DEVELOPMENT FRAMEWORKS OF THE INDONESIAN PARTNERSHIP 21ST-CENTURY SKILLS STANDARDS FOR PROSPECTIVE SCIENCE TEACHERS: A DELPHI STUDY

By Afandi Afandi

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Afandi[1], Sajidan[2], Muhammad Akhyar[1], Munuk Suryani[2], D. Harjunowibowo[3]
[1]Educational Sciences Postgraduates Program, Sebelas Maret University, Central Java, Indonesia
[2]Faculty of Teacher Training and Education, Sebelas Maret University, Central Java, Indonesia
[3]Department of Architecture & Built Environment, the Faculty of Engineering, University of Nottingham

Corresponding e-mail: sajidan@fkip.uns.ac.id

ABSTRACT

In the 21st century, students from all levels of education face extreme global competition, technology that is driven by information, and rapid media-saturation. These dramatic accelerational challenges are the reason why the educational system must prepare students with the skills needed in the era of globalization. Based on a document published by The Board of National Education Standards in 2010 on the importance of establishing a framework for 21st-century education in Indonesia, the necessity of appropriate standards has become very important to the current educational system. This paper aims to discuss conceptual frameworks for prospective science teachers in Indonesia. Using an extensive literature review of three document (P21, enGauge-21CS, and ATC21S) and group discussion with a two-round Delphi study, we have constructed the Indonesian Partnership for 21st-Century Skills Standards (IP-21CSS) based on agreement between 15 panelists. From the results of this study, we have established four IP-21CSS that were perceived by panelists as appropriate standards for prospective science teachers in Indonesia ranging from 4.5 to 5 or in the high level. These standards include: (1) 4Cs (critical thinking, creative thinking, collaboration, and communication); (2) ICTs (technology, media, and information literacy); (3) spiritual values (religious beliefs and spiritual awareness); and (4) character building (teachers' attitudes and scientific attitudes). Therefore, it concludes that the implementation of 21st-century education learning that emphasizes each IP-21CSS indicator needs to be considered as an essential component in the courses process for prospective science teachers in Indonesia.

Keywords: Conceptual Frameworks, Delphi Study, IP-21CSS

INTRODUCTION

The explosion of information, the rapid development of technology, and the widespread globalization in the 21st century bring out the concern of many practitioners, educators, and international organizations in the world about what skills sets students should have for the future (Levy & Murnane, 2004; Friedman, 2007; Wagner, 2008; National Research Council, 2010). This concern arises as the results from many empirical investigations showed that in the 21st century, technology would evolve into automation. The computer will substitute for each job in performing manual and cognitive tasks because each job requires information rapidly, and computers can process information quickly (Autor, Levy, & Murnane, 2003; Levy & Murnane, 2004; Je 38 2019; Levy, 2010).

Similarly, the report on young people's readiness for work found that over 400 business executives and managers agree that critical thinking and innovation, communication, collaborat 2 n, digital literacy, creativity and problem-solving were at the top of the list of the job success of the new workforce (CasnerLotto and Barrington, 2006; National Reseach Council, 2010).

The students, in the 21st century and in many levels of education, will be faced with the boom of digital technology and information, impacting the growth of the millennial generation (NcRel & Metiri Group, 2003; Wehling, 2007; IEAB, 2008). One of the characteristics of the millennial generation is their affinity with the digital world (Kolnhofer-Derecskei, Reicher, & Szeghegyi, 2017). They grow up with internet facilities, smartphones, unlimited access to information, and social media as the norm, and t 15 always expect convenience in communication with only a few minutes of "search time" on the PC and a few clicks of a mouse (PwC, 2011; Lau, 2011).

With the world currently producing about 2.5 quintillion gigabyte data in the forms of the file, print, and digital (50% of this information fake), they can be faced with a dilemma between the need of accurate information and the rapid transformation of information into obsolete data (Lau, 2011; IBM, 2014). It is making a reason that we need our students to achieve the learning outcomes to be a good thinker. If students cannot think intelligently and openly about the myriad of information and issues that confront us, they will be in confusion and uncertainty. It is, thus, crutial to deal with the daunting challenge to cultivate various skills, for students in the 21st century, that will be embedded in their educational systems (Levin-Goldberg, 2012; Anazifa & Dzukri, 2017; Wang, Lavonen, & Tirri, 2018). 21

Ken Kay (*President of Partnership for 21st Century Skills*), gives three reasons that our students should be prepared to learn to think, work to solve problems and making innovation, able to communicate and collaborate, and able to contribute effectively throughout their lives (Kay & Greenhill, 2011). First, these skills are considered

difficult to be taught and thoroughly evaluated, so they are rarely deliberately included in the entire curriculum. Second, this skill is crucial for all students today facing challenges in the era of globalization. Third, these skills are skills that are essential for the world of work (Kay, 2010).

This reality then brings us a view that our curricula, philosophies, assessments, and teaching methods must be designed to meet the current workforce skills (Levy & Murnane, 2005; Wagner, 2008). This skill includes five domains: cognitive, metacognitive, intrapersonal, interpersonal, and other competencies related with the 21st century (such as literacy and social-civic responsibilities) (Pellegrino & Hilton, 2012; Chia & Goh, 2016).

In the educational system, teachers lead a vital role in developing 21st-century skills (Guo, 2014; Chia & Goh, 2016). Teachers must be adaptable to 21st-century curricula and then be able to use their imagination to teach them in creative ways (Dra & Reid, 2018). The question then arises as to whether our teachers today have been prepared to face this reality. The answer falls on the option to develop prospective teachers in the future to be able to produce 21st-century skills mastery. As a consequence, teachers and prospective teachers are the most influential and central factors in the firm's educational need to be equipped with new new skills such as the problem-solving, communicate and collaborate with others, learn how to learn, and efficiently work with multiple modalities.

To share the vision for a real transformation of the prospective teacher's education system, the summit "Redefining Teacher Education for Digital-Age Learners" brings out an effort to introduce a national dialogue on how to bring out prospective teachers who can teach their students for success in 21st century colleges, careers, and civil society (Learning Technology Center, 2010). They concluded that the necessity to transform education in the schools into 21st century learning staffed by professional leaders and pre-service teachers institution is key to the transformational redesign of teacher education programs in the 21st century (Learning Technology Center, 2010). This is in line with the statement delivered by *The American Association of Colleges of Teacher Education* and *The Partnership for 21st Century Skills* that believe a prospective teachers have to equipped with 21st century skills and knowledge, and they should have learned how to incorporate these skills into their classroom practice to grasp its goal of successfully meeting the challenges of this century (AACTE & P21, 2010).

In relation to the science education programs, the need to cultivate 21st century skills sets for prospective teachers becomes the main agenda that should have focused on reaching consensus on science standards (Suwono, Pratiwi, Susanto, &Susilo, 2017). Schuun (2009) found that there is a high intersection between science and 21st century skills standard. For example, the science of inquiry includes references to communication skills and planning and selecting appropriate evidence, which may promote system thinking and non-routine problem-solving (Schunn, 2009).

Engaging prospective science teachers in scientific processes (i.e., expressing opinions and argument, experimenting and modeling, and reporting detailed data) can build science proficiency, and at the same time, it can develop 21st-century skills that are useful when they become a teacher (National Research Council, 2010; 2011).Overall, the need to establish 21st-century skills standards for prospective science teachers will be helpful in driving leaders to make the right policies that fit on the demands and challenges that arise in the 21st century.

In Indonesia, the attention to 21st-century education has been conceptually voiced since 2010, whereas The Board of National Education Standards (Badan Standar Nasional Pendidikan, BSNP) released a document about Indonesia's 21st-century education paradigm. BSNP (2010) states that the goal of Indonesian national education in the 21st century is to realize the ideals of the nation - the Indonesian peoples who are prosperous and happy with an honorable and equal position with other nations in the global world through the establishment of a community that consists of qualified human resources, namely an independent, willing and capable person to realize the ideals of nation.

This goal indicates that Indonesian 21st century national education is not only directed to make a learner knowledgeable, but also to adopt a scientific attitude (i.e., critical-logical thinking, inventive-innovative thinking, consistent, and adaptable) and cultivation of noble values and commendable attitudes in social life oriented towards mathematics, science, and humanities.

Every level of education must be a closely-linked system that fully supports the next level towards the frontier of science by considering aspects of ethnic, cultural, religious and social diversity in society (BSNP, 2010). It is in line with the vision of the Indonesian Long-Term National Education Development Plan (RPPNJP) 2005-2025 to produce smart and competitive Indonesia citizenship by the year 2025. This concept then encourages leaders in strengthening the achievement of the national education paradigm in the 21st century, among others through mastery of science knowledge and science process skills (BSNP, 2010).

The regulation of the Indonesian National Education Minister (Permendikbud) No. 20, 21, 22, and 24 years 2016 which contains the competency standards of graduates (attitudes, knowledge, and skills), content standards, process standards, and core and basic competencies standards, principally referring to 21st century education standards. For example, on the competency standards of graduates in the dimension of skills where it had stated that the graduates must have the skills of thinking and act creatively, productively, critically, independently, collaboratively, and communicatively through a scientific approach to the development of the learned unity of education and other resources independently.

The regulation of the Indonesian National Education Ministry numbers 21 and 22 of 2016, established that, in the teaching and learning process, science teachers should be able to encourage students to understand the scope of science and its application in the conceptual era of the 21st century and to apply science process skills to understand science problems and relate them to the environment, technology, and society. Students also have the ability to present data on research and observation and, then, communicate both written and oral data, using various media, which, as a whole, can be obtained by multiple forms of activity, such as observing, asking, trying, reasoning, tasting, and creating.

Prospective science teachers, tobe able to teach the science standards, must, firstly, master the skills, as well. Thus, the course process for prospective science teachers should always rely on 21st-century education standards. The question is: What 21st-century education standards are appropriate for prospective science teachers in Indonesia? This study aims to create a conceptual framework of the 21st-century skill standards for prospective science teachers in Indonesia. This standard is called the Indonesian Partnership of 21st Century Skills Standards (IP-21CSS).

RESEARCH METHODS

This study involved exploratory research with qualitative analysis in developing conceptual frameworks of Indonesian 21st century skills standards to be integrating into the prospective science teachers curriculum. The data in this study were collected using the Delphi method. This method brings out discussion on specific areas to obtain a strong consensus from perception or judgments held by expert knowledge (Booberg & Morris-Khoo, 1992; Hasson, Keeney, & McKenna, 2000; Jiang, Yan, Zheng, Liu, & Wei, 2016).

A two-round Delphi study process was used to initiate an agreement between 15 panelists to make decisions about 21st century standards for prospective science teachers in Indonesia. All panelists involved in this research were grouped according to three categories including qualification (QL), teaching experience (TE), and scientific expertise (SE). The data of panelists' demographics can be seen in Table 1.

Table 1. The Data of Panelists Demographic

Data Panelist	N
Total Sample	15
Qualification	
Magister	9
Doctor	6
Teaching experience	
Expert Assistant	6
Lector	4
Senior Lector	4
Professor	1
Scientific expertise	
Biology education	8
Physics education	3
Chemistry education	4

The Delphi Process

Primarily, to build on the IP-21CSS, we employed a two-step process. The first step aims to identify and compare standard 21st century skills from numerous documents based on literature reviews. The second step aims for the preparation of questionnaires based on the result of literature reviews and conducting focused group discussion to establish the conceptual frameworks of IP-21CSS perceived by panelists using a two-round Delphi study.

1. Literature reviews

The conceptual framework of IP-21CSS is arranged based on the results of depth literature reviews that related with numerous documents of 21st century education. The documents includes: (a) frameworks for 21st century skills (P21) (Partnership for 21st Century Learning, 2010), (b) enGauge of 21st century skills (enGauge-21CS) (NcRel & Metiri Group, 2003), and (c) Assesment and Teaching 21st Century Skills (ATC-21S) (Griffin & Care, 2015). The selection of these three documents based on the consideration that 21st century educational designs that are widely used throughout the world often adapt the framework of the three documents. For example, the education system model used at Nanyang Technological University (Tan, Choo, Kang, & Liem, 2017) developed the ATC-21S framework which was later adopted in Singapore education. Similarly, the 21st century education system model developed at the Dominical University of California University adopted the 21st century educational framework of the P21 document (Urbani, Roshandel, Michaels, & Truesdell, 2017).

2. Preparation of Questionnaires and Conducting Focus Group Discussion

The entire skills from all documents that have reviewed became the basis for the preparation of questionnaires. Moreover, we are also doing focus group discussion with panelists on determining the standard which becomes the benchmark of 21st century education for prospective science teachers in Indonesia.

After discussion, we conclude two standards that need to be considered as standards competence for prospective science teachers in Indonesia, namely character building (teacher attitudes and scientific attitudes) and spiritual values (religious belief and spiritual awareness). These two domains were chosen based on the consideration that strengthening the character education program and planting a spiritual attitude in Indonesia has become the basis of the program of the national education program according to the mandate of Minister of Education and Culture No. 20 of 2018. In detail, the stage to build the IP-21CSS conceptual framework can be described as follows:

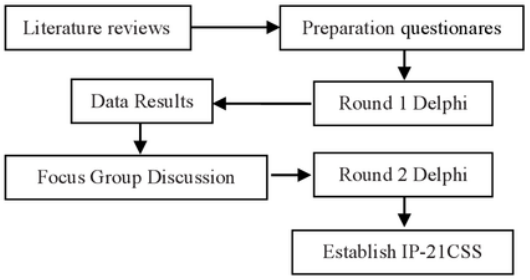

Figure 1. Two-Round Delphi Process in Developing IP-21CSS.

3. Research Instrument

Instruments in this study consist of two-form questionnaires for a two-round Delphi study. In the first round, the instrument used a checklist questionnaire form. Some 26 skills in six domains were used in this questionnaire. This domain includes four cognitive skills (creativity and innovation, critical thinking and problem solving, the ability to produce high-quality products, and scientific literacy), four ICT skills (information literacy, media and visual literacy, technology literacy, and effective use of real-world tools), four metacognitive skills (initiative and self-direction, adaptability and managing complexity, curiosity, and metacognition), six interpersonal skills (productivity and accountability, flexibility and adaptability, life and carrer, leadership and risk-taking, personal responsibility, and prioritizing, planning, and managing results), four intrapersonal skills (communication, collaboration, social and civic responsibility, and social and cross-cultural skills), and four other skills related to literacy (basic literacy, economic literacy, multicultural literacy and global awareness).

Panelists in this round were directed to rank the core skills in each domain that they felt were the most essential and eligible for teaching in the course for prospective science teachers in Indonesia. In the second round, the instruments used a rating scales questionnaires form with Likert's five-scales ranging from strongly agree (5) to strongly disagree. A total of 13 skills used in this study were developed based on eight skills that were assessed as most important from round one and four skills from two standards based on a recommendation from a focus group discussion.

4. Research Analysis

Data in this study employed descriptive statistical analysis. In round one, the data was analyzed based on a percentage (%) that were chosen by the panelist. In this round one of the Delphi study, each core skill was considered as a consensus if it was selected by over 70% of the panelists. In round two, the data was analyzed using descriptive statistical analysis by computing the median values. In doing so, the relevancy of the 21st-century skills was categorized into two levels: high (the median value equal or above 4) and low (the median value equal or below 3.5) (Osman & Marimuthu, 2010).

RESULT AND DISCUSSION

Literature Reviews Findings

In this study, we have identified 43 skills from three documents that analyzed includes P21 (12 skills), enGauge-21CS (20 skills), and AT-21CS (11 skills). The result of this study found that most of the core skills in each document are interchangeable to each other. The result becomes evidence that essentially the demands of the skills contained in the three documents have similar content (for example, on P21 there is the creativity and innovation domain which has content similar to ATC-21S), and there is reflect on fitness among the various competency frameworks, indicating a degree of agreement among researchers in the field (The Ontario Public Service, 2016). It is making significant contributions in aiding this reconceptualization of education for the 21st century (Dede, 2010). For more details, it can be seen in Table 2.

Furthermore, Table 3 shows that less than 50% of skills recorded from the three documents selected by the panelist show that not all skills contained in the three documents fit the character of the prospective teacher in Indonesia. This can be seen from the low acceptance of the metacognitive, intrapersonal, and other forms of literacy domains. This situation is confirmed by Owusu-Ansah, Neill, & Haralson (2011) which states there are some obstacles to implementing 21st century education. According to Owusu-Ansah Neill, & Haralson (2011), this condition is possible due to the constraints of academic culture, limited facilities, and low support from all institutional leaders to realize the direction of 21st century education achievement.

Round 1 Delphi Findings

The list of skills collected from the three documents is categorized into six domains, such as cognitive, ICT, metacognitive, interpersonal, intrapersonal, and other domains related to 21st century education. In this grouping, the screening of relevant core skills or sub-skills is done in this study. For example, reasoning and risk-taking on ATC-21S are grouped into critical thinking and problem-solving in P21, with the consideration that decision-making sub-skill of critical thinking. The same is true for high-order thinking and sound reasoning in Gauge-21CS that assessed include in more specific skills such as critical thinking, creative, and problem-solving.

In the first round of the Delphi study, panelists were then presented to assess with the list of skills that are considered very important and possible to taught for the current prospective science teachers in Indonesia. The panelist then directed to assessing the list of proposed skills by considering various aspects, such as curriculum demands, learner characteristics, availability of facilities and infrastructure, teacher readiness, and institution support in realizing 21st century education standards for prospective science teachers.

The results of this study show that from 26 skills recorded, there are 11 core skills considered by panelist as urgent to have in prospective science teachers, including three core skills on cognitive domain and ICT, two core skills in the interpersonal domain, and one core skill on metacognitive, intrapersonal domain, and other domains (Table 3).

Moreover, all panelists agree that these eleven skills are the core skills that must be taught for prospective science teachers in the course process. This agreement showed the high percentage of the eleven core skills that overall are above 70% or in other words this response category can be used to determine consensus. It is indicating that experts have a firm intention to establish a professional curriculum for prospective science teachers.

Table 3. Percentage Panelist Votes of Core Skills from Six Domains on Round 1 Delphi Study

No	Domains	Core Skills	Total	Percentage
1	Cognitive	Creativity and Innovation	15	100%
		Critical thinking and Problem Solving	15	100%
		Scientific Literacy	15	100%
		ity to Produce Relevant, High-Quality Products	7	46,7%
2	ICT	Information Literacy	15	100%
		Media and Visual Literacy	12	80%
		Technology Literacy	15	100%
		Effective Use of Real-World Tools	8	53,3%
3	Metacognitive	Initiative and Self-Direction	10	66,7%
		Adaptability and Managing Complexity	9	60%
		Curiosity	13	86,7%
		Metacognition (Leaning to Learn)	10	66,7%
4	Intrapersonal	Productivity and Accountability	7	46,7%
		Flexibility and Adaptability	5	33,3%
		Life and Carrer	4	26,7%
		Leadership and Risk-taking	11	73,3%
		Personal Responsibility	10	66,7%
		Prioritizing, Planning, and Managing Results	10	66,7%
5	Interpersonal	Communication	15	100%
		Collaboration	15	100%
		Social and Civic Responsibility	9	60%
		Social and Cross-Cultural Skills	8	53,3%

6	Others	Basic Literacy	15	100%
		Economic Literacy	4	26,7%
		Multicultural Literacy	7	46,7%
		Global Awareness	10	66,7%

The Results of Focus Group Discussion

To obtain a benchmark of 21st century education for prospective science teachers in Indonesia, we employed one round of focus group discussions. The discussion activities start from highlighting paradigm of Indonesian 21st century education with two questions.

1. What are the "domain specific" to prospective teachers in Indonesia in the 21st century?
2. What are "unique-skills sets" that can represent characteristics of 21st century education for prospective teachers in Indonesia?

To be able to answer both questions, all panelists in this discussion were given the opportunity to voice their opinions, mainly related to the current Indonesian national education system requirements. The results of the discussion concluded that the Indonesian national education system not only is directed to mastering cognitive and ICT domains but more than that, there are requires another domain to be its benchmarks. In this case, there are two main focuses that panelists insist on being constructed for prospective science teachers education programs.

First, the need for characters building related to the characteristics of the Indonesian nation. The degradation of the nation's morality due to excessive euphoria to foreign cultures without going through the filtering process that affects the weakening of national values and the eroding of local wisdom is a strong reason why future teachers need to be equipped with substantial characters building. Second, the need to encourage spiritual values that can be implemented in the classroom learning. The need based on the mandate by of Indonesian national education system No 20/2003 article 3 which states that the goal of Indonesian national education is "*...the development of the potential of learners to become a man of faith and cautious to God Almighty, be noble, healthy, knowledgeable, capable, creative, independent, and become a democratic and responsible citizen*"

Overall, the discussion creates two domains-specific are suggested by the panelist to added as a benchmark of 21st century education for prospective teachers in Indonesia, namely character building and spiritual values. To highlight the implementation of the both domain-specific, a set of indicators called "core skills" was developed. In this study, the core skills in character building domains include the teacher's attitude and scientific attitude, while the core skills in the spiritual awareness domain include religious belief and spiritual awareness.

Round 2 Delphi Findings

The data obtained from round 1 of the Delphi study and focus group discussion became the material in preparing a conceptual framework of IP-21CSS. In this study, we classified data in round 1 of the Delphi study into two domains, i.e., 4Cs (creativity and innovation, critical thinking and problem solving, collaboration, and communication) and ICTs (information literacy, media and visual literacy, and technological literacy) referring to document P21. Meanwhile, the panelist consensus based on the focus group discussion results has established two domain-specific areas, which are character-building and spiritual values.

Moreover, with the consideration of the experts, the researchers then classify the scientific literacy into scientific attitudes, visual literacy grouped into media literacy, and leadership and risk-taking grouped into teachers' attitudes. The results of this study in round 2 of the Delphi study show that all panelists receive frameworks on all IP-21CSS domains with the high category (Table 4).

In order to facilitate the process of implementation IP-21CSS domain,this study also prepared indicators on each domain. This indicator covers the skills that prospective science teachers are required to learn in the 21st century and the skills needed for prospective science teachers to become teachers in the 21st century (Table 5).

Table 4. Median Values Core Skills of IP-21CSS Domain on Round 2 Delphi Study

No	IP-21CSS Domain	Core Skills	Median	Interpretation
1	4Cs	Creativity and Innovation	5	High
		Critical thinking (includes Sound Reasoning, Decision Making, and Risk Taking) and Problem Solving	5	High
		Communication (includes Basic literacy)	5	High
		Collaboration	5	High
2	ICTs	Information Literacy	5	High
		Media and Visual Literacy	4.5	High
		Technology Literacy	4.5	High
3	Character Building	Teachers attitudes (includes Leadership)	4	High
		Scientific Attitudes (includes Scientific literacy and Curiosity)	4.5	High
4	Spiritual Values	Religion beliefs	4	High
		Spiritual awareness	4.5	High

Table 5. Indicators on Each IP-21CSS Domain.

No	IP-21CSS Domain	Indicators

1	4Cs	• The capability to design new ideas or produce new products from something's existence (redesign) independently or in groups--this ability involve many forms, including imitation, modification, and invention. • The capability to associate, investigate, interpret, and examine claims, arguments, evidence, and data using rational thought process to decide whether to believe it or not and to find the best solutions. • The capability to collaborate with others in order to share knowledge, experience, and information that enrich personal quality. • The capability to use a variety of models, methods, and media that can encourage students to think critically and creatively and develop students' communication and collaboration skills in order to solve problems.
2	ICS Skills	• The capability to access and assess information from multiple sources accurately and critically, generate media-message delivery using various tools, and use different technological tools, especially digital technology. • The capability to apply various models, methods, and learning strategies that utilize technology and digital information.
3	Character Building	• The capability to demonstrate scientific attitudes (curiosity, honesty, thoroughness, openness, and prudence), display adaptability to the norms prevailing in society, exhibit a vigor of leadership, and establish the attitudes and character of a teacher • The capability to teach moral values and scientific attitudes in the teaching and learning processes that guide the students' characters to conform to the identity of the Indonesian nation.
4	Spiritual values	• The capability to believe and appreciate the Creator through science and internalize it in daily life. • The capability to teach the concept of the Creator to the student through science.

CONCLUSION

In response to the call for all students to learn 21st century skills, some organizations have developed frameworks for the new content and processes that should be delivered as part of their institutional brand (Dede, 2010) that indicates horizontal consistency in curriculum intentions (Voogt & Roblin, 2012). IP-21CSS is a conceptual framework that was developed as a response to the educational intentions of 21st century education in Indonesia. This framework was developed as part of the embodiment of the discourse of changing the 21st century education paradigm in Indonesia according to a document released by BSNP (2010). The embodiment of this framework begins with a study of the literature of three 21st century educational documents most widely used as a reference in the development of 21st century education around the world.

Based on the results of the literature review, we find that there is a high interrelation between the skills of 21st century educational document that describes the benchmarks of the institutional brand, such as P21, enGauge-21CS, and ATC-21S. These interrelations include some of the broader aspects, such as high order thinking and ICT Literacy, while others are sub-skills, such as sound reasoning, decision-making, risk-taking, learning to learn, and metacognition, which are sub-skills of critical thinking. Many organizations have frameworks that are mostly consistent regarding what should be added to the curriculum, and each group has different areas of emphasis within the overarching skillset (Dede, 2010).

The study result found 12 core skills in four domains (4Cs, ICTs, character-building, and spiritual values), which are considered relevant to the characteristics of prospective science teachers in Indonesia. The domains of 4Cs and ICTs in this study refer to terms proposed by a P21 framework that released a document from the research series in 2015 on how to conceptualize, develop, and assess communication, collaboration, critical thinking, and creativity skills (Partnership of 21st century skills, 2017) using various media, technology, and information in the digital age. With ICTs, prospective science teachers are expected to have the ability to obtain, use, apply, and present information gained from a variety of sources in order to increase knowledge capacity to work collaboratively and independently (Cheeraphan, 2013). Two other domains, namely, character-building and spiritual values, are specifically developed with the help of an expert as benchmarks of 21st-century education in Indonesia for prospective science teachers. As a benchmark within the IP-21CSS framework, these two domains are notably aimed at coping with the nation's competition due to youths' moral and spiritual degradation through loitering, drugs, sex, school and rider gangs, bullying, and various other cases.

In science education, character and spiritual education cannot be taught as a separate curriculum because science education is the basis of education in the information era that allows all people to take part in the freedoms and democratic society that necessitate great character and spiritual values (Berkowitz & Simmons, 2003). For example, when teachers and students address scientific and technological content in the context of character education, they can join in informed reflection about ethics in science and technology (Berkowitz & Simmons, 2015). It is then a reason why building character and spiritual values in a science education curriculum can be used as a foundation in shaping the behavior and culture of

advanced societies in this challenging century (Made 22 2015). Furthermore, these skills must to teach using a wide range of teaching techniques such as simulation, debates, discussions, and other models that lead to the formation of a scientific attitude, with the final goals being to build a moral and religious citizenry (Choudhury, 2016).

.Nevertheless, this study's findings are limited to a conceptual framework. The implementation of this framework is essential for determining the strengths and weaknesses of the established IP-21CSS framework. With the development of pedagogical models, methods 28 nd strategies aimed at encouraging the acquisition of 21st-century skills based on the results of emerging research, the opportunity exists to infuse this framework into the course to develop a more reliable framework for prospective science teachers.

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