

Improvements in bASES21: 21st-Century Skills Assessment Model to K12

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Abstract: Digital age has been impacted worldwide economy, human communication, knowledge access, democracy and days by day citizen lives. Consequently, several international entities make strategies for educational system and to empower people to labour market. One strategy has been to define what skills are important develop in 21st-century. To introduce educational systems approaches that aim to develop 21st-century skills it is necessary encompass how to teach, how to learn, and how to assess this personal development. Some practices have been indicated that teaching computing in basic education could act synergistically with 21st-century skills learning. So that, bASES21 is an instrument created to assess such skills. The first version was tested with a group of 148 high school students. Statistical studies pointed out the need of expand the sample size. Then in a second study sample size reach 560 students. New statistical analyses were done, and it was proposed several changes in first model. The instrument upgraded can assess such skills with 56 questions instead of 82, that were originally taken. These results can be very useful to ensure to attain necessary reliability and validity and to make possible popularization in using this instrument in K12 school setting.

1 INTRODUCTION

In the last two decades, human society has been coped with new challenges, especially related to the way to deal with knowledge. The enormous increase in machine throughput and distributed processing, massive data creation and also higher speed and processing capacity of the electronic devices, associated to great popularization of smartphones and personal computers, are allowing, even for a common citizen, to access, to create, to disseminate information and knowledge easily and quickly worldwide.

These great technological possibilities have become globalization, in fact, a reality. Even facts in remote places could have a fast impact worldwide.

This context has a strong influence on the economy, in the workforce, in consumer profiles, in democratic practices, and the global organization of countries. This new scenery brought up several doubts, especially about the future: What must be taught and learned to our youth? (Harari, 2018) Which kind of knowledge will be more useful? What must they know to enter the formal work market? What must they know to practice democracy and citizenship? For example, Szikora and Ali (2018) called attention to *the various dangers connected to smart phones, the importance of data and the privacy of the public, which would develop security conscious thinking.*

Concerning to digital inclusion of people, subjects must develop skills to take advantage of these benefits (Pischetola, 2019). The endeavour is to know

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which skills are essential and indispensable and how to teach and learn them. In this sense, since the last decade of the 20th century, several international entities have tried to recognize and to define such skills (Delors et al., 1996). Citizens must incorporate the flexibility that new technology demands to engage in social changes, democratic processes, communication flows, and employment opportunities. *Given the rapid rate of change and the influence of technology, employees need to develop 21st-century digital skills to cope and thrive in this changing society* (van Laar et al., 2017).

Ananiadou and Claro (2009) consider that *young people are already experiencing the new forms of socialisation and social capital acquisition that ICT developments are contributing to. Their education, both at school and at home, needs to provide them with the social values and attitudes as well as with the constructive experiences that will allow them to benefit from these opportunities and contribute actively to these new spaces of social life* (p. 5).

As an example of international initiatives, there are *Partnership for 21st Century Skills - P21*¹ and *Assessment and Teaching of 21st Century Skills Group*² - ATC21S (Binkley et al, 2011). Several skills are frequently considered for many authors, for example, creativity, critical thinking, problem-solving, communication, teamwork, collaboration, ICT proficiency, flexibility, proactivity, social responsibility, and so on.

This scenario brought several studies to try to define these skills and some instruments aiming to measure and assess such skills. In this sense, in this article, we present BASES21, which is a self-assessment instrument to measure 21st-century skills focus in the K12 Brazilian context. At first, we show some definitions of 21st-century skills and their approach to computer science education.

2 21ST-CENTURY SKILLS AND COMPUTER SCIENCE EDUCATION

Table 1 shows a summary of five approaches to 21st-century skills and compares them (Care and Griffin, 2014). What is highlighted in grey shadow bold represents a category of skills.

Another approach is *Partnership for 21st Century Skills* – P21 – that also shows several details impor-

tant for assessment and measurement. *The Partnership for 21st Century Learning recognizes that all learners need educational experiences in school and beyond, from cradle to career, to build knowledge and skills for success in a globally and digitally interconnected world* (P21, 2015 – Framework Definitions).

OECD approach is concerning to a collaborative problem-solving framework that also shows some intersection with the other approaches. *There has been a marked shift from manufacturing to information and knowledge services. Much of the problem-solving work carried out in the world today is performed by teams in an increasingly global and computerised economy. However, even in manufacturing, work is seldom conducted by individuals working alone. Moreover, with the greater availability of networked computers, individuals are increasingly expected to work with diverse teams spread across different locations using collaborative technology* (OECD, 2013, p.3-4).

The approach *Assessment and Teaching of 21st-century skills group* - ATC21S defined Binkley et al. (2012) defined ten skills and identified into four categories. Each skill is unfolded in detail in three domains: knowledge, skills, attitudes/values/ethics. These details are very important in identifying aspects of assessment. *ATC21S model for assessments of 21st-century skills, based on an analysis of curriculum and assessment frameworks for 21st-century skills developed around the world, identifies ten important skills in four broad categories. This model provides measurable descriptions of the skills, considering knowledge, skills, and attitudes, values, and ethics.*

Gordon et al. (2009), sponsored by the European Commission, created a significant document concerned to lifelong learners defining keys competences with connection with 21st-century skills. *The aim of the study is to provide a comparative overview of policy and practice concerning the development and implementation of key competences in the education systems (...) of the European Union.*

UNESCO approach (Delors et al., 1996) is a substantial document related to education for the 21st-century which defined the four pillars of education as learning to know, learning to do, learning to be and learning to live together. There is a significant overlap with 21st-century skills defined in other approaches.

It is possible to identify strong relations between computer science (CS) education and 21st-century skills. Digital competences encompass ICT and information proficiency, collaborative work, teamwork, and so on. These issues are central in

¹ www.p21.org

² www.atc.org

Table 1: Comparison of 21st-century skills approaches based on Care and Griffin (2014).

P21 (2015)	LEARNING AND INNOVATION:		INFORMATION, MEDIA AND TECHNOLOGY:	LIFE AND CAREER:
	Creativity; Critical thinking; Problem solving	Communication; Collaboration	Literacy: Information; Media; ICT	Flexibility and Adaptability; Initiative and Self-direction; Social and Cross-cultural Skills; Productivity and Accountability; Leadership and Responsibility.
OECD (2015)		INTERACT IN HETEROGENEOUS GROUPS:	USE TOOLS INTERACTIVELY:	ACT AUTONOMOUSLY:
		Relate Well to Others; Co-operate; Work in Teams, Manage and Solve Conflicts	Interactively: Use Language, Symbols and Texts; Use Knowledge, Information and Technology	Act within the Big Picture; Form and Conduct Life Plans and Personal Projects; Defend and Assert Rights, Interests, Limits and Needs.
ATC21S (Binkley et al., 2012)	WAYS OF THINKING:	WAYS TO WORK:	TOOLS TO WORK:	LIVING IN THE WORLD:
	Creativity and Innovation; Critical Thinking; Problem Solving; Decision Making; Learning to Learn; Metacognition	Communication; Collaboration	Information and ICT Literacy	Citizenship (local/global); Life and Career; Responsibility (social/personal); Including Cultural (awareness/competence)
European Commission (Gordon et al., 2009)	LEARNING TO LEARN:			
		Communication in Mother tongue and Foreign Languages	Mathematical, Science, Technology and Digital Competences	Social and Civic Competences; Initiative and Entrepreneurship; Cultural Awareness and Expression
UNESCO (Delors et al., 1996)	LEARNING TO KNOW	LEARNING TO DO	LEARNING TO DO	LEARNING TO BE AND TO LIVE TOGETHER

teaching and learning computer science. For example, Gordon et al. (2009) defined: *Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure, and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet* (p.45).

It is important to distinguish the difference between skills and competence. According to Ananiadou and Claro (2009), *skill is the ability to perform tasks and solve problems, while a competence is the ability to apply learning outcomes adequately in a defined context (education, work, personal, or professional development* (p. 8). For

them, *competence is not limited to cognitive elements (involving the use of theory, concepts, or tacit knowledge); it also encompasses functional aspects (involving technical skills) as well as interpersonal attributes (e.g., social or organizational skills) and ethical values* (p.8). Consequently, this broad vision of competence clarifies that people that are involved with computer science education, teaching or learning, or even as a user or developer or designer must be engaged in incorporated 21st-century skills. Computer science and technological development impact society all around the world, and the workforce trained must have an ethical commitment to their decisions.

We dare assert that 21st-century skills approaches are especially effect of the digital age, approached

people and provided new ways of communication and knowledge access, practically available for everyone. Practices particularly involved 21st-century skills as creativity, innovation, critical thinking, problem-solving, communication and collaboration (P21, 2017) are very useful for computer science students and professionals. In this sense, van Laar et al. (2017) identified key 21st-century skills or digital skills dimensions resulting in *a framework of seven core skills: technical, information management, communication, collaboration, creativity, critical thinking and problem solving, and five contextual skills: ethical awareness, cultural awareness, flexibility, self-direction and lifelong learning*. Therefore, these issues encourage this present study aiming to contribute to the development of 21st-century skills in the K12 Brazilian educational context.

3 BASES21 ASSESSMENT MODEL

The model BASES21 (Assessing 21st-Century Skills), began to be developed by Mioto (2018). After tests in the first version, Degering (2019) expanded the sample size and performed new statistical tests. Both authors were under the supervision of the fourth one. They developed this research as part of the bachelor thesis.

Both studies began searching by state of the art by means of a systematic mapping of literature (SML) according to Petersen et al. (2015) methodology. Mioto (2018) found eight models related to assessment of 21st-century skills (Chai et al., 2015; Rosen, 2015; Siddiq et al., 2017; Claro et al., 2012; Rosen and Tager, 2014; Aesaert et al., 2014; Lau and Yuen, 2014; Susnea and Vasiliu, 2016). These models only assess one skill or a cluster of skills but not all skills, as were defined by Binkley et al. (2011) or by P21 (P21, 2015).

Mioto (2018), based on SML findings, to create an instrument for 21st-century skills assessment. To assess this instrument, she considered the methodologies proposed by Basili et al. (1994), Kasunic (2005), Beecham et al. (2005), Wohlin et al., The instrument was a questionnaire, written originally in Brazilian Portuguese, composed of 82 questions, divided into 13 categories, which is shown in Table 2. Each question was defined based on the 2012, DeVellis (2016) and Trochim and Donnelly

(2008).

The instrument was a questionnaire, written originally in Brazilian Portuguese, composed of 82 questions, divided into 13 categories, which is shown in Table 2. Each question was defined based on the showed references beside it. Binkley et al. (2011) and P21 (P21,2015) supported a great number of questions. This instrument is a self-assessment questionnaire. Four points Likert scale is used with these options: *Totally Agree; Agree; Disagree; Totally Disagree*. It was designed for K12 Brazilian students as target public. The model can be applied in non-experimental studies using one-shot post-test designs. Also, it can be used in quasi-experimental studies by means of pre-test/post-test designs.

The assessment of the instrument consisted of the application to 148 students in middle schools. After that, statistical analysis was done based on the collected data. The complete study is available in Brazilian Portuguese³ language.

Degering (2019) followed Mioto (2018) aim to increase the size of the sample and improve the quality of the instrument assessment. He used the same methodology and redone the SML also problem-solving, according to Petersen et al. (2015). He found 13 models, eight covered by the first SML added to 5 new ones (Ball et al., 2016; Osman et al., 2010; Van Laar et al., 2018; Cevik, Senturk, 2019; Mioto et al., 2019). The own BASES21 appeared and was selected. Details of this SML are showed in Mioto (2018) and Degering (2019). Spite of the increasing of assessment 21st-century skills models found in second SML, only Mioto et al. (2019) proposed to assess a set bigger than others using as main foundation Binkley et al. (2011).

The findings of the two SMLs showed that skills related to ICT use are more frequent among models. Also, there is no consensus concerning the 21st-century skills classification. The instrument more usual is a self-assessment questionnaire using a Likert scale. These found instruments were statistically assessed for validation. They presented good statistical results or need to increase the sample size for more consistent conclusions. Statistical tests in the model proposed by Mioto (2018), in spite of a good internal consistency among items, indicate inconclusive validity (Ross, 2006). So, Degering (2019) applied BASES21 to other groups extending sample size. It is explained ahead in the sequence of this document.

4 DATA ANALYSIS

Table 3 synthesizes the data collection. We highlight

³ <https://repositorio.ufsc.br/handle/123456789/187851>

Table 2: bASES21 questionnaire version 1.0 - based on Mioto (2018) – free translate to English.

I - CREATIVITY AND INNOVATION:	
1	I invent/imagine many things that do not yet exist. (Chai et al., 2015); (Petway et al., 2016); (Susnea and Vasiliu, 2016)
2	My ideas are useful (Chai et al., 2015)
3	I can solve problems in different ways. (Chai et al., 2015); (Kang et al., 2010)
4	I am a curious person. (Susnea and Vasiliu, 2016)
5	I am not embarrassed to talk about my ideas. (Susnea and Vasiliu, 2016)
6	I learn with my errors or when my ideas go wrong. (Binkley et al., 2011)
7	I need to improve my ideas. (P21, 2015)
II - CRITICAL THINKING, PROBLEM-SOLVING AND DECISION MAKING:	
8	I compare different opinions/ideas to see which is the better. (Chai et al., 2015); (Binkley et al., 2011)
9	I make decisions according to the information that I have. (Binkley et al., 2011)
10	I like to ask and to answer questions to learn something new. (Kang et al., 2010); (Binkley et al., 2011); (IFL, 2015)
11	I listen to the ideas of my friends and consider them when I form my opinion. (Binkley et al., 2011)
12	I try to understand a problem before trying to solve it. (O'Neil and Schacter, 1997)
13	I choose and organize the material that I need when I am going to do something (homework, works, studies, etc.). (O'Neil and Schacter, 1997)
14	I ask myself if I am doing my tasks well at school. (O'Neil and Schacter, 1997)
15	I make an effort when I do my school tasks. (O'Neil and Schacter, 1997)
16	I can explain my opinions and decisions. (Chai et al., 2015)
III - LEARN TO LEARN AND METACOGNITION:	
17	I plan how to study (which tasks I am going to do in which days/time, etc.). (Chai et al., 2015)
18	If I have difficulty in a subject of a course, I spend more time studying this subject. (Chai et al., 2015)
19	I believe that I can learn everything that I want. (Binkley et al., 2011)
20	I like to learn new things. (Binkley et al., 2011)
21	I can keep concentrated for a long time. (Binkley et al., 2011)
IV - COMMUNICATION:	
22	I listen attentively to understand what others are saying. (Binkley et al., 2011)
23	Other people understand what I say. (Binkley et al., 2011)
24	When I read a text, I understand what I am reading. (Binkley et al., 2011)
25	I am not embarrassed to talk to an audience. (Binkley et al., 2011)
26	I like to say and to listen to different opinions. (Binkley et al., 2011)
27	I can argue well in a discussion. (Binkley et al., 2011)
V - COLLABORATION AND TEAMWORK:	
28	I like to work together with my colleagues and to solve problems. (Chai et al., 2015); (Kyllonen, 2012); (Petway et al., 2016); (Kang et al., 2010)
29	I can find time to help other people. (Kyllonen, 2012)
30	I like to be the group leader. (Kyllonen, 2012); (Kang et al., 2010)
31	I always do my part when I work in a group. (Kang et al., 2010)
32	I can create a sequence of tasks in group work (Binkley et al., 2011)
33	I like to be a good example for others. (Binkley et al., 2011)
34	I respect differences among people from other regions, countries, and religions. (Binkley et al., 2011)
35	I commit to doing the necessary tasks to achieve a goal in group work. (P21, 2015)
36	In group work, my colleagues usually agree with my ideas. (Kang et al., 2010)
37	I do not easily give up. (Kyllonen, 2012); (Susnea and Vasiliu, 2016)
38	I usually finish the things that I start. (Duckworth et al., 2007)
VI - INFORMATION PROFICIENCY:	
39	I can find the necessary information to do a task/ to solve a problem. (Lau and Yuen, 2014); (Aesaert et al., 2014); (Binkley et al., 2011); (Kang et al., 2010)
40	I analyze if a piece of information is truthful or not. (Lau and Yuen, 2014); (Aesaert et al., 2014); (P21, 2015); (Binkley et al., 2011)
41	I can change my opinion, depending on how much I know about the issue. (Siddiq, Gochyyev and Wilson, 2017)
42	I can explain why I change my opinion. (Siddiq, Gochyyev and Wilson, 2017)
43	I can interpret graphics and tables. (Claro et al, 2012); (Binkley et al., 2011)
44	I regard as wrong copying, sharing, or changing (information, text, pictures, etc.) that belong to other people without their permission. (P21, 2015)
45	When I study, I search for more information beyond my notebook notes, didactical material/books. (Kang et al., 2010)
VII - ICT PROFICIENCY:	
46	When I study, I access the internet to find useful information. (Aesaert et al., 2014); (Chai et al., 2015); (Kang et al., 2010); (Lau and Yuen, 2014); (CSTA, 2016)
47	I use instant message Apps (WhatsApp, Messenger, etc.). (Lau and Yuen, 2014)
48	I know how to create documents (doc, pdf, spreadsheets, etc.) or presentations in the computer. (Chai et al., 2015)
49	I can use electronic devices (computer, internet, cellphone, etc.) to do my tasks. (Siddiq, Gochyyev and Wilson, 2017)
50	I understand the importance of taking care of my personal information on the internet. (Wangenheim, Alves, Weber, 2017)

Table 2: bASES21 questionnaire version 1.0 - based on Mito (2018) – free translate to English. (cont.)

VIII - COMPUTATIONAL PROFICIENCY:	
51	I can create programs in computers (games, apps, etc.). (CSTA, 2016)
52	I can identify the most important parts of a computer. (CSTA, 2016)
53	I know the risk of using a simple password. (CSTA, 2016)
54	I know how computers communicate on the internet. (CSTA, 2016)
55	I know how to identify, to test, and to correct an error in a computer program. (Tsai, Wang and Hsu, 2018)
IX - LOCAL AND GLOBAL CITIZENSHIP:	
56	I have the right to give my opinion. (Binkley et al., 2011)
57	I pay attention to the news that appears in the media (TV, social networks, sites, etc.). (Binkley et al., 2011)
58	I respect that people can express different cultures, religions, lifestyle, and opinions. (Binkley et al., 2011); (P21, 2015))
59	I speak/understand well another language (Spanish, French, etc.) beyond English. (P21, 2015)
60	I can establish a good relationship with people with personalities or interests different from my own. (Kang et al., 2010)
61	I am friendly and kind with new colleagues in the classroom. (Kang et al., 2010)
X - PERSONAL AND SOCIAL RESPONSIBILITY:	
62	I can learn many things from other people. (Siddiq, Gochyyev and Wilson, 2017)
63	I can teach something to other people. (Siddiq, Gochyyev and Wilson, 2017)
64	I make an effort to, as much as possible, fulfill the promises that I make. (Kang et al., 2010)
65	I treat people as I would like to be treated. (IFL, 2015)
66	I admit my errors, and I apologize. (Kang et al., 2010); (Petway et al., 2016)
67	I know that government decisions can affect me in different ways. (P21, 2015)
XI - LIFE AND CAREER:	
68	I imagine where/in what I want to work when I grow up. (Binkley et al., 2011); (Kang et al., 2010))
69	I accept criticism even when I believe that I have done a good job. (Binkley et al., 2011))
70	I always do my homework. (Kyllonen, 2012); (Kang et al., 2010); (Petway et al., 2016))
71	When I get a low score in school, I try to understand the reason for this. (Kang et al., 2010)
72	I make a to-do list. ((Kang et al., 2010); (Kyllonen, 2012)
73	I can do my homework by myself. ((Duckworth et al., 2007); (Kyllonen, 2012)
74	I avoid as much as possible to talk or to use a cellphone during classes. (IFL, 2015)
75	I can adapt to the changes in my routine. (Binkley et al., 2011)
76	I can achieve the goals that I create for myself. ((Binkley et al., 2011)
XII - HEALTH PROFICIENCY:	
77	I understand what is necessary for a healthy life. (P21, 2015)
78	I know how to prevent common diseases. (P21, 2015)
79	I know how to take care not to catch a cold. (P21, 2015)
XIII - ENVIRONMENTAL AWARENESS:	
80	I know the causes of global warming. (P21, 2015)
81	I separate organic and recyclable trash. (P21, 2015)
82	I try not to take a long shower to save water. (P21, 2015)

that the number of students in high school encompasses 148 that came from the first study (Mito, 2018).

Mito (2018) made a statistical analysis of the data collected using a sample size equal to 148 high school students. The consistency analyses base on Cronbach alpha (Cronbach, 1951) shows a strong consistency among questions with a range between 0.957 and 0.958. However, the validity of the instrument was showed inconclusive by means of polychoric correlation matrix analysis (Drasgow, 1986); (Cohen, 1988). Likely because the instrument has a great number of questions. So. it pointed the need for more studies and expansion of sample size.

Degering (2019) performed an analysis of the new data collection. He excluded the sample of 166 undergraduate students to keep the goal of these

studies that is K12. Then it was calculated internal consistency by means of Cronbach alpha coefficients for each item. The result was that Cronbach alpha coefficients were equal or above 0.93 that indicated a very good consistency among items. Also, Cronbach alpha of instrument was 0.95, and no item was above this. This analysis means that no item must be excluded to improve internal consistency (DeVellis, 2016). Instead of this second analysis has a sample size bigger than the first one, the results were very similar) in terms of internal consistency.

The calculations of correlations among items were done aimed to find pieces of evidence concerning convergent and discriminant validation (DeVellis, 2016) of the bASES21 instrument. The convergent validity shows if items that must be related indeed are related and discriminant validation shows if items that

must be no related indeed are not related (Souza et al., 2017). Through the polychoric correlation matrix and Cohen coefficient analysis (Drasgow, 1986), (Cohen,1988), it was possible to figure out that some items must be included in a different category and some could be excluded. Details of this analysis are shown in Degering (2019). For example, items related to *Creativity and Innovation* showed a low correlation among them what could indicate that they do not measure the same factor. On the other hand, the items related to *ICT proficiency* showed good results concerning the validity, which indicates that no change is necessary.

Table 3: Synthesis of data collection.

SCHOOL DEGREE	1 ST TO 5 TH	6 TH TO 9 TH	HIGH SCHOOL	UNDERGRADUATE
Quantity	74	120	200	166
Sample size = 560 students				
Age Range: 8-19 years old				
Average = 14.5 years Median = 15 years				
Standard deviation = 2.71 years				

In addition, it was performed a factorial analysis by means of Cattell's Scree Test (Cattell, 1966); (Raiche et al., 2013). The results indicate that three or four factors showed better results than 13. Therefore, statistical analysis showed that the questionnaire needs to be changed: some categories and items could be excluded, and some items could be reorganized. The summary of changes proposed by Degering (2019) is shown in Table 4.

Degering (2019), based on exploratory factorial analysis, proposed, instead of 13 categories (factors), to regroup skills in four categories (factors): Learning and Teamwork; Citizenships and Social Responsibility; ICT Proficiency; Communication. Also, 26 items were excluded due to low factorial charge; or low relation to other items in the category or because there is another similar item. Table 4 shows the changes proposed by Degering (2019), the reorganization of items. We keep the original index number of items to facilitate comparison. Discussion

⁴ <http://agenciabrasil.ebc.com.br/educacao/noticia/2018-09/mec-divulga-nesta-segunda-indice-de-qualidade-do-ensino-basico> (access 02042020)

and conclusion.

5 DISCUSSION AND CONCLUSION

The Brazilian educational context of K12 is challenging. The performance of the students in the national examination is poor. Takahashi and Sadaña (2018) consider that difficult insertion in the labor market by the youth, are related to violence in society and to poverty. Even government agencies⁴ consider that it is necessary to change public policies to improve K12 education. In this context, initiatives that promote student motivation and could aim to prosperous future for youths are welcome. One possibility is to take into account 21st-century skills in special ICT and information proficiency. These concerning is emphasized by several international organization. To teach, to learn and to assess 21st-century skills are important to make possible to include these aspects educational system for social development updating for this century. They are allies of prosperity and citizenship because these skills aggregate technical aspects, interpersonal aspects and an ethical appeal in terms of behavior and attitudes.

Therefore, bASES21 could be an interesting instrument to play a role in the Brazilian K12 Educational scenario. Mioto (2018) and Degering (2019) followed a serious statistical methodology that increases the reliability and validity (Ross, 2006) of the instrument. New tests could bring up new benefits in the instrument.

The improvements proposed in bASES21 allow assessing with fewer questions. It tends to make an easier answer in a shorter time. In addition, a self-assessment instrument enables participants to get awareness because it calls their attention to the skills. It is important to have an appropriate instrument for Brazilian reality. It could support educational practices to promote 21st-century skills. Also, other counties could adapt the instrument for their reality or for opening new opportunities.

It is important to highlight that we did not find any other instrument for assessing 21st-century skills written in the Brazilian Portuguese language, so it seems that it is very original. bASES21 could call the attention of the educational system to approach the development of 21st-century skills in K12. We believe Our perspectives for future works are to perform new tests in bASES21 and to publicize this study in the Brazilian Portuguese language aiming to contribute to bringing these issues as part K12 Brazil educational policies.

Table 4: bASES v2.0 according to suggestion of Degering (2019)⁵.

I - LEARNING AND TEAMWORK (21 questions)	
10	I like to ask and to answer questions to learn something new. (Kang et al., 2010); (Binkley et al., 2011); (IFL, 2015)
12	I try to understand a problem before trying to solve it. (O'Neil and Schacter, 1997)
13	I choose and organize the material that I need when I am going to do something (Homeworks, works, studies, etc.). (O'Neil and Schacter, 1997)
14	I ask myself if I am doing my tasks well at school. (O'Neil and Schacter, 1997)
15	I make an effort when I do my school tasks. (O'Neil and Schacter, 1997)
17	I plan how to study (which tasks I am going to do in which days/time, etc.). (Chai et al., 2015)
18	If I have difficulty in a subject of a course, I spend more time studying this subject. (Chai et al., 2015)
20	I like to learn new things. (Binkley et al., 2011)
21	I can keep concentrated for a long time. (Binkley et al., 2011)
22	I listen attentively to understand what others are saying. (Binkley et al., 2011)
31	I always do my part when I work in a group (Kang et al., 2010)
33	I like to be a good example for others. (Binkley et al., 2011)
35	I commit to doing the necessary tasks to achieve a goal in group work. (P21, 2015)
37	I do not easily give up. ((Kyllonen, 2012); (Susnea and Vasiliu, 2016))
38	I usually finish the things that I start. (Duckworth et al., 2007)
39	I can find the necessary information to do a task/ to solve a problem. (Lau and Yuen, 2014); (Aesaert et al., 2014); (Binkley et al., 2011); (Kang et al., 2010))
70	I always do my homework. ((Kyllonen, 2012); (Kang et al., 2010); (Petway et al., 2016))
71	When I get a low score in school, I try to understand the reason for this. (Kang et al., 2010)
72	I make a to-do list. ((Kang et al., 2010); (Kyllonen, 2012))
74	I avoid as much as possible to talk or to use a cellphone during classes. (IFL, 2015)
76	I can achieve the goals that I create for myself. (Binkley et al., 2011)
II - CITIZENSHIPS AND SOCIAL RESPONSIBILITY (16 questions)	
6	I learn with my errors or when my ideas go wrong. (Binkley et al., 2011)
26	I like to say and to listen to different opinions. (Binkley et al., 2011)
44	I regard as wrong copying, sharing, or changing (information, text, pictures, etc.) that belong to other people without their permission. (P21, 2015)
56	I have the right to give my opinion. (Binkley et al., 2011)
58	I respect that people can express different cultures, religions, lifestyle, and opinions. (Binkley et al., 2011); (P21, 2015))
60	I can establish a good relationship with people with personalities or interests different from my own. (Kang et al., 2010)
61	I am friendly and kind with new colleagues in the classroom. (Kang et al., 2010)
62	I can learn many things from other people. (Siddiq, Gochyyev and Wilson, 2017)
63	I can teach something to other people. (Siddiq, Gochyyev and Wilson, 2017)
64	I make an effort to, as much as possible, fulfill the promises that I make. (Kang et al., 2010)
65	I treat people as I would like to be treated. (IFL, 2015)
66	I admit my errors, and I apologize ((Kang et al., 2010); (Petway et al., 2016))
67	I know that government decisions can affect me in different ways. (P21, 2015)
77	I understand what is necessary for a healthy life. (P21, 2015)
78	I know how to prevent common diseases. (P21, 2015)
79	I know how to take care not to catch a cold. (P21, 2015)

⁵ Original instrument in the Brazilian Portuguese language

Table 4: bASES v2.0 according to suggestion of Degering (2019). (cont.)

III - ICT PROFICIENCY (11 questions)	
40	I analyze if a piece of information is truthful or not. (Lau and Yuen, 2014); (Aesaert et al., 2014); (P21, 2015); (Binkley et al., 2011)
43	I can interpret graphics and tables. (Claro et al, 2012); (Binkley et al., 2011)
46	When I study, I access the internet to find useful information. (Aesaert et al., 2014); (Chai et al., 2015); (Kang et al., 2010); (Lau and Yuen, 2014); (CSTA, 2016)
47	I use instant message Apps (WhatsApp, Messenger, etc.) (Lau and Yuen, 2014)
48	I know how to create documents (doc, pdf, spreadsheets, etc.) or presentations in the computer (Chai et al., 2015)
49	I can use electronic devices (computer, internet, cellphone, etc.) to do my tasks (Siddiq, Gochyyev and Wilson, 2017)
50	I understand the importance of taking care of my personal information on the internet (Wangenheim, Alves and Weber, 2017)
52	I can identify the most important parts of a computer. (CSTA, 2016)
53	I know the risk of using a simple password. (CSTA, 2016)
54	I know how computers communicate on the internet. (CSTA, 2016)
55	I know how to identify, to test, and to correct an error in a computer program. (Tsai, Wang and Hsu, 2018)
IV - COMMUNICATION (8 questions)	
5	I am not embarrassed to talk about my ideas. (Susnea and Vasiliu, 2016)
16	I can explain my opinions and decisions. (Chai et al., 2015)
23	Other people understand what I say. (Binkley et al., 2011)
24	When I read a text, I understand what I am reading. (Binkley et al., 2011)
27	I can argue well in a discussion. (Binkley et al., 2011)
36	In group work, my colleagues usually agree with my ideas. (Kang et al., 2010)
42	I can explain why I change my opinion. (Siddiq, Gochyyev and Wilson, 2017)
59	I speak/understand well another language (Spanish, French, etc.) beyond English. (P21, 2015)

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