Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017. ISSN 1516-3687 (impresso), ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191. **Sistema de avaliação**: às cegas por pares (*double blind review*). Universidade Presbiteriana Mackenzie.

Validity evidence for a learning style measure

Katya Luciane de Oliveira[1]
Federal University of Londrina, SP, Brazil

Acácia Aparecida Angeli dos Santos
University of São Francisco, SP, Brazil

Fabio Alexandre Pereira Scacchetti
Federal Technological University of Paraná, PR, Brazil

Abstract: This study aimed at obtaining validity evidence for a learning style scale and at analyzing student's learning styles. The study included 709 students from professional technical education. We used a Scale of Learning Styles, with 80 items for the description of the preferred styles, and evaluated five dimensions, namely: environmental, social, instrumental, personal, and activity conditions. We applied the test collectively on the day and time set by each educational institution. A factor analysis with Varimax rotation indicated three-factor structure for the scale. The factors were grouped as follows: factor 1 – personal terms and conditions of activity, with 16 items ($\alpha = 0.78$); factor 2 – environmental conditions, with 11 items ($\alpha = 0.79$); factor 3 – social conditions, with 11 items ($\alpha = 0.81$). Overall, we observed that the students were more personal conditions and activity style-oriented. A scale that can map students' learning styles is relevant to Brazilian education because it allows students to know their learning preferences and can provide them with better learning conditions.

Keywords: styles; learning styles; cognitive styles; psychological assessment; high school coach.

EVIDÊNCIAS DE VALIDADE PARA UMA MEDIDA DE ESTILOS DE APRENDIZAGEM

Resumo: Este estudo objetivou buscar evidências de validade para uma escala de estilos de aprendizagem, bem como identificar quais são esses estilos. Participaram do estudo 709 estudantes do ensino técnico profissional. Utilizou-se uma escala de Estilos de Aprendizagem, com 80 itens destinados à descrição dos estilos de aprendizagem, avaliados em cinco dimensões: condições ambientais, sociais, instrumentais, pessoais e da atividade. A aplicação ocorreu de forma coletiva em dia e horário estabelecidos pelas instituições de ensino. A análise fatorial com rotação Varimax indicou estrutura de três fatores para a escala. Os fatores se agruparam da seguinte maneira: fator 1 – condições pessoais e condições da atividade, com 16 itens ($\alpha = 0,78$); fator 2 – condições ambientais, com 11 itens ($\alpha = 0,79$); fator 3 – condições sociais, com 11 itens ($\alpha = 0,81$). No geral, os estudantes se mostraram mais orientados pelos estilos das condições pessoais e da atividade. Uma escala que possa mapear o estilo de aprendizagem dos estudantes parece ser relevante para a educação brasileira por permitir que se conheça as preferências no modo de aprender, podendo propiciar-lhes melhores condições de aprendizado.

[1] **Mailing address:** Dra. Katya Luciane de Oliveira: Laboratório de Avaliação e Pesquisa Psicológica/LAPPSIC; Depto de Psicologia e Psicanálise. Centro de Ciências Biológicas. Universidade Estadual de Londrina, *campus* Universitário Rodovia Celso Garcia Cid (PR 445), km 380 – Caixa Postal 6.001. CEP: 86051-990. Phone: +5543 3371-4397. *E-mail:* katyauel@gmail.com

Palavras-chave: estilos; estilos de aprendizagem; estilos cognitivos; avaliação psicológica; ensino técnico profissional.

EVIDENCIAS DE VALIDEZ PARA UNA MEDIDA DE ESTILOS DE APRENDIZAJE

Resumen: Los objetivos del presente estudio fueron obtener evidencia de la validación de la escala de estilos de aprendizaje y analizar los estilos de aprendizaje de estos estudiantes. El estudio incluyó a 709 estudiantes de la enseñanza técnica profesional. Se utilizó una escala de evaluación de estilos de aprendizaje, con 80 artículos para la descripción de los estilos preferidos y evaluamos cinco dimensiones, a saber: las condiciones ambientales, sociales, instrumentales, personales y de la actividad. La aplicación se produjo colectivamente en día y hora fijadas por cada institución. Un análisis de factores con rotación Varimax indicó estructura de tres factores de la escala. Los factores se agrupan de la siguiente manera: factor 1 – términos personales y las condiciones de la actividad, con 16 ítems ($\alpha = 0,78$); factor 2 – condiciones ambientales, con 11 ítems ($\alpha = 0,79$); factor 3 – condiciones sociales, con 11 ítems ($\alpha = 0,81$). Los estudiantes fueron más guiados por los estilos personales de las condiciones y actividad. Una escala que pueda mapear el estilo de aprendizaje de los estudiantes parece ser relevante para la educación brasileña por permitir que se conozca sus preferencias en el modo de aprender, pudiendo propiciarles mejores condiciones de aprendizaje.

Palabras clave: estilos; estilos de aprendizaje; estilos cognitivos; evaluación psicológica; enseñanza técnico profesional.

Introduction

Learning is a complex cognitive phenomenon because it requires the connection of a neuronal abilities broad network that interact concomitantly. Thus, those researches that aim at understanding cognitive skills to elucidate how the learning process is efficient in the school context has gained prominence in the last decades (Cheng, Hu & Sin, 2016; Oliveira, Santos & Scacchetti, 2016; Oliveira, Inácio & Buriola, 2016; Curry, 1983; Riding & Cheema, 1991; Zhang & Sternberg, 2005).

Zhang and Sternberg (2005) observe that learning, being a multifaceted process, presents aspects that permit the organization, storage, and reorganization of knowledge, which therefore goes beyond the notion of action. In addition to the cognitive characters involved, it is essential to consider that personal traits of each directly influences the way in which he/she acquires knowledge (Felder, 2002; Felder & Spurlin, 2005; Litzinger, Lee, Wise, & Felder, 2007).

Therefore, learning is a dynamic task that requires different cognitive skills to work together. For learning to take place within a specific context, such as the school, the student needs to be able to employ and diversify both more sophisticated patterns of thinking and elaboration, as well as more superficial patterns in processing the information to be learned (Gomes, Marques & Golino, 2014).

Authors such as Litzinger et al. (2007) consider that each student may present a cognitive pattern considered unique at the time of learning. Each learner will have a preferred way of processing new information to carry out the school activities, and it may somehow interfere in their learning (Fan, 2016; Gomes et al., 2014; Zhang, 2015). Based on this premise, Oliveira, Trassi & Santos (2017) argue that, by observing the

specificities of how learning occurs in each student, turning into actions applied at the moment of studying and learning, scholars have expanded the framework of knowledge about the construct learning styles.

Concerning the terminology "styles", Zhang and Sternberg (2005) point out that the term is broad. In this sense, it is possible to find expressions such as cognitive style, time management style, decision-making style for problem-solving, learning style, mind style, perceptual style, thinking style, intellectual style, among others.

As Zhang & Sternberg (2005) point out, among the leading style models established over time, the ones that deserve to be highlighted: the onion model of learning styles (Curry, 1983); the model of cognitive processes and styles (Miller, 1987); the integrative model of cognitive styles (Riding & Cheema, 1991); the cognition, personality, and activity-centered model of styles (Gringorenko & Sternberg, 1995); and the mental self-governmental theory model (Zhang & Sternberg, 2005). The latter, according to Zhang (2011), aggregates most because it manages to incorporate the elements proposed in the previous models.

In the model employed by researchers such as Fan (2014), Fan & Zhang (2014), Zhang & Sternberg (2005), and Zhang (2015), learning styles can be understood as part of a broader scope called intellectual styles. The intellectual style would encompass both cognitive (such as memory, attention, readiness, among others, that is, it would contain cognitive style elements) and learning elements (because they are characterized by applied and learning-oriented actions such as the choice of resources used, socialization conditions, among others, that is, it would include learning style elements).

In this study, we will adopt the learning styles terminology, since we have used only the theoretical framework aimed at understanding learning actions applied that students prefer(onion model of learning styles – Curry, 1983), that is, their learning style (Santos & Mognon, 2010). In other words, learning styles encompass people's characteristics and preferences in the way they learn. The student can be seen as the learner who has a style or preference when it comes to process, analyze, and archive new information, becoming someone who participates in the interaction process of the learning process itself. Therefore, the student will adopt practical actions, expressed in preferences that can be done before, during, and after the learning situation.

Santos & Mognon (2010) observe that differences can be found in students' learning styles, some may be more self-oriented to learning through oral information, while others benefit more from written information, and yet others prefer information through other media, like the internet. Some students focus on environmental conditions, for example, so aspects like noise, temperature, lighting, among others, are fundamental for the learning experience.

The scientific literature seems to indicate that there is no positive or negative quantum to classify learning styles. It seems that there is not a better or worse learning style; common sense is necessary to promote different styles development in the

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

classroom, so that teaching does not favor certain types of learning styles (Santos & Mognon, 2010). In this train of thought, learning styles can not only be stimulated in the school environment but can also be altered according to contingency factors, such as affective experiences, social and environmental conditions, among others (Cardoso, 2007; Oliveira et al., 2016).

One student may be able to study while listening to music and another not because he considers the sound disturbing. It may be that, for the former, learning while listening to music can be stimulating and conducive to learning. Thus, literature emphasizes that students who have their learning style can direct their actions to obtain better results (Oliveira et al., 2017). Authors like Oliveira & Oliveira (2007) and Watanabe, Cassetari, Santos, Lombard-Platet, & Di Domenico (2001) consider that students committed to their learning can evaluate and modify inappropriate learning habits, that is, it is possible to modify or adapt a learning style, aiming at optimizing one's learning.

Gracio & Rosário (2004) and Stoker & Faria (2012) extend the discussion when they mention that personal factors may be associated with environmental contingencies at the time of the study. Thus, aspects such as motivation, dedication, and performance, among others would also make a difference in knowledge acquisition. In this context, the teacher's role is essential to mediate the student's learning as it facilitates knowledge acquisition and can guide the student given the requirements of each content or study environment. Therefore, if the teacher himself can be able to evaluate his students' learning styles, he can look for more efficient resources at the moment of teaching.

Although the study of learning styles seems promising, in Brazil, there is a gap in the production of knowledge and psychoeducational instruments that aim at evaluating the construct studied here. At the international level, Volkova & Rusalov (2016) and Zhang (2011) point out that, because of the discrepancies in the terminology used for the study of styles, there is a shortage of research aimed at standardizing instruments and methods to evaluate the styles in a theoretically more consensual way.

When reviewing the ways of measuring styles, Zhang & Sternberg (2005) identified that the available tools also present theoretical diversity in the way the construct is understood, as Volkova & Rusalov (2016) also pointed out. As observed, the instruments have multiple terminologies and conceptual differences. Some instruments available are: the Learning Style Inventory – LSI (Kolb's, 1976); the Self-Directed Search – SDS (Holland, 1985); the Kirton Adaptive Innovation Inventory – KAII (Kirton, 1987) and the Myers-Briggs Type Indicator – MBTI (Myers & McCaulley, 1988); the Thinking Styles Inventory for Students (Sternberg & Wagner, 1992); the Studying Inventory (Wilson, Smart & Watson, 1996) and the Strategic Flexibility Questionnaire (Cantwell & Moore, 1998); the Thinking Styles Inventory – TSI-R and TSI-R2 (Sternberg, Wagner & Zhang, 2003, 2007).

Given the above, this study aims at identifying validity evidence regarding the analysis of learning styles scale items internal structure focused on technical vocational students. Also, it aimed at distinguishing the best items for a possible refinement of the scale studied. Additionally, it aimed at recognizing the predominant learning styles in these students.

Method

Participants

The study participants were 709 technical vocational students, including 652 students from a unit of the National Industrial Learning Service (Senai) and 57 technical high school students from the Federal Technological University of Paraná (Universidade Tecnológica Federal do Paraná – UTFPR). The female gender represented 65.6% (n = 465) and the male 34.4% (n = 244). Student's average age was 18 years and two months (SD = 4.39), with a minimum age of 13 and a maximum of 49.

Tools

The Learning Styles Assessment Scale, developed by Santos in 2006, was used to describe preferred styles (according to onion model learning style, Curry, 1983). In Curry's model (1983), the learning behavior is based on learners' action, and it manifests through the learning styles they express because of their educational preferences. Thus, the theoretically elaborated items evaluate five dimensions, namely: environmental, social, instrumental, personal, and activity conditions. It should be clarified that style would not be just a learning condition but, in the proposed model, it would be considered a learning style.

Initially, the instrument underwent a procedure to evaluate the items' content and their representative dimensions. Five expert judges participated, being two Ph.D. and three M.Sc. from the cognitive and learning processes field. This group of experts judged the items considering the construct operational definition. The Ph.D. judges were Psychology college professors that worked for Stricto Sensu Graduate Programs from different universities, and the students were enrolled in the same institution the judges worked. They received the scale by e-mail, together with the items' classification, so that they could judge what the item was referring to (whether it included environmental, social, instrumental, personal, or activity preferences). We found no discrepancies in the items' judgment (results within the expected 80%).

The scale had 80 Likert-type questions, with four alternatives: always (3 points), often (2 points), few times (1 point), and never (0 points). The environmental conditions dimension (dimension 1 – composed of 22 items 2, 6, 10, 11, 28, 30, 39, 41, 42, 45, 48, 49, 56, 58, 59, 62, 67, 68, 69, 70, 71, and 75) refers to physical stimuli in the immediate environment, such as lighting, ventilation, noise, time, space (type of environment –

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

formal or informal and its physical structure). To exemplify this dimension, we can cite item 2 "I prefer to study in silence." The social condition dimension (dimension 2 – consisting of 14 items 9, 12, 15, 21, 27, 31, 34, 36, 51, 54, 57, 61, 77, and 80) refers to the preferred way of performing the task, considering those involved in the teaching-learning process (student-colleagues-teacher). Item 9 can exemplify this dimension "I prefer to perform group tasks." The instrumental condition dimension (dimension 3 – contains 12 items 14, 16, 23, 32, 35, 37, 40, 52, 55, 60, 72, and 73) concerns the preference for didactic and technological resources during the learning situation (resources such as games, magazines, newspapers, books, handouts, blackboard, overhead projector, computer, TV, and video). Item 14 is an example that evaluates this dimension "Learning little through games." The personal condition dimension (dimension 4 – includes 20 items 1, 4, 7, 13, 18, 20, 22, 24, 26, 38, 43, 44, 46, 50, 53, 63, 64, 66, 76, and 79) refers to the learner's sensory, perceptual, and cognitive preferences when performing a task (doing, observing, listening, reading, pacing, and problem-solving). Item 1 is an example of this dimension "I learn best by making notes during classes." Finally, the activity condition dimension (dimension 5 – consists of 12 items 3, 5, 8, 17, 19, 25, 29, 33, 47, 65, 74, and 78) is related to the activity's preferred format and proposition (more detailed, directed, organized, clear, closed, free, conventional, controlled, original, and/or creative activities). An example would be item 3 "I learn better with the teacher's explanations."

Data Collection Procedures

The participants (or in case they were under the age of 18, their legal guardians) signed a free and informed consent form. The data collection took place collectively in the classroom, on the day and time scheduled by the participating institutions. The data collection, which was performed and accompanied by one of the researchers, lasted approximately 30 minutes, between the explanation of the questionnaires and the time to answer them.

Data Analysis Procedures

We have organized the data in a spreadsheet and submitted it to descriptive and inferential statistics, aiming to meet the objectives. We used the statistical software SPSS IBM®. We employed Bartlett's sphericity test to check the feasibility of applying exploratory factor analysis. The Kaiser-Meyer-Olkin (KMO) index indicated that the sample was fit for analysis. We applied the Exploratory Factor Analysis (EFA) as, according to Damásio (2012), we can implement it when the researcher does not depart from an underlying background theory or does not have sufficient empirical evidence to affirm how to group specific items.

Results

Bartlett's sphericity test verified the possibility of applying the exploratory factor analysis method. The test indicated a correlation among items (x2 [3160; N = 709] = 10819.884; p <0.001), and, therefore, the appropriateness of using factor analysis. We checked the sampling adequacy measure with the Kaiser-Meyer-Olkin index (KMO), which corresponded to 0.779.

The factor analysis with Varimax rotation was the model that best adapted to the analysis, indicating a three-factor structure for the scale, with eigenvalues above 1.0 and capable of explaining 21.88% of the total variance. The factors were grouped as follows: factor 1 – personal conditions and activity conditions, with 16 items (3, 13, 17, 18, 22, 24, 25, 26, 46, 47, 50, 63, 64, 65, 66, and 74); factor 2 – environmental conditions, with 11 items (2, 6, 10, 11, 41, 42, 49, 56, 58, 59, and 62); and factor 3 – social conditions with 11 items (9, 15, 21, 27, 31, 36, 51, 54, 57, 77, and 80). Table 1 shows the items distribution by factor and their respective factor loadings and communalities:

Table 1. Distribution of items per factor and their respective factor loadings.

Items		1	2	3	Communality
2	I prefer to study in silence.		0.555		0.313
3	I learn better with the teacher's explanations.	0.367			0.144
6	It disturbs my learning when the radio is on.		0.618		0.382
9	I prefer to do group work.			0.758	0.596
10	Even when there is noise I am able to study.		-0.633		0.458
11	I prefer to study in quiet places.		0.693		0.484
13	Being free to do my homework makes my learning easier.	0.394			0.180
15	I learn more when my colleagues help me.			0.599	0.365
17	I learn better from examples.	0.401			0.221
18	I prefer activities in which I can create new things.	0.531			0.333

(to be continued)

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

Table 1. Distribution of items per factor and their respective factor loadings.

Items		1	2	3	Communality
21	I prefer to do schoolwork individually.			-0.648	0.450
22	I find it easier to learn by listening.	0.417			0.257
24	I like activities that make me think.	0.529			0.342
25	I learn more when I follow an organized script.	0.384			0.314
26	I learn better when I discuss the subject.	0.522			0.308
27	I prefer to learn by interacting with my classmates.			0.588	0.456
31	I learn better in group situations.			0.771	0.655
36	I learn little when I study alone.			0.423	0.189
41	I prefer to study lying down.		-0.366		0.138
42	I like to study with the TV on.		-0.512		0.298
46	I like to do activities that depend on my imagination.	0.430			0.256
47	The summaries help to understand the subject.	0.355			0.189
49	I prefer to study in well-lighted spaces.		0.400		0.204
50	I usually get new ideas while I learn.	0.563			0.320
51	I feel satisfied when what I think is similar to what my classmates think.			0.411	0.232
54	Studying in group makes me learn better.			0.753	0.606
56	I prefer to study in a seated position.		0.452		0.259
57	I find it easier to learn with my classmates.			0.712	0.534

(to be continued)

Table 1. Distribution of items per factor and their respective factor loadings.

Items		1	2	3	Communality
58	Any noise negatively affects my learning.		0.582		0.345
59	I prefer to study in calm environments.		0.706		0.518
62	It disturbs my learning when the TV is on.		0.614		0.385
63	I learn more when I have to talk about the subject.	0.388			0.197
64	I learn better by doing.	0.469			0.291
65	Practical exercises help my learning.	0.397			0.230
66	I like to learn by hearing the explanations.	0.465			0.264
74	Detailed tasks facilitate my learning.	0.384			0.213
77	I agree with my classmates' ideas about the themes we study.			0.462	0.241
80	I learn little when I study in group.			-0.556	0.358

Source: Elaborated by the authors.

The lowest factor loading was 0.351, and the highest was 0.771. The Cronbach's alpha coefficient found for factor 1 – personal conditions and activity conditions was 0.78; 0.79 for factor 2 – environmental conditions; and 0.81 for factor 3 – social conditions.

After analyzing the 80-item scale, we have reduced it to 38 items. We excluded items 12, 34, 61 (social conditions), and 55 (instrumental conditions) as they loaded in factor 1. Also, we omitted items 25 and 29 (activity conditions), and 52 (instrumental conditions) for loading in factor 2. We removed items 43 (personal conditions) and 73 (instrumental conditions) for loading in factor 3. We excluded the remaining items (i.e., 1, 4, 5, 7, 8, 14, 16, 19, 20, 23, 28, 30, 32, 33, 35, 37, 38, 39, 40, 44, 45, 48, 53, 60, 72, 75, 76, 78, and 79) from the version because they did not present factor loadings for the three factors imposed. Table 2 presents the items grouped according to the scale's theoretical congruence:

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

Table 2. Distribution of items, their respective theoretical dimensions and Cronbach's alpha.

Items		Dimension	Cronbach's alpha
3	I learn better with the teacher's explanations.	Personal and Activity Conditions	0.78
13	Being free to do my homework makes my learning easier.		
17	I learn better from examples.		
18	I prefer activities in which I can create new things.		
22	I find it easier to learn by listening.		
24	I like activities that make me think.		
25	I learn more when I follow an organized script.		
26	I learn better when I discuss the subject.		
46	I like to do activities that depend on my imagination.		
47	The summaries help to understand the subject.		
50	I usually get new ideas while I learn.		
63	I learn more when I have to talk about the subject.		
64	I learn better by doing.		
65	Practical exercises help my learning.		
66	I like to learn by hearing the explanations.		
74	Detailed tasks facilitate my learning.		
2	I prefer to study in silence.	Environmental Conditions	0.79
6	It disturbs my learning when the radio is on.		
10	Even when there is noise I am able to study.		

(to be continued)

Table 2. Distribution of items, their respective theoretical dimensions and Cronbach's alpha.

Items		Dimension	Cronbach's alpha
11	I prefer to study in quiet places.	Environmental Conditions	0.79
41	I prefer to study lying down.		
42	I like to study with the TV on.		
49	I prefer to study in well-lighted spaces.		
56	I prefer to study in a seated position.		
58	Any noise negatively affects my learning.		
59	I prefer to study in calm environments.		
62	It disturbs my learning when the TV is on.		
9	I prefer to do group work.	Social Conditions	0.81
15	I learn more when my colleagues help me.		
21	I prefer to do schoolwork individually.		
27	I prefer to learn by interacting with my classmates.		
31	I learn better in group situations.		
36	I learn little when I study alone.		
51	I feel satisfied when what I think is similar to what my classmates think.		
54	Studying in group makes me learn better.		
57	I find it easier to learn with my classmates.		
77	I agree with my classmates' ideas about the themes we study.		
80	I learn little when I study in group.		

Source: Elaborated by the authors.

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

To identify students' technical vocational learning styles, we verified the average scores in the subscales of personal and activity, environmental, and social conditions, as described in Table 3:

Table 3. Distribution of means, standard deviation, minimum and maximum score of subscales for learning strategies.

Subscale	Score Range	*M* points on Scale	SD	Minimum Score	Maximum Score
Personal and activity conditions	0 – 48	33.94	5.99	8	48
Environmental conditions	0 – 33	18.79	3.99	6	29
Social conditions	0 – 33	17.61	3.85	6	29

Source: Elaborated by the authors.

The results obtained from this analysis revealed that 46.8% of the students (n = 332) scored higher than the average score reached, granting more importance to personal and activity conditions. For environmental conditions, 50.5% of the students (n = 358) scored above average, valuing those conditions. Regarding social conditions, 44.8% of the students (n = 318) scored above average regarding the relevance of social conditions for learning.

Discussion

Studying learning styles is not an easy task, as there are controversies in the literature concerning the definition of this terminology (Oliveira et al., 2017). We can discuss the understanding that learning style involves deep processing. On the same train of thought, assuming that styles would be more superficial behaviors concerning the cognitive process seems plausible (Oliveira et al., 2016). If cognitive processing is complex, involving the mobilization of various brain functions, learning styles could express the subject's preferred mode to acquire and process information (Santos & Mognon, 2010; Zhang, 2011). So, the preference behavior would relate more to senses and to the way the subject reads and interprets reality. It would depend on the personal experiences of each subject with his/her learning process.

When studying the scale's factorial structure, we can observe that the exploratory factor analysis classified the first factor of the scale as representative of personal conditions (learner's sensory, perceptual, and cognitive preferences in the execution of a task) and activity conditions (preferred format and proposition of the activity). It seems that this congruence in the items organization that composed this factor

agree with the literature. In this sense, Grácio & Rosário (2004) agree that personal characteristics are related to situational demands at the moment of the study. The conditions of the activity/task itself may be directly involved in the personal way in which each subject learns. The alpha coefficient of this factor (0.78) can be considered positive.

When analyzing the items that composed the second factor, that is, environmental conditions (physical stimuli of the immediate environment), we can also conclude that this factor presented an acceptable alpha (0.79). This result seems to indicate that students' studying and reading conditions (see Oliveira & Oliveira, 2007) directly influence knowledge acquisition and the way in which it optimizes the activities directed to its study.

In the third factor, social conditions (the way they prefer accomplishing a task, considering those involved in the teaching-learning process: student-colleagues-teacher), we observed an alpha coefficient of 0.81, this being the highest internal consistency coefficient. This factor items' express the preferred way of studying, focusing activities/situations that involve social interactions among the stakeholders. Ribeiro & Ribeiro (2011) and Santos & Mognon (2010) call attention to the teacher's essential role as the person who influences the construction of preference for a particular learning style. This factor also covered the student-peers relationship, so it seems that we can positively associate study partnerships and friendship relationships in the school context with the achievement of this student's learning.

The instrumental condition factor (preference for educational and technological resources during the learning situation) was not a scale factor. Also, it is important to mention that we did not calculate an alpha coefficient for the scale as a whole because each item of the scale represents a learning style and the fact that a person has a more prominent preferential mode at the time of the study is neither positive nor negative.

Of the 80 items that made up the scale in its initial format, 38 remained after the treatment of the data through exploratory factor analysis. Despite the acceptable alphas coefficients for each subscale, we should mention the need for further research on the instrument to check that the instrumental condition factor does not appear as a factor in this 38-item scale format.

In a more qualitative analysis of each item in the factors in which they were grouped compared to the original scale, we verified that the first factor of the new scale joined items from factor 4 of the original scale, referring to personal conditions. Some examples are "I prefer activities in which I can create new things" or "I learn better by discussing the subject," as well as from the original factor 5, concerning activity conditions, "Practical exercises help my learning" and "Detailed tasks facilitate my learning." In this sense, we observed that the separation of both did not obtain empirical support, but there was no compromise of the theoretical sense, as the factor produced can perfectly group the operational details of students' preferred activities in the form of effectively engaging in the academic tasks. The

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

second factor included elements of the original scale factor 1, which relate to preferences for environmental and facilitating learning conditions, such as "I prefer to study in quiet places," "I prefer to study in well-illuminated places." Finally, the third factor concerns the preferences related to items of the original scale factor 2, which refers to a social interaction that may or may not be present in the study situation, such as "I prefer to do the school work individually" and "Studying in a group makes me learn better." Thus, it seems plausible to say that this study is a base to identify the best items for a proposed reformulation of the instrument, with fewer items that can produce the same information as originally intended. No empirical support was found to maintain the items related to the instrumental conditions that constituted Factor 3 of the original learning styles assessment scale. This is a limitation of the study, which needs to be better investigated with samples from another educational segment.

Regarding the identification of students' learning styles, Table 3 indicated that the highest average of preferences concentrated in the factor personal and activity conditions. We must better investigate this finding future studies, given the fact that the sample was exclusively composed of vocational students. It is crucial, therefore, to investigate regular high school students to verify if the result would be same or if it was due to the specificity of the sample in this study.

Final considerations

Learning styles and their broader framework, that is, intellectual styles, constitute a complex and multifaceted field of study, and they involve each person's characteristics and personal behaviors. Although studying in a noisy environment may be inappropriate for some student, others may think this type of condition is favorable to learning.

Thus, when discussing learning styles, we are dealing with a preferred action with the intention to study and learn. We should also note that style is an adaptive attribute, as individual preferences may change, especially considering situational and environmental contingencies. What supports this finding is the fact that there are differences in students' learning styles which can shift because preferences are variable and can change over time, depending on learning conditions. The framework of intellectual style considers the integrative model seems to be a promising model to be used for future research because it presents a broader theoretical congruence in understanding the facets of students' various learning styles. From this perspective, we should add that building and studying a scale that presents such a complex construct becomes a challenge that can significantly contribute to understanding the diverse ways of learning in a world filled with information from a myriad of different sources.

References

Cheng, S., Hu, X., & Sin, K. F. (2016). Thinking styles of university deaf or hard of hearing students and hearing students. *Research in Developmental Disabilities, 55*, 377–387. doi:10.1016/j.ridd.2016.04.004

Damásio, B. F. (2012). Uso da análise fatorial exploratória em psicologia. *Avaliação Psicológica, 11*(2), 213–228.

Gomes, C. M. A., Marques, E. L. L., & Golino, H. F. (2014). Validade incremental dos estilos legislativo, executivo e judiciário em relação ao rendimento escolar. *Revista Eletrônica de Psicologia, Educação e Saúde, 3*(2), 31–46. Recuperado de http://revistaepsi.com/wp-content/uploads/artigos/2013/Ano3-Volume2-Artigo3.pdf

Grácio, M. L. F., & Rosário, P. (2004). Olhares dos estudantes sobre o que torna difícil aprender. In C. Machado, L. S. Almeida, M. Gonçalves & V. Ramalho (Orgs.), *Avaliação Psicológica: formas e contextos* (pp.164–169). Braga: Psiquilíbrios Edições.

Fan, J. (2016). The role of thinking styles in career decision-making self-efficacy among university students. *Thinking Skills and Creativity*, *20*, 63–73. doi:10.1016/j.tsc.2016.03.001

Fan, J., & Zhang, L. F. (2014). The role of perceived parenting styles in thinking styles. *Learning and Individual Differences*, *32*, 204-211. doi:10.1016/j.lindif.2014.03.004

Felder, R. (2002). *Index of Learning Styles Page*. Recuperado de http:/ /www2.ncsu.edu/unity/lockers/users/f/felder/public/RMF.html

Felder, R. M., & Spurlin, J. E. (2005). Applications, Reliability, and Validity of the Index of Learning Styles. *Intl. Journal of Engineering Education, 21*(1), 103–112.

Litzinger, T. A., Lee, S. H., Wise, J. C., & Felder, R. M. (2007).A Psychometric Study of the Index of Learning Styles. *J. Engr. Education, 96*(4), 309–319.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs: Prentice Hall.

Oliveira, K. L., Inácio, A. L. M., & Buriolla, H. L. (2016). Diferenças considerando ano escolar no ensino fundamental: um estudo com estilos intelectuais. *Argumentos Pró-Educação, 1*(3), 408–422. Recuperado de http://ojs.univas.edu.br/index.php?journal=argumentosproeducacao&page=article&op=view&path%5B%5D=143&path%5B%5D=130

Oliveira, K. L., Trassi, A., & Santos, A. A. A. (2017). Estilos intelectuais: revisitando e atualizando conceitos. In S. C. Martinelli & D. C. Fernandez (Orgs.), *Aprendizagem escolar na contemporaneidade* (pp.64–77). Curitiba: Editora Juruá.

Revista Psicologia: Teoria e Prática, *19*(3), 176-191. São Paulo, SP, set.-dez. 2017.
ISSN 1980-6906 (*on-line*). http://dx.doi.org/10.5935/1980-6906/psicologia.v19n3p176-191

Oliveira, K. L., Santos, A. A. A., & Scacchetti, F. A. P. (2016). Medida de estilos de aprendizagem para o ensino fundamental. *Psicologia Escolar e Educacional*, *20*(1), 127–136. doi:10.1590/2175-3539/2015/0201943

Oliveira, K. L., & Oliveira, R. A. M. (2007). Propriedades psicométricas de uma escala de condições de estudo para universitários. *Avaliação Psicológica, 6*(2), 181–188.

Ribeiro, V. M. B., & Ribeiro, A. M. B. (2011). A aula e a sala de aula: um espaço-tempo de produção de conhecimento. *Revista do Colégio Brasileiro de Cirurgiões*, *38*(1), 71–76.

Santos, A. A. A., & Mognon, J. F. (2010). Estilos de aprendizagem em estudantes universitários. *Boletim de Psiclogia* [online]. 2010, *60*(133), 229–241.

Sternberg, R. J., & Wagner, R. K. (1992). *Thinking Styles Inventory*. Unpublished manual, Yale University.

Sternberg, R. J., Wagner, R. K., & Zhang, L. F. (2007). *Pensando em inventário de estilos – Revised II (TSI-R2),* Tufts University.

Sternberg, R. J., Wagner, R. K., & Zhang, L. F. (2003). *Thinking styles inventory: revised.* Unpublished: Yale University.

Stoker, J., & Faria, L. (2012). Desenvolvimento intraindividual das concepções pessoais de competência ao longo do ensino secundário. *Boletim de Psicologia, 62*(137), 183–199.

Volkova, E., & Rusalov, V. (2016). Cognitive styles and personality. *Personality and Individual Differences, 99*, 266–271. doi:10.1016/j.paid.2016.04.097

Watanabe, O. M., Cassetari, L., Santos, M. L. M., Lombardi-Planet, V. L. V., & Di Domenico, V. G. C (2001). Um levantamento dos hábitos dos alunos do curso de psicologia do Centro Universitário FMU. *Psikhê: Revista do Curso de Psicologia do Centro Universitário FMU, 6*(2), 61–68.

Zhang, L. F. (2011). The developing field of intellectual styles: four recent endeavours. *Learning and Individual Differences*, *21*(3), 311–318. doi:10.1016/j.lindif.2010.11.018

Zhang, L. F. (2015). Fostering successful intellectual styles for creativity. *Asia Pacific Educ. Rev., 16*, 183–192. doi:10.1007/s12564-015-9378-5

Zhang, L., & Sternberg, R. J. (2005). A Threefold Model of Intellectual Styles. *Educational Psychology Review, 17*(1), 1–53.

Submission: 4.3.2014

Acceptance: 23.8.2017