

## Validation of the competences for the 21<sup>st</sup>-century skill scale in higher education students

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### Abstract

In a global society, the importance of knowledge and assessment of transversal competences emerges to cope with the challenges of contemporary society, from a perspective of development and lifelong learning. Therefore, it is a priority to use assessment tools adapted to different cultures. The main objective of this study is to validate the instrument 'Multidimensional 21st Century Skills Scale' for the Portuguese population. The sample was composed of 413 participants of both genders, with a mean age of 24.30 years (standard deviation = 8.69), aged between 18 and 64 years, attending Higher and Vocational Education. The translation and back-translation of the instrument were carried out by experts (researchers and university professors in the areas of psychology, management, and entrepreneurship). The final version of the scale was composed of 30 items and the exploratory analysis identified three dimensions: Knowledge and Entrepreneurial Skills, Career Awareness and Innovation, and Critical Thinking and Problem Solving. These factors were validated by confirmatory analysis. The authors suggest that the difference found in relation to the original version is related to cultural reasons, the age range of the respondents, as well as their academic level.

Keywords: 21st century, skill scale, entrepreneurial skills, higher education innovation..

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## 1. Introduction

The 21st century presents itself full of technological, environmental, economic, and political challenges where resilience, truth, and hope are skills that should always be present in the daily lives of all citizens, so that they remain lucid, ethical and with a strong desire for truth, innovation, and hope (Harari, 2018; Jardim, 2021a). Such technological developments produce a continuous impact on society and induce constant change in such sensitive areas as economic, scientific, social, cultural, political, and environmental, where communication occurs as never before society has experienced (Schwab, 2016). Challenges are posed that are difficult to imagine, and where young people will have to be prepared to deal with unprecedented technological breakthroughs, accentuated by the decreased use of natural resources and adaptation to a new economic era generating new opportunities. Also, should be considered more interdependent and globalising, which will bring a closer coexistence of multicultural societies and a greater respect and impact of the Sustainable Development Goals in local, national, and global daily life (OECD, 2018). On the other hand, the interdependence and permeability of societies, in their most varied aspects, make any phenomenon a global fact. The repercussions of the recent COVID-19 pandemic proved the interdependence and complexity of economic, academic, political, and cultural societies, which is a virus capable of crossing borders, religions, and continents in such a short space of time (Gabriels & Benke-Aberg, 2020; Jardim et al., 2021a; Järvenpää & Szymaszek, 2020; Poisson, 2020, p.104).

The need for a real and cohesive cooperation of the 21st-century people, generating a balanced globalisation, induces the adoption of cooperative skills in younger people, fundamental factors for a globalisation where cultural, environmental, and social balance is a deep reality (Rosolen et al., 2014).

Twenty years past the first year of the 21st century, the ever-increasing various speeds of information dissemination and knowledge creation, cannot be a reason to neglect the knowledge versus skills of the individual in a society never experienced before, a result of the changing labour paradigm where manual work is replaced by mental work based on ideas and innovation (Tan et al., 2017).

Skills for the 21st century could be defined as what one will be able to do with the knowledge acquired and not the knowledge itself.

The competencies identified as necessary for the 21st century are not new; they are only becoming more important as argued by Elen Silva (2008). They are usually defined as those that are necessary for the individual to overcome the demands of everyday tasks, both at leisure and at work, in a society dominated by the growing predominance of technological, informational where global phenomena are increasingly present as reports the OECD Learning Framework 2030 (OECD, 2018). They are the result of the intersection of knowledge, literacy, and skills, but there is no agreed definition by the academic community (Tican & Deniz, 2019).

From the various approaches of skills for the 21st century, we highlight those of Trilling and Fadel (2009), National Research Council, Tican and Deniz (2019) and Çevik and Şentürk (2019). In the first approach, it is suggested that the 21st-century skills are agglutinated in three major chapters: Life and Career, Learning and Innovation and Information Technology. In the second, they would be grouped into Cognitive Skills, Interpersonal Skills, and Management Process Skills. In the third, Critical Thinking and Problem-Solving Skills, Collaboration and Leadership Skills, Agility and Adaptability Skills, Initiative and Entrepreneurship Skills and, finally, Oral and Written Communication Skills.

Çevik and Şentürk (2019), on the other hand, proposed five major groups of skills: Information and Technological Literacy Skills, Critical Thinking and Problem-Solving Skills, Entrepreneurship and Innovation Skills, Social Responsibility and Leadership Skills and Career Awareness. In turn, Jardim (2021b) proposed a tripartite model of competencies composed of three dimensions: being open to novelties, creating solutions to emerging problems and communicating effectively. In this model, which aims to meet the need to be successful in the current global and digital world, these dimensions integrate the following skills: creativity and innovation, the spirit of initiative, self-efficacy and resilience, strategic planning and evaluation, problem solving and decision-making, transformational leadership, clear and visual communication, teamwork and networking, and digital communication.

This model has also been developed from the perspective of entrepreneurial culture (Jardim et al., 2021b), soft skills (Jardim et al., 2020) and entrepreneurship education (Jardim, 2021a).

The bipolarity experienced in the 20th century also gave way to a society without borders for which the ease of communication between cultures is very important, thus losing a specific identity, but now living a collective identity where the role of a global and borderless economy has particular importance in the independence of world markets. Europe, anticipating and being aware of the challenges posed to society by globalisation and the development of technology in the 21st century, have produced projects and encouraged studies in order to define the skills necessary for its citizens to be able to overcome the challenges posed by a technological and non-cooperative society. We agree with some authors or organisations and we highlight the DeSeCo project (OECD, 2018), the study 'Saberes básicos para todos os cidadãos do século XXI' (Basic skills for all citizens in the 21st century) (Cachapuz et al., 2004), the reports 'Key competences for lifelong learning European reference frameworks' (European Union, 2019), and 'Learning for the 21st Century: a report and mile guide for 21st Century' (Partnership for 21st Century Skills, 2002).

Scientific production on the competences of the 21st century has also been fruitful in achieving the identification of the competences necessary for citizens, seeking a taxonomy of competences. There is no strict consensus as to their composition. However, a set of basic skills can be grouped into major areas: cognitive, relational and skills surrounding new information and communication technologies (ICT). Thus, critical, and creative thinking, self-learning (learning to learn), problem solving and adaptability, will be part of the personal skills while communication, group work, ethical and responsible skills may be under the umbrella of interpersonal or relational skills (Almerich et al., 2020).

Having addressed the skills considered as those necessary to face the challenges posed by the 21st century, considered by Wagner (2008) as the 'Survival Skills', it is important to make reference to the instruments used to assess them, knowing that it is in the sphere of teaching and learning that we find greater emphasis in the most recent literature (Care et al., 2018; Irgatoğlu & Pakkan, 2020; Sondergeld & Johnson, 2019; Tican & Deniz, 2019), where scales and semi-structured interviews prevail.

Skills are predominantly evaluated through interviews, observation, and mixed approaches. Some authors highlight the assessment of skills through Likert-type questionnaires that identify self-perceptions of their skills as is the case of 'The 21st-century learner skills use scale', 'The 21st century teachers skills use scale' (Tican & Deniz, 2019), 'Scale for 21st Century skills of primary Scholl Students' (Boyaci & Atalay, 2016) all of them very close to the one used by us in this work.

We did not find in the literature any Portuguese scale aimed at assessing the skills for the present century – search run on EBSCO (Elton Bryson Stephens Company) and other academic databases – encouraging us to adapt a scale for the Portuguese reality. With this work we intend to contribute to the validation of an instrument that identifies the competences for the 21st century adapted to the Portuguese reality, knowing that these result from the crossing and inclusion of learning, literacy, and behaviours.

## **2. Methods and materials:**

### *2.1. Sample*

#### *2.2.1. Sample characterisation*

The sample characterisation data identified the variables collected through the sociodemographic questionnaire (e.g., gender, nationality, education, and course). The sample was composed by 413 participants, with a mean age of 24.30 years [standard deviation (SD) = 8.69], within an age range of 18 to 64 years.

The sample comprises 295 (71.4%) female and 118 (28.6%) male students. They are mostly single 361 (87.4%) and of Portuguese nationality 381 (92.3%). In terms of education, 17 (4.1%) are attending a vocational course, 263 (63.7%) a degree course, 105 (25.4%) a master's course, 25 (6.1%) a PhD course and 3 (0.7%) a post-doctoral course.

## 2.2. Assessment instrument

This study, adopting quantitative methodologies for studies of this nature, is based on the instrument built by Çevik and Şentürk (2019) and which we translated and adapted to the Portuguese language.

The original version of this scale is a Likert-type scale with five response options with a purpose of determining the respondent's level of agreement [Strongly disagree (1), Disagree (2), Neither agree nor disagree (3), Agree (4) and strongly agree (5)]. It is composed of 41 items and organised into five factors: Information and Technological, Critical Thinking and Problem Solving (CTPS), Entrepreneurship and Innovation, Social Responsibility and Leadership, and Career Awareness. It was validated in a population of secondary school, polytechnic, and university students (undergraduate only) aged between 15 and 25 years old (N = 640). The initial number of items in this scale was 146 and, after statistical treatment, it was reduced to 41.

The development of the Portuguese version of the 'Multidimensional 21st century skills scale' was adapted to the Portuguese reality. Its items were analysed and approved by a panel of experts composed of researchers and university professors in the areas of psychology, education, management, and entrepreneurship. Several statistical analyses were performed, namely exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), and a final version with 30 items and three dimensions or factors was obtained for the Portuguese population. To obtain adequate adjustment indexes, all 30 items were considered in the CFA. The adaptation for the Portuguese reality was legitimated without any restriction by its authors and is registered at the Inspeção-geral das Atividades Culturais – Direção de Serviços de Propriedade Intelectual (ref. 690/2021).

## 2.3. Procedures

The instrument was made available to all higher education institutions and was placed on the Universidade Aberta's IT platform and supported by the LimeSurvey software (version 2.06). Higher education students were invited to respond. The answers to the questionnaires were obtained freely and voluntarily. Full privacy was also guaranteed and the current regulations (GDPR- General Data Protection Regulation) as well as the Fundamental Rights Charter of the European Union (2019) were respected. The questionnaires were online during the first quarter of 2021. Participants' ethical treatment was safeguarded, the following the guidelines of the American Psychological Association (2020).

## 2.4. Data analysis

The sample size complies with Joseph Hair's definition for factor analyses (Hair et al., 2009).

Initially, a principal components analysis/EFA was performed considering the original version (5 factors). No coincidences of the items in the dimensions were found. Then, a reduced 3-factor EFA was performed, which proved to be adequate to the theoretical model and the adjustment indexes, using the IBM SPSS Statistics software (v.24, SPSS Inc., Chicago, IL). Assumptions of normality and multinormality, outliers and missing values were validated. Descriptive statistics were used to characterise the sample.

The factor structure was validated by CFA using AMOS v24.0 software. The maximum likelihood estimator was used to assess robust standard errors of non-normality and the chi-square. The quality of fit of the models, were assessed by meeting reference values of good quality indicators: i)  $\chi^2 / gl \leq 5$ ; ii) the Comparative Fit Index (CFI); iii) the Tucker Lewis Index (TLI)  $\geq 0.95$ ; iv) the Root-Mean Square Error Approximation (RMSEA)  $< 0.08$ ; and v) the Standardised Root Mean Square Residual (SRMR)  $< 0.05$  (Hu & Bentler, 1999). Cronbach's alpha ( $\alpha$ ) was used to test internal consistency.

## 3. Results/findings

### 3.1. Construct validity

The result of the EFA showed that the items saturated in three dimensions as shown in Table 1. All items saturated above 0.30 so 36 items were considered. The value obtained by Kaiser-Meyer-Olkin Criterion (0.912) and Bartlett's test of sphericity (7,407.851,  $p < 0.000$ ) explaining the first component

30.391% of the variance and the second component 8.996% of the variance and the third component 6.301% of the variance, being 45.688% of the variance thus explained by these 3 factors.

Table 1. EFA of the 21st Century Skills Survey with Varimax Rotation

Items	Factor 1 KES	Factor 2 CAI	Factor 3 CTPS
G06_L01	0.347	0.685	
G06_L02		<b>0.704</b>	
G06_L03	0.368	<b>0.628</b>	
G06_L04	<b>0.706</b>		
G06_L05	0.730		
G06_L06	0.645		
G06_L07	0.597	0.396	
G06_L08	<b>0.601</b>		
G06_L09	<b>0.604</b>	0.318	
G06_L10	<b>0.644</b>		
G06_L11	<b>0.547</b>	0.328	
G06_L12	<b>0.527</b>	0.305	
G06_L13	<b>0.648</b>		
G06_L14	<b>0.567</b>		
G06_L15	<b>0.754</b>		
G07_L01			<b>0.633</b>
G07_L02			<b>0.682</b>
G07_L03			.579
G07_L04			<b>0.766</b>
G07_L05			<b>0.681</b>
G07_L06			<b>0.600</b>
G08_L02	0.514	0.335	
G08_L03	<b>0.475</b>		
G08_L04	<b>0.605</b>		
G08_L05	<b>0.581</b>		
G08_L06	<b>0.536</b>	0.369	
G08_L07	<b>0.485</b>	0.335	
G08_L08	<b>0.567</b>		
G08_L09	<b>0.594</b>		
G08_L10	<b>0.650</b>		
G10_L01		<b>0.701</b>	
G10_L02		<b>0.619</b>	
G10_L03		<b>0.552</b>	
G10_L04		<b>0.786</b>	
G10_L05		<b>0.778</b>	
G10_L06		<b>0.617</b>	

KES (Knowledge and Entrepreneurial Skills); CAI (Career Awareness and Innovation); CTPS (Critical Thinking and Problem Solving). Values in bold were considered due to their saturation being above 0.30 and because they make theoretical sense. N=413.

A CFA was also performed according to the structure, i.e., a three-factor model for the 21st century skills scale. However, to have an adequate robustness index, it was necessary to exclude six items according to the CFA performed. The three-factor solution in the 21st Century Competencies scale showed good adjustment indexes,  $\chi^2/df = 3.30$ ,  $p < 0.001$ ; GFI = 0.809; AGFI = 0.779; CFI = 0.811; RMSEA = 0.075. All items significantly saturated in the factors,  $p < 0.001$ , with saturations above 0.30 or close to it, and most correlations between items and factors proved to be strong (0.44 to 0.82) (Figure 1).

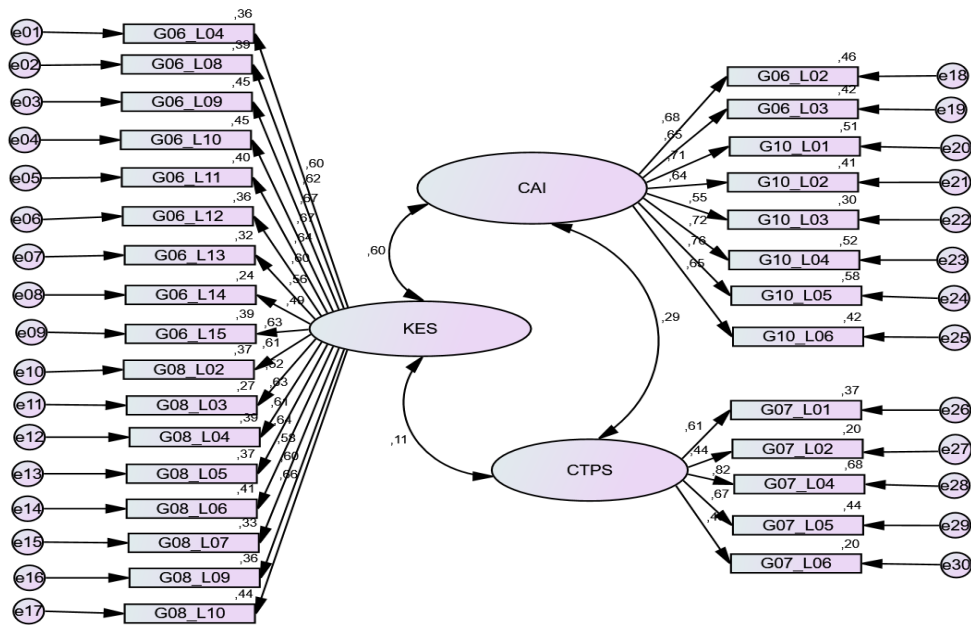


Figure 1. Factorial Confirmatory Analysis of the 21st Century Skills Scale: 1. KES - Knowledge and Entrepreneurial Skills; 2. CAI - Career Awareness and Innovation; 3. CTPS -Critical Thinking and Problem Solving

### 3.2. Internal consistency

As presented in Table 2, all three factors demonstrated good construct reliability. Each factor exhibited adequate Cronbach's alpha (from 0.73 to 0.90). The goodness of fit measures is within the recommended range and thus a good fit was achieved.

Table 2. Internal Consistency (Cronbach's alpha) of the Dimensions of the 21st Century Skills Scale

Factor	KES	CAI	CTPS	Global competence scale 21st century
Num of items	17	8	5	30
Alfa	0.90	0.85	0.73	0.90

- (KES) - Knowledge and Entrepreneurial Skills; 2. (CAI) - Career Awareness and Innovation; 3. (CTPS)-Critical Thinking and Problem Solving; 4. 21st Century Skills

### 3.3. Gender differences (female/male) at the level of the factors of the 21st century skills scale

The genders (female/male) showed differences in terms of the CAI factor. The female gender reported higher competence in CAI when compared to the male gender [ $t(411) = -173.3, p = 0.013$ ]. The female gender has higher competence when compared to the male gender, however, there were no differences in the other factors (Table 3).

Table 3. Gender differences (female/male) at the level of the factors of the 21st Century Skills Scale

		Number	Mean	SD	t	p
KES	Female	295	63.09	9.07	-1.79	0.074
	Male	118	64.94	10.36	-1.69	0.092
CAI	Female	295	35.49	3.67	2.50	<b>0.013**</b>
	Male	118	34.38	4.83	2.23	<b>0.027*</b>
CTPS	Female	295	20.63	2.88	-0.870	0.385
	Mele	118	20.91	3.05	-0.848	0.397
21st Century Skills - Total	Female	295	119.22	12.27	-0.721	0.472
	Male	118	120.24	14.72	-0.667	0.506

\*\*p < 0.01, \*p < 0.05

#### 4. Discussion

The present objective was to translate and adapt the instrument to the Portuguese reality. The results suggested that this study proved to be adequate for the Portuguese population, i.e., they were in line with the study of Çevik and Şentürk (2019).

The competences identified by us also corroborate those referred in the studies by Almerich et al. (2020), which highlighted the various denominations that integrate relational, personal, and interpersonal competences.

The EFA excluded eleven questions from the original model, now with thirty questions. Four from factor 1, one from factor 2, two from factor 3 and four from factor 4. Thus, our instrument has 30 items. The apparent non coincidence of the factors found in the Portuguese version (Figure 2) may be explained by the process of translation and back-translation of the instrument which was indirectly performed. We obtained the translation from Turkish into English, and English to Portuguese, and this gave rise to the Portuguese version, which may bring loss or blurring of concepts caused by linguistic and cultural differences. For example, the term literacy in Portuguese already has the concept of knowledge. The fact that there are some questions posed in a negative way may empower this explanation.

We found a parallelism with entrepreneurial skills because they suggest a variation depending on the society where they are inserted (Parente et al., 2011). On the other side, the respondent's level of education is different, as well as the age range which is diverse. These factors are in line with what has been stated by Çevik and Şentürk (2019) who advocate that their instrument, when applied to other realities, such as culture, age group or academic background, should be complemented with reliability and validity studies.

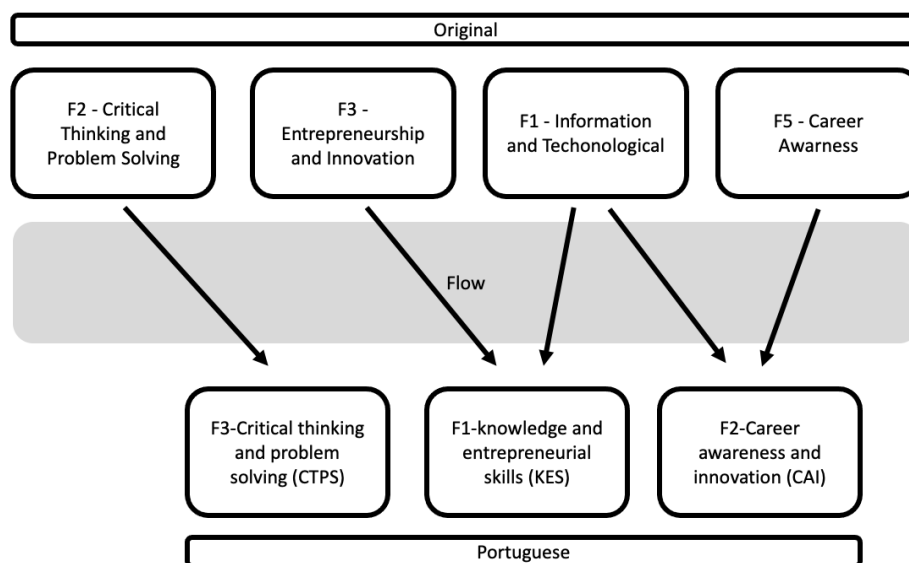


Figure 2. Relationship Between the Factors of the Original Version and the Portuguese Version

The questions merged into factor 5 of Çevik and Şentürk (2019) (Career Awareness) matched almost entirely with those of the Portuguese version (CAI), which was completed with two items from the areas of knowledge and innovation. This fact gives robustness to the set of competences desired in a 21st century professional in which Portuguese women have gained a greater weight as students in the education system. This fact is mirrored both in the difference in early school dropout compared to men (5.1% vs. 12.6%) (FFMS, 2021a), as well as in obtaining a doctoral degree, where, in 2015, 53.5% of doctoral exams were carried out by women (FFMS, 2021b). The number of factors found in our study matched with those found in the scales validated by Boyacı and Atalay (2016) and Ongardwanich et al. (2015) as well as in the line followed by the P21 Partnership for 21st Century Learning (P21, 2019) although there is no consensus on the composition of each dimension (Almerich et al., 2020).

Like all studies, this one also has some limitations. Due to COVID-19 outbreak the survey was carried on by online study with limitations, such as tiredness of answering questionnaires that have proliferated especially in periods of confinement and remote working. Also, the fact that studies of this nature are not abundant in the academic literature makes it difficult to cross-reference the results of this study with others of similar nature. The fact that women responded to our survey in a more massive way constitutes a limitation to the study presented since it does not translate the existing gender difference in higher education students in our country (FFMS, 2021c) but also found in the studies of Tican and Deniz (2019) and of (Sumen & Calisici, 2017).

We suggest the development of future studies in which the student population is culturally different from the Portuguese reality, or the authors of the original version, with the purpose of validating the factors found. Some longitudinal studies are suggested to understand the evolution of contextualised competencies in the era of globalisation.

## 5. Final considerations

The statistical analyses used at the level of EFA and CFA showed a consistent and robust validity of the studied construct. The robustness of the data allows us to affirm that such an instrument may be an added value for the study of skills for the 21st century. We thus corroborate the statements made by the authors of the original version (Çevik & Şentürk, 2019).

This study aimed at validating the instrument 'Multidimensional 21st century skills scale' for the Portuguese reality. The original scale is composed of 5 sub-factors: Information and Technological, CTPS, Entrepreneurship and Innovation, Social Responsibility and Leadership, and Career Awareness. The Portuguese version includes three domains – KES, CAI, and CTPS. The reductions in the number of factors were mainly related to cultural and linguistic differences of the surveyed population, as well as by their age group or academic level. However, this scale (see appendix), is a useful tool for the study of 21st century skills. A statistically significant difference was found between genders in the CAI factor.

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## Conflict of Interest

The authors declare no conflict of interest.

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## Appendix

### 21st Century Multidimensional Competency Scale (Portuguese version)

Dimensões / Factores	Item	Descrição	Discordo completamente	Discordo	Nem concordo nem discordo	Concordo	Concordo completamente
Conhecimento e competências empreendedoras (KES)	G06 L04	Acompanho as inovações no nosso país e no mundo.					
	G06 L08	Sei que tipo de informações necessito no dia-a-dia					
	G06 L09	Ácedo às informações que preciso a partir de fontes seguras					
	G06 L10	Investigo a exatidão das informações que obtive a partir de diferentes fontes					
	G06 L11	Eu uso as informações que adquiri e aplico-as corretamente na minha vida					
	G06 L12	Transmito as informações que tenho a certeza da sua exatidão, para as pessoas ao meu redor					
	G06 L13	Óigo regularmente a imprensa escrita e audiovisual					
	G06 L14	Conheço o significado dos símbolos televisivos que indicam o tipo de audiência a que um determinado programa se destina					
	G06 L15	Acompanho de perto os desenvolvimentos da tecnologia					
	G08 L02	Transformo situações adversas em oportunidades					
	G08 L03	Sei planejar e gerir bem o meu tempo.					
	G08 L04	Eu envolvo vários produtos nos meus trabalhos.					
	G08 L05	Gosto de lidar com trabalhos complexos e difíceis					
	G08 L06	Observo e examino tudo com um intenso sentido de curiosidade.					
	G08 L07	Penso nos métodos e nas técnicas que facilitarão a vida das pessoas.					
G08 L09	Eu penso nas necessidades que podem surgir no futuro e faço pesquisas sobre isso.						
G08 L10	Apresento facilmente aos outros as matérias e ideias que desenvolvi.						
Consciência de carreira e inovação	G06 L02	Gosto de ouvir ideias novas e diferentes.					
	G06 L03	Esforço-me por adquirir novos conhecimentos					
	G10 L01	Esforço-me por cumprir com sucesso as tarefas que me são confiadas.					
	G10 L02	Decido sobre a minha futura atividade profissional.					
	G10 L03	Tento determinar a profissão mais adequada para mim, pesquisando as características das profissões.					
	G10 L04	Quero ter sucesso na minha futura profissão.					
G10 L05	Tenho consciência que as minhas decisões atuais têm impacto sobre o meu futuro.						
G10 L06	Aproveito as oportunidades ao meu alcance que contribuirão para o meu desenvolvimento pessoal e futura carreira profissional (cursos, seminários, congressos, estágios, etc.).						
Pensamento Crítico e Resolução de Problemas (CTPS)	G07 L01*	- Aceito como verdadeira qualquer informação que recebo.					
	G07 L02*	- Não quero relacionar-me com pessoas que Não pensam como eu.					
	G07 L04*	- Aceito como certas todas as informações que leio					
	G07 L05*	- Falo sem pensar sobre os tópicos que aprendi.					
	G07 L06*	- Em vez de enfrentar um problema prefiro ignorá-lo.					