools.

To conduct the second stage of the study, the required information was collected from principals, teachers, and knowledgeable experts working in 192 schools through the researcher-designed questionnaire. Considering the nature of the research topic and its novelty, it was likely that some teachers might not have the information required for

completing the questionnaire. Therefore, to administer the questionnaire, the population was sampled in the following ways:

- All the principals in 192 schools participated in the study through random sampling.
- Two knowledgeable teachers from each school were selected via purposeful sampling and involved in the study. Thus the total number of teachers participating in the study was 384.
- From among experts and practitioners, five were identified and involved in the study.

Therefore, 192 school principals, 384 teachers and 5 experts participated in the study with a total of 581 people. In this study, semi-structured interviews were used in the first stage and two researcher- designed questionnaires (open and closed questionnaire) was employed in the second stage. Open ended questionnaires were also used in this study to probe in more depth into the findings from the interviews and this instrument was designed based on the findings from the interviews. In this section, two researcher-made close ended questionnaires were used. The first questionnaire consisted of 42 items that were related to available capacities for SSP and the second one consisted of 29 items that were related to the barriers to SSP. In designing both questionnaires attention was given to the five dimensions of SSP. The face validity and content validity of both questionnaires were confirmed through experts' opinions; and reliability, after a sample of 63 people were piloted, was calculated through Cronbach's alpha coefficient reliability and was estimated to be 0.87 and 0.89, respectively. In the study, two open-ended questions about the potentials and barriers to the SSP in the education department of District Two in Hamadan were administered, and the answers given by 215 respondents were appropriate for the purpose of the study.

In this study, content analysis was employed for the analysis of the interview data. That is, the interviews were first carefully read through and transcribed onto the paper. Next, the transcribed data were analyzed through the three steps of open coding, axial coding, and selective coding, by repeatedly reviewing and matching the material on paper with the recorded material and ensuring their accuracy. Following the three steps, the researcher, after repeatedly and cyclically reviewing the interviews, identified important concepts and codes (open coding) and then put the similar codes together in a single category (axial coding), and then in the next step proceeded with the classification of the identified categories (selective coding). Similarly, open, axial, and selective coding were employed to analyze the findings from open-ended questions.

In this study, the triangulation strategy was used to increase the validity of the findings, and the data from semi-structured interviews, closed-ended questionnaire, and open-ended questionnaire were combined for the purpose of the research (Carter et al. 2014). Moreover, the peer debriefing method was drawn on to increase the validity of the qualitative data. In analyzing data from interviews and open-ended questionnaire, two colleagues (who had three articles on integrating ICT with curriculum and were expert in qualitative research) were asked to oversee the data analysis process.

Both questionnaires were also analyzed quantitatively via exploratory factor analysis and the important factors associated with the potentials and barriers were identified. In

this study, the data from 522 questionnaires completed by teachers, principals and experts working in smart schools in District Two were analyzed. The statistical distribution of the participants by gender, age, experience, field of study and academic degree is presented in Table 1.

In order to examine the data obtained from the questionnaire using factor analysis, different tests were first used to ensure the adequacy of sampling, which are presented in Table 2.

As illustrated in Table 2, the KMO value was 0.930 and the Bartlett test was significant at the level of 0.001. Therefore, given the adequacy of sampling and the significance of the Bartlett test, the correlation matrix of the data was possible for factor analysis. Accordingly, after ensuring the relevance and adequacy of the correlation matrix, factor analysis could be initiated.

The scree plot was another criterion used to determine the number of extraction factors. In this graph the horizontal axis represents the number of components, and the vertical axis represents the specific value of each component. The point at which the curve for Eigen value is displayed horizontally is called the scree point, and the factors on its left, the real factors, and those on the right are the error factors. They are considered. Thus, by counting the number of factors to the left of the Scree point, the number of extractable factors is determined. Therefore, the Scree Plot (Fig. 1) confirms seven factors as factors effective in persuading teachers to use ICT in the curriculum implementation process.

Table 1 Distribution of the sample studied in terms of gender, age, experience, field of study, and academic degree

Item	Subcategories	Frequency	Percentage
Gender	Female	243	46.5
	Male	279	53.5
Age	20–30	86	15.70
	31–40	143	27.39
	41–50	245	46.93
	51-above	48	9.19
Experience	1–5	59	11.30
	6–10	74	14.17
	11–15	127	24.32
	16–20	112	21.45
	20-above	150	28.73
Academic Major	Teaching	161	30.84
	Arts & Humanities	108	20.68
	Natural Sciences	188	36.01
	Technical	65	12.45
Academic Degree	Associate Degree	9	1.72
	Bachelor's	278	53.25
	Master's	209	40.03
	PhD	26	4.98

Table 2 Sampling adequacy test

Type of Test	
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	0.930
Bartlett's Chi-Square Approximation	10,222.301
degrees of freedom	1225
Significance level	000

Two open-ended questions were also asked to probe into the potentials of and barriers to SSP in depth, to which 215 teachers responded either briefly or with detailed explanations.

5 Findings

Findings from the semi-structured interview, two closed-ended questionnaires, and one open-ended questionnaire were combined. Later, the potentials of and barriers to SSP development were categorized and presented separately.

6 The potentials of SSP development

Data from semi-structured interviews, as well as closed-ended and open-ended questionnaires revealed that SSP development has eight potentials as follows:

1) gradual improvement in the knowledge, skills and attitudes of teachers, school principals, and students in ICT use

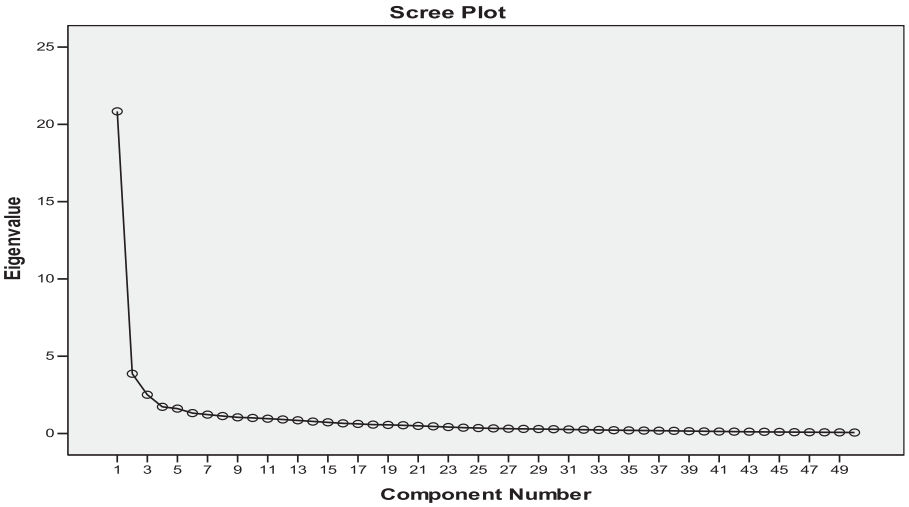

Fig. 1 Scree diagram related to factor identification

The findings indicated that SSP development improved the knowledge, attitude and skills of teachers, principals and students in ICT use. The interview responses emphasized that some teachers were more encouraged to use learner-centered methods and some of them produced contents according to their students' characteristics.

> *I, with some of our colleagues, took over the content production process, and asked our school not to order outside companies the content production, because in this type of electronic contents, students' characteristics and the classroom structure are ignored (*interviewee 6*).*

> *The main concern for teachers who are interested in using technology is students' learning and their future. We need to apply technologies for their better learning and participation in the teaching process* (Interviewee 8).

The effective application of ICT requires the belief in active learning and continuous student learning. Nevertheless, some teachers still view learning as the transfer of lesson content from the teacher or textbook to the student. However, in the light of the development of ICT, some teachers have realized that the teacher's main role in teaching is to empower students in the learning process. Further, the findings of the closed-ended questionnaire (Table 3) indicated the following items regarding the improvement in teachers' educational beliefs.

the development of smart schools had gradually changed principals' attitude toward and way of using ICT facilities. They used ICT for some of the administrative affairs, financial issues, and communication with students' parents. Table 4 also reveals that SSP development has helped school principals benefit from ICT in improving education.

Table 5 shows that SSP development improves students' computer skills and their attitudes to use ICT better.

In addition, the analysis of open-ended questions revealed that SSP development can contribute to availability of experienced teachers at city level, some teachers' and students' readiness for using technology, teachers' interest in participating in e-content production, availability of trained staff in some schools, presence of talented students and teachers' interest in their computer literacy improvement, students'

Table 3 Factors and factor loadings associated with improving teacher beliefs

Row	Item	Factor loading
1	Teachers believe that they need technology to create an active learning environment.	0.857
2	Teachers have enough self-efficacy to use technology.	0.744
3	To use active approaches, teachers integrate curriculum to fit technology capabilities.	0.603
4	To use technology, some teachers define active roles for students.	0.527
5	Some teachers have turned to active learning techniques and methods while using technological tools in their classroom.	0.524
6	Teachers have completed in-service training courses to make good use of new technologies.	0.496

Table 4 Items and factor loadings associated with the factor of principals' extent and manner of how ICT use

	Item	Factor loading
1	Principals use technology to report students' academic achievement to parents.	.0863
2	Principals use technology for the student registration process.	0.733
3	Principals often use the information technology available in their smart school systems to communicate with parents.	0.657
4	Principals run numerous workshops to expand their smart school plan.	0.495

enormous enthusiasm for technology, and a gradual shift in teachers' beliefs about active learning.

2) Access to quality e-content

The second theme, based on data from the semi-structured interviews and closed-ended questionnaire, is the facilitation of access to quality electronic content. In SSP, educational content can be presented to students in the form of movie, text, animation and simulation. This point has been highlighted in some interviews. An experienced teacher, said,

> *When I use a movie to show the function of white blood cell, my students can easily understand but in a non-smart class, you can't show the function and movement of white blood cell with words* (interviewee 11).

> *The kids don't like us to talk all the time; film and PowerPoint can have a better effect. We should devote some of our energy to producing video clips which are more effective than speech and text (*interviewee 14).

According to the teachers, the use of simulations is another factor that plays a significant role in enhancing the quality of education.

> *Most teachers use online labs and simulation space to illustrate the heart and to explain it, and doing this is impossible for students in non-smart classrooms (*Interviewee 15).

Table 5 Factors and factor loadings related to computer skills and students' interest

	Item	Factor loading
1	Students cooperate with each other in different subject areas using ICT facilities.	0.843
2	Students use ICT facilities to do learning activities and homework assignments.	0.836
3	Students use ICT tools to design their own lesson questions.	0.801
4	Students exchange learning resources using ICT facilities.	0.759
5	Students have the required skills for using technological tools to communicate with teachers.	0.713
6	Students use ICT facilities to have easier access to supplementary educational resources.	0.700

Most inaccessible situations can be presented to students with simulation software (Interviewee 14).

> *For example, to illustrate environmental destruction, you can show gradual and twenty-year destruction to students in a clip to learn from this and control their behavior* (Interviewee 21).

The data from the questionnaire (Table 6) also showed that the development of SSP has provided good opportunities for the production of electronic content.

3) Increasing school facilities

Even though the technological facilities available in the current schools were far from desirable, the SSP had created an opportunity for schools to equip themselves with some of the technological facilities required. According to the findings of the present study, the facilities and equipment available in the schools were potentials that could be used to develop SSP. Data from the closed-ended and open-ended questionnaires indicated that SSP development has created new potentials in schools. Table 7 presents the factors associated with the development of school facilities.

Open-ended questionnaire data also revealed that smart school development contributed to the equipment of schools with the required technology as well as the availability of the required resources in schools.

4) Potentials available in the social environment

The analysis of the findings of the open-ended questionnaire revealed that the development of SSP increased the capacity of the social environment in terms of the availability of efficient manpower at city level, of donors interested in assistance, of

Table 6 Factors and factor loadings associated with the factor of opportunities for electronic content production

	Item	Factor loading
1	Teachers' familiarity with electronic content production techniques and methods has increased.	0.704
2	Teachers are familiar with the process of designing a scenario for producing electronic content.	0.673
3	Teachers encourage students to produce electronic content by using active learning approaches to.	0.623
4	Teachers are adequately familiar with the educational and technical aspects of producing multimedia content.	0.617
5	Electronic content production software is easily accessible to teachers.	0.601
6	Private companies and organizations are actively working to provide the required electronic content.	0.559
7	Teachers' eagerness to participate in electronic content production has increased.	0.546
8	The guidelines, frameworks, and templates for e-content provision have been set by the Ministry of Education and submitted to schools.	0.538

Table 7 Factors and factor loading associated with school facilities

	Items	Factor loading
1	In most schools, there is the technology required to do administrative work.	0.881
2	In some schools, principals use technological facilities to monitor and evaluate staff and students.	0.796
3	Teachers and principals have access to the national school network in school and at home.	0.732
4	Principals dedicate the required technological facilities to parents to gain parental support for the SSP.	0.710
5	Students can have access to the national school network in school and at home.	0.674
6	Principals have attended numerous workshops to equip schools.	0.580
7	The required software is easily available to students, teachers and school principals.	0.547
8	Most principals devote part of their time to equipping schools.	0.528
9	Some schools have been adequately equipped with the required facilities.	0.501

experienced and knowledgeable experts, and the availability of private companies qualified for content production, and also it created new potentials.

5) Developing curriculum beyond school

One of the important potentials of integrating ICT into the curriculum is access to educational content at anytime and anywhere. Some interviewees considered this ICT capability as a potential of SSP.

> *Due to voluminous textbooks and frequent vacations, smart schools provide students with the opportunity to do their homework, have access to lesson contents, and interact with their classmates outside of classroom (*interviewee 11*).*

> *Using online tests will provide more time in class for teaching and students' learning". Concerning curriculum development beyond school* (interviewee 17)

Interviewee 8maintained that, "*Schools can provide an opportunity for students to ask their seniors about their questions and exchange answers"*.

In this relation, Interviewee 10, a principal, mentioned that, "*We give online exams in our high school. For example, we announce to the students that they are allowed to answer the specified questions from a specific point of time, and our students can choose their favorite time to answer the questions and doing so has a huge positive impact on their learning*".

6) Student participation in the learning process

The curriculum should be designed to encourage learners to participate in knowledge construction. Some interviewees highlighted this point.

In school we have engaged our students in the production of electronic content and have made it possible to benefit from their experiences (Interviewee 4).

When you use technology in class, you have more time for student engagement and discussion. This is because with technology content can be transferred faster and you can interact with students better (interviewee 16).

7) Enhancing the relationship between school and parents

The relationship between school and parents has always been an issue since for various reasons parents do not participate in school decisions and affairs. One of the reasons is the lack of parents' time; yet, using virtual capabilities, parental involvement in school affairs can be improved.

We have provided an option for students to upload their homework on our school website and we have provided their parents access to the homework and they can see the result of their children's efforts (Interviewee 20).

By using electronic capabilities and the SMS system, one can have access to parents more easily and use their opinions on a variety of issues (interviewee12).

8) Social supports and enacted laws

Based on the findings of the open-ended questionnaire, SSP has enhanced certain budget allocation to SSP, as well as the public demand for and awareness of the technological resources in learning.

7 The barriers of SSP development

The data from the semi-structured interviews, as well as closed-ended and open-ended questionnaires related to SSP development barriers were classified into 9 themes.

1) Inaccessibility and teachers', principals', and students' weakness in making proper use of ICT

This theme was derived from the triangulation of the findings from the semi-structured interview, closed-ended and open-ended questionnaires. According to the findings from the interviews, teachers' lack of access to computers and the Internet was a serious obstacle to integrating ICT with the curriculum. In some countries, to develop ICT in the education department, teachers are provided with computers free of charge.

*The teacher should not spend out of his own pocket to develop smart schools; so the education department should provide teachers with a computer and even a free internet password (*Interviewee 3*).*

Some teachers, despite their interest in technology, do not have sufficient computers at home and even in school to do their classroom activities such as content production (interviewee11).

Moreover, the results of closed-ended questionnaire analysis indicated that students' lack of computer skills and the lack of technical infrastructure was the barrier to developing SSP in the Iranian education system. Table 8 indicates items associated with this factor.

Even though teachers' knowledge and skills in using technology have improved with the development of smart schools, some teachers and principals still lack the knowledge needed to use ICT. Thus, teachers and principals' lack of knowledge and skills are considered as barriers to the SSP. Items related to this factor are given in Table 9.

The analysis of the open-ended questionnaire also indicated that students' weaknesses in some cases such as their lack of awareness of content production processes, access to computers, the Internet and the required software at home, their insufficient motivation to use technology, and their lack of attention to technological teaching practices are among the barriers to SSP. Furthermore, lack of required training for teachers in some cases including lack of required skills for integrating lessons with technology, lack of educational support for teachers, lack of experts in teacher training, lack of sufficient training for teachers, poor skills for applying technology among teachers and principals, teachers' habit of using traditional teaching methods and lack of belief in the use of technology, lack of in-service training in ICT integration with curriculum or SSP, and the presence of old teachers and their resistance to change are barriers to SSP development.

2) Vagueness of the policies, missions, and goals of ICT integration into school curriculum

This theme emerged from the integration of findings of the semi-structured interview and open-ended questionnaire. When integrating school curricula with ICT, all components of the educational system should be considered together. Decisions that are

Table 8 Factors and factor loadings associated with students' poor computer skills and lack of technical infrastructure

	Item	Factor loading
1	The lack of required communication infrastructure such as local network and Internet connection	0.653
2	Lack of attention to the infrastructure required for organizing a network of computers in school level	0.619
3	Lack of motivational tools for smart school teachers	0.564
4	Students' lack of sufficient access to computer and other technological facilities	0.549
5	Students' lack of awareness of the objectives of the SSP	0.501
6	Students lack of familiarity with smart school processes and trends and manner of technology use	0.500

Table 9 Factors and factor loadings associated with teachers and principals' poor knowledge of ICT use

Row	Item	Factor loading
1	Low levels of computer literacy among teachers and school principals	0. 598
2	Teachers and school principals' lack of ICDL skills	0.576
3	Smart school teachers' lack of motivation for integrating ICT into classroom teaching	0.529
4	School principals' lack of familiarity with their duties in smart schools	0.499
5	Teachers' lack of teaching skills in technological environments	0.491

made at the policy adoption stage and regardless of the implementation stage remain unsuccessful and ineffective in practice. Interviewees 12 and 17 referred to the issue of the impact of the entrance exam on teachers and parents' educational behaviors.

> *Movie and slide shows take too much of teachers and students' time, and students taking the university entrance exam like to receive the exam-related issues and material. They oppose any additional explanation on teachers' side or their attempt to make the learning more profound; so the development of technology requires the removal or change of the entrance exam (interviewee 12).*

We installed a board and a projector for the fourth grade students but since the teachers didn't use it, we had to remove them and put them aside (Interviewee 17).

Interviewee 20 also referred to equipping schools without specifying policies and training teachers, saying,

The school should become smart but the policy and way of doing this should be clear and also teachers should receive the necessary training. Finally, this smart school development policy should be implemented by the teacher.

Moreover, data from the open ended questionnaire indicated that lack of an appropriate plan, i.e., vagueness of the objectives of the project, and lack of an organized and integrated curriculum in schools are among the barriers to SSP.

3) Lack of support system and supervision

This theme resulted from the integration of findings of the semi-structured interviews, closed-ended and open-ended questionnaires. To advance the objectives of the SSP, a variety of supportive and supervisory mechanisms need to be designed, and without the required support and supervision to implement it, the project will not be effective.

As a teacher, when I spend a lot of time developing electronic content, but I don't get paid for it or I don't get psychological support, I gradually lose my motivation to do so (Interviewee 1).

A content production festival is held but there is no good use of the content provided; these contents should be distributed among the schools after careful supervision and this can provide a lot of motivation to other teachers (Interviewee 14).

Table 10 illustrates weaknesses in the support system and lack of support for ICT integration in schools.

Table 10 Factors and factor loadings related to cultural weakness and lack of support

Row	Item	Factor loading
1	Haste in the implementation of different levels of SSP by the Officials.	0.814
2	Disharmony between practitioners in charge of ICT use in school	0.805
3	Lack of a clear picture of ICT by the society and educational practitioners.	0.798
4	Weakness of the programs intended to inform teachers and parents of SSP.	0.795
5	Limited financial resources for improving the culture to implement SSP.	0.790
6	Lack of necessary cultural support from teachers and students in school.	0.786
7	Lack of basic rules and regulations for ICT use in schools	0.783
8	Lack of cultural support from the community for ICT applications	0.771
9	Weak cooperation between parents and other organs in implementing the SSP.	0.764
10	Lack of appropriate structure and culture for the implementation and application of ICT.	0.729
11	Lack of educational support from teachers.	0.720
12	Lack of a positive attitude on the effectiveness of e-Learning application in learning and teaching	0.679

Further, data from the open-ended questionnaire indicated that lack of a proper motivational system in some cases including officials' neglect of their colleagues' educational products, lack of support for e-content production, lack of proper monitoring and evaluation system, lack of a serious demand on teachers' use of the available resources, and teachers' lack of motivation to improve the quality of education are barriers to SSP development.

4) Lack of specialized training for principals and teachers

This theme was obtained by combining the findings of the semi-structured interview and open-ended questionnaire. Interviews revealed that teachers and principals often do not acquire ICT skills during teacher training courses:

Getting acquainted with the integration of ICT into the curriculum is a broad field; {but} most teachers and principals have not received the training needed to work with it, and they do so mostly because of their personal interest (interviewee 3).

Another interviewee (8) highlighted the poor training and stated that,

The quality of in-service courses on SSP is very poor. About 100 people gather in a class for a certificate, and the class is usually a noisy one that deprives us of any learning. In addition, most courses are taught by teachers who do not have sufficient experience in the related field.

Another interviewee (19) noted that.

Sometimes my students' computer skills are far better than mine, and they intentionally tamper with the classroom computer to cancel my class.

Additionally, finding from the open-ended questionnaire showed that lack of required training for teachers in some cases including lack of required skill for integrating lessons with ICT, lack of educational support for teachers, lack of experts for teacher training, lack of sufficient training for colleagues, poor skills for applying technology among colleagues, teachers' habit of using traditional teaching methods and lack of belief in the use of ICT,

lack of in-service training in ICT integration with curriculum or SSP, and the presence of old teachers and their resistance to change act as barriers to SSP development.

5) Barriers concerned with the nature of ICT

Some interviewees pointed to cases that highlighted the nature of technology integration into education, and they believed that technology should not be considered a panacea for educational problems.

This {the integration of technology} makes the respect and emotional relationship between the teacher and the student vulnerable. With this practice, the relationship between the teacher and the students fall in to mechanical manner (Interviewee 10). Disagreeing with the integration of ICT, Interviewee 3 pointed out that:

The learning quality of this system is lower than that of the traditional system; it doesn't matter whether the students see the movie or the slide; but the question is if they learn the relevant material well. The answer to this question is negative.

Similarly, Interviewees 15 and 18 both pointed out to the difficulty of using technology, and believed that teachers can enhance their knowledge and improve their behavior toward students instead of learning how to work with technology. Other interviewees (10, 13 and 14) pointed out that this {anti-technology} behavior is clearly seen with the appearance of any technology. Most teachers, like ordinary people, do not welcome innovation; they also considered the introduction of technology into the school as an innovation and rejected it on various grounds.

6) Incompatibility of curriculum structure to ICT

This theme was obtained by combining the findings of the closed-ended and open-ended questionnaires. Curriculum structure and physical space in most schools are organized for traditional teaching and the transfer of content from teacher to student. Therefore, the current structure is a major obstacle to the SSP. Table 11 illustrates the items associated with the incompatibility of school structure with ICT.

In addition, the analysis of the data from the open-ended questionnaire indicated that incompatibility of the existing curriculum with ICT in some cases including incompatibility of time and class schedules with the use of ICT, high volume of textbooks, traditional assessment and its impact on teachers' educational practices, and university entrance exam-based education in high school hinder SSP development.

Table 11 Factors and factor loadings associated with incompatibility of school structure with ICT development

Row	Item	Factor loading
1	Incompatibility of prepared content with e-learning method	0.680
2	Overcrowded classrooms for students	0.634
3	Lack of sufficient physical space for setting up a computer center in schools	0.588
4	School curriculum incompatibility with ICT	0.567
5	Lack of standard equipment such as smart kits or data projectors	0.476

7) Structural and organizational barriers

The open-ended questionnaire data analysis showed that some factors including absence of technology experts, limiting facilities to the city center and disregard for schools located in the suburbs and rural areas, absence of facilities in all classrooms and schools, unfair distribution of facilities between schools, small budget, lack of cooperation between ICT-related departments, poor cooperation between the department of education and schools, having schools with two shifts (morning and afternoon shifts), absence of knowledgeable and quality staff, absence of a technology expert in schools, unexpected and untoward technical problems, principals' habit of using traditional practices, principals' technological skills, and lack of free internet and access to it in schools are debilitating factors in SSP development

8) Cultural conditions and barriers

The data from the open-ended questionnaire indicated that lack of a positive attitude toward computer effectiveness in schools, principals' and parents' negligence in providing the necessary resources, parents' unfamiliarity with ICT, as well as the distance between them and their children are barriers to SSP development.

9) Lack of space and equipment

The open-ended questionnaire data indicated that some cases including high cost of equipment, lack of enough space, insufficient classroom space, lack of proper curtains, insufficient space for practical activities, and old school atmosphere along with the computers in it proved to be obstacles to SSP development.

8 Discussion and conclusion

The purpose of this study was to identify potentials and barriers to the development of SSP in Iranian secondary school. The findings of this study which were obtained through semi-structured interviews, two researcher-made questionnaires on barriers and potentials, as well as two open-ended questions disclose various barriers to and potentials of SSP. With the integration of findings from three data collection sources and techniques in this research, it can be said that factors such as Gradual improving in teachers, principals and students' knowledge, skills and attitudes in using ICT, Access to quality e-content, Increasing School Facilities, using available Potentials of the social environment, developing curriculum beyond school, Student participation in the learning process, Enhancing the relationship between school and parents and Social supports and enacted laws are considered as potentials of SSP in Iranian secondary education system. In addition, the findings revealed various barriers to the SSP including Teachers, principals and students' lack of access to ICT and using it, vagueness in ICT integration policy and plan, Lack of support system, of specialized training for principals and teachers, problems concerned with the nature of ICT, Incompatibility of school curriculum structure to ICT, organizational and cultural hindrances and space and equipment. It appears that in different models of ICT integration with school

curriculum various factors such as ICT development policies, students' skills, technology project, teachers' beliefs and skills, school contexts and the nature of technology should be taken into account. Educational policies in the information age should be formulated based on research into the needs of the information society and examining students' interests and talents. In planning such policies, student's active role in knowledge construction and the search for meaning should be taken into account, and hence students' skills, knowledge and attitude towards technology should be highlighted. In some researches consist with these findings, teachers' role in integrating ICT has been emphasized. For instance, in a research by Zamani et al. (2010), changing teachers' beliefs from direct teaching to guiding students has been highlighted as a strong point. Likewise, their research highlights enhancing teachers' technological skills as another potential of the SSP. Concerning teachers' role, in a research Tabari (2013) indicated that teachers' lack of computer literacy is one of the major challenges in integrating ICT with school curriculum.

Additionally, regarding the potentials of smart schools, Zaini et al. (2004) report that the SSP has gradually led the school-governing culture and its management towards technology-based activities. Shafiepoor Mothlagh & Yarmohammadian (2013) reveal that attention to individual differences, possibility of learning at mastery level, and research-based activities are among SSP potentials. In another research, Mohajeran et al. (2013) consider multimedia content-based learning environment, developed ICT infrastructures, having powerful ICT staff and integrated computer communication with other smart schools and especially the management system among the potentials of smart school development.

The data for this study were collected from school principals and teachers. The involvement of ICT policymakers and planners in data collection could enrich the findings, but lack of access to these individuals was a limitation of the current research. Thus, future researchers could develop and contribute to knowledge in this field by collecting richer data from policy makers and planners. Since the potentials of and barriers to the development of ICT integration are associated with the knowledge, beliefs and skills of different individuals such as students, teachers, principals, and parents, and also with the diverse fields of electronic content, home and school boundaries, student participation in the learning process, social environment, cultural conditions and the passing of laws, thus one should focus on the level of development of ICT integration and the cultural similarities of countries and regions in generalizing the findings of this research to an international context. Future researchers can study the barriers and potentials identified in this study, taking into account the cultural similarities and level of development of ICT integration in other countries, and add to the body of knowledge in this field.

SSP is one model among the various ones used in Iranian high schools, where ICT integrates into curriculum. Having identified SSP barriers and potentials, the present study can provide the basis for enhancing curriculum quality and educating the information society. This can prove possible through efforts to remove the barriers and further strengthen the potentials.

Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest.

References

Admiraal, W., van Vugt, F., Kranenburg, F., Koster, B., Smit, B., Weijers, S., & Lockhorst, D. (2017). Preparing pre-service teachers to integrate technology into K–12 instruction: evaluation of a technology-infused approach. *Technology, Pedagogy and Education, 26*(1), 105–120. https://doi.org/10.1080/1475939x.2016.1163283.

Ali, W. W., Nor, H. M., Hamzah, A., & Alwi, N. (2009). The conditions and level of ICT integration in Malaysian Smart Schools. *International Journal of Education and Development using ICT, 5*(2), 21–31 https://www.learntechlib.org/p/42320/.

Baek, Y., Jung, J., & Kim, B. (2008). What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computers & Education, 50*(1), 224–234 https://dl.acm.org/citation.cfm?id=1296509.

Barbour, M. K., & Reeves, T. C. (2009). The reality of virtual schools: A review of the literature (2009). *Computers in Education, 52*(2), 402–416. https://doi.org/10.1016/j.compedu.2008.09.009.

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum, 41*(5), 82–97. https://doi.org/10.1188/14.ONF.545-547.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. *Handbook of Mixed Methods in Social and Behavioral Research, 209*, 240.

Eshkali, M. (2018). *The individual and social barriers to school smartization from the viewpoint of secondary school teachers in District Two of Bandar Abbas*. Master's Thesis, Educational Psychology, Islamic Azad University, Bandar lengeh Branch.

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior, 68*, 441–449. https://doi.org/10.1016/j.chb.2016.11.057.

Goldhammer, F., Gniewosz, G., & Zylka, J. (2016). ICT engagement in learning environments. In *Assessing Contexts of Learning* (pp. 331–351). Springer, Cham.

Gülbahar, Y. (2007). Technology planning: A roadmap to successful technology integration in schools. *Computers & Education, 49*(4), 943–956. https://doi.org/10.1016/j.compedu.2005.12.002.

Hamzah, M. I., Embi, M. A., & Ismail, A. (2010). ICT and diversity in learners' attitude on smart school initiative. *Procedia-Social and Behavioral Sciences, 7*, 728–737. https://doi.org/10.1016/j.sbspro.2010.10.099.

Huang, R., & Price, J. K. (2016). ICT in education in global context. *Editors, R. Huang, BN University, Beijing, China, Kinshuk, & Athabasca, Eds.). Albuquerque: Springer, 10*, 978–3.

Lim, C. P. (2007). Effective integration of ICT in Singapore schools: pedagogical and policy implications. *Educational Technology Research and Development, 55*, 83–116. https://doi.org/10.1007/s11423-006-9025-2.

Mee, A. (2007). E-learning funding for schools: a policy paradox? *British Journal of Educational Technology, 38*(1), 63–71. https://doi.org/10.1111/j.1467-8535.2006.00596.x.

Minstry of Education. (2011). Guideline for Smart School Projct. Tehran: Centerfor Statictic and ICT.

Mohajeran, B., Ghaleei, A., & Hamzehrobati, M. (2013). The Main Reasons for the Lack of Correct Formation of the Smart Schools and Presenting Solutions for Developing Them in Mazandaran province. *Interdisciplinary Journal of Virtual Learning in Medical Sciences (IJVLMS), 4*(2), 13–23 http://ijvlms.com/en/articles/58958.html.

Sanchez, J., & Salinas, A. (2008). ICT & learning in Chilean schools: Lessons learned. *Computers & Education, 51*, 1621–1633. https://doi.org/10.1016/j.compedu.2008.04.001.

Seraji, F., & Attaran, M. (2011). *E-learning: Principles, implementation design and evaluation*. Hamedan: Bu - Ali Sina University and Iranian Curriculum Studies Association.

Serdyukov, P. (2017). Innovation in education: what works, what doesn't, and what to do about it? *Journal of Research in Innovative Teaching & Learning, 10*(1), 4–33. https://doi.org/10.1108/JRIT-10-2016-0007.

Shafiepoor Mothlagh, F., & Yarmohammadian, M. H. (2013). Designing a Model for Examining the Factors influencing the Perceived Efficiency Relationship between Student-Teacher in Smart Schools. *Research in Curriculum Planning, 10*(36), 16–26 http://jsr-e.khuisf.ac.ir/article_534264_en.html.

Sivagami, A., & Samundeeswari, R. (2015). A Study on use of information communication technology in higher education in Thanjavur district. *International Journal of Management (IJM), 6*(1), 418–426 Retrieved from https://www.iaeme.com.

Tabari, M. (2013). *Investigating the barriers and problems of smartization of educational complexes of Tehran's Education Department from the perspectives of male principals and teachers*. Master's thesis, Islamic Azad University, Central Tehran Branch.

Tondeur, J., Aesaert, K., Pynoo, B., van Braak, J., Fraeyman, N., & Erstad, O. (2017). Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century. *British Journal of Educational Technology, 48*(2), 462–472. https://doi.org/10.1111/bjet.12380.

Wu, D., Yu, X., Rao, J., & Yu, L. (2016). Comparative study on the status and strategies of infrastructure construction of ICT in education between China and the United States. In *ICT in Education in Global Context* (pp. 95–106). Springer, Berlin, Heidelberg.

Zaini, M., Atan, A., & Idrus, R. M. (2004). The ICT Implementation in the Management of Smart Schools: A Study of Success factor. *Journal of Educational Research (Malaysia), 6*, 93–102.

Zamani, E., Ghasabpour, B., & Jebel Ameli, J. (2010). Investigating the strengths, weaknesses, opportunities and threats of smart schools. *Journal of Educational Innovation, 36*, 100–179.

Zamani, E., Ghasempour, A., Homaei, R., & Mousavi, S. (2016). Investigating the opportunities and threats, strengths and weaknesses of using smart innovations (case study: Isfahan high school teachers). *Research in Curriculum Planning, 13*(49), 84–98 http://jsr-e.khuisf.ac.ir/article_534435.html.

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