Development and Validation of KOLB 4.0 Learning Style Questionnaire

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Abstract

A great deal of individual difference with reference to learners' beliefs, thoughts, and behaviors can be explained in terms of the learning style the individuals adopt during the learning process. These learning styles have been labeled initiating, experiencing, creating / imagining, reflecting, analyzing, thinking, deciding, acting, and balancing according to Kolb and Kolb (2013). This research was conducted to develop and validate a multidimensional structure of the Kolb learning style inventory v. 4.0 (KLSI 4.0) in an Iranian context. KLSI 4.0 which is conceptualized in Experiential Learning Theory was then developed and evaluated through a series of validation procedures. Eight hundred thirty-three EFL learners studying English as ESP in IAU East Tehran Branch participated in the main phase of this study. Confirmatory Factor Analysis (CFA) through Structural Equation Modeling validated the proposed nine types KLSI 4.0. The outcomes of the initial piloting of the KLSI 4.0 did not show an acceptable fit due to high degree of correlation between some factors under the broad construct of learning style. Three factors indicating the highest degree of correlation were thus merged and the model was run again with modified six-factor LSI. Findings confirmed that learning style is a multidimensional construct in which the six factors are conceptually related. Reliability and validity estimates were examined and provided satisfactory psychometric properties of the inventory. In fact, the six-factor-correlated model of KLSI 4.0 revealed an acceptable model fit. Pedagogical implications and suggestions for further research were also discussed. The CFA applied in the research is distinguished from the initial assumptions in the literature and is more straightforward than originally presumed. This paper might be therefore used as a starting empirical point for further cross-validation analyses and educational implications.

Keywords: learning style, validation procedures, confirmatory factor analysis, structure equation modeling

Introduction

Learning styles have been the focus of many scholars within the past decades as they have to do with the way learning takes place (Fletcher et al., 2008). Kolb and Kolb (2013) classified the learning styles as initiating, experiencing, creating, reflecting, analyzing, thinking, deciding, acting, and balancing. Many studies have been carried out on learning styles and their impact(s) on learners' achievement / success within the few past decades. The Kolb learning style questionnaire in different versions have been used in plenty of studies up to now and shown appropriate reliability and validity (e.g., Kayes, 2005; Yahya, 1998). However, the Kolb learning style v.4 has not been validated to date. The learners who took the Kolb Learning Style Inventory version 3.2 (KLSI 3.2) sometimes report difficulty in answering the items. They report that the feedback they get from the learning style inventory (LSI) gives them more insight than has been the case when a normative Likert rating scale version is used. This is because the social desirability response bias in the rating scales fails to define a clear learning style, that is, they say they prefer all learning modes. Kayes (2005) views KLSI as the most influential model that has been proposed to-date.

Literature Review

The Learning Styles: Backgrounds and Characteristics

Learners should be aware of the significance and goals of knowledge, skills, and perceptions which are important in their future success (Laguador, 2013). During the learning process, learners make some mistakes along the way. However, they need to recognize that they will finally learn at some point. They gradually change from someone who did not have any appreciation of the specific knowledge to someone who does. Learning is composed of change and variation and it has a permanent impact on learners' behavior. Santrock (2005) defines learning as an approximately long-lasting variation in behavior that arises from experience.

Learning styles refer to the preferred ways the learners often choose to process information. They also describe an individual's typical mode of thinking, analyzing, or problem solving. The Kolb LSI is different from other tests of learning style (LS) due to its unique nature. It is in fact based on a comprehensive theory of learning and development and is known as the Experiential Learning Theory (ELT) put forward by Kolb (1984). As name displays, it has to do with experiential learning process and de-emphasizes the fixed learning parameters (Turesky & Gallagher, 2011). In this theory, experience plays the most important role in the learning / understanding of human beings and development. ELT views learning as "the process whereby knowledge is created through the transformation of experience and results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). The Original ELT Model proposed by Kolb (1984) displays two models of gaining experience, that is, Concrete Experience (CE) and Abstract Conceptualization (AC) as well as two modes of transforming experience, including Reflective Observation (RO) and Active Experimentation (AE). Previous studies on KLSI versions 1-3.1 highlighted four LS including Diverging, Assimilating, Converging, and Accommodating. Further empirical and clinical studies over the

past years have shown that the original four LS types can be refined into a nine LS that could better define the unique patterns of individual learning styles and decrease the ambiguities represented by borderline in the old four style typology (Boyatzis & Mainemelis, 2000; Erickmann et al., 2004; Kolb & Kolb, 2005a; 2005b).

Learners must be aware of their learning styles in order to be motivated to create the other learning styles (Gyeong & Myung, 2008). The LSI is not a criterion-referenced test and is not usually used for the purpose of prediction, selection, placement, etc. Such measurement is based on a single test score that runs counter to the ELT which focuses on the individual uniqueness. The purpose of LSI is to raise learners' understanding of their learning from experience. By increasing awareness of how the individuals learn, learners' capacity of their learning process will be enhanced and they would be able to monitor and choose the most appropriate learning approaches under various circumstances. By exposing the learners to different learning styles, raising their consciousness and talking about those learning styles, the educators could pave the way for them to create the best path for themselves along with the learning process. That is why the inventory is not regarded as a test, but preferably as an experience to understand how an individual learns best. It is crystal clear that the score obtained from the inventory should not be treated as absolute but rather a starting point to explore how an individual learns best. Rogers (2009) emphasized the importance of awareness of learning styles and believed that it can help the learners recognize their strengths, accept their weak points, and work more efficiently with other peers in group.

Different types of Learning Styles

There are numerous learning styles in the literature and the differences among all these learning styles lie in the platform in which learning occurs. Kolb and Kolb (2013) believe that if learning is to take place, it needs a space. This space is not solely limited to the physical environments but rather it is multidimensional. These dimensions consist of physical, cultural, institutional, social, and psychological features according to Kolb and Kolb (2013).

The learning styles themselves have been defined differently by many scholars in the course of time. Shuell (1986) confirms that learning styles refer to different ways individuals usually use to process and organize information confronting the social and / or environmental stimuli. Lohri-Posey (2003) proposed that "learning styles indicate an individual's preferential focus on different types of information, the different ways of perceiving information, and the rate of understanding information" (p. 54). Lucas and Corpuz (2007) believe that learning styles describe an individual's mode of thinking, remembering, or problem solving. Abante et al. (2014) relate learning styles to the variations in one's ability to accumulate and assimilate information. They add individuals' learning styles are the methods that enable them to gather and use knowledge in the most appropriate manner. The new KLSI 4.0 introduced by Kolb and Kolb (2013) representing nine style types described briefly as hereunder:

The **Initiating** *style* deals with experiences and situations. It involves active experimentation (AE) and concrete experience (CE).

The **Experiencing** *style* is characterized by the ability to find meaning from deep involvement in experience. It draws on concrete experience (CE) while balancing active experimentation (AE) and reflective observation (RO).

The **Imagining** *style* refers to imagining possibilities by observing and reflecting on experiences. It combines the learning steps of concrete experience (CE) and reflective observation (RO).

The **Reflecting** *style* relates to connecting experience and ideas through sustained reflection. It draws on reflective observation (RO) while balancing concrete experience (CE) and abstract conceptualization (AC).

The **Analyzing** *style* deals with integrating ideas into concise models and systems through reflection. It combines reflective observation (RO) and abstract conceptualization (AC).

The **Thinking** *style* refers to disciplined involvement in abstract reasoning and logical reasoning. It draws on abstract conceptualization (AC) while balancing active experimentation (AE) and reflective observation (RO).

The **Deciding** *style* relates to using theories and models to decide on problem solutions and courses of action. It combines abstract conceptualization (AC) and active experimentation (AE).

The **Acting** *style* is a strong motivation for goal directed action that integrates people and tasks. It draws on active experimentation (AE) while balancing concrete experience (CE) and abstract conceptualization (AC).

The **Balancing** *style* balances the experience, conceptualization, experimentation, and observation.

As is clear all the LS types can be represented on the two dimensions of Abstract Conceptualization-Concrete Experience and Active Experimentation-Reflective Observation as confirmed by Kolb and Kolb (2013).

Empirical Perspectives

There are various studies that have touched upon questionnaire validation in different fields of study in education. Yasar and Cogenli (2013) analyzed the validity and reliability of inventories that were used in program evaluation studies. They found content validity and Cronbach Alpha Coefficient have been furnished in almost all inventories. They also added there were many inventories that have been applied with no validity and reliability studies. Mohamad et al. (2014) developed three sets of questionnaires including Index of Learning Style (ILS), Students' Perception in Cognitive Dimension (SPCD), and students' Cognitive Mastery Achievement Test (CMAT). They assessed the validity and reliability of these questionnaires and found the values of reliability based on Cronbach Alpha lied within appropriate value ranges. The construct and content validity were also satisfactory according to the outcomes. Alvarado et al. (2016) validated a questionnaire to measure research skills with engineering students. Questionnaire validation was performed by literature review, semantic and content validation by

experts from three Latin American universities finishing with a factorial and reliability validation. The instrument was applied to 150 students (75.3% men and 24.7% women) who were enrolled in the basic level of engineering. The statistical results to validate the questionnaire (that is, validity and reliability) have been significant. Herrmann and Wichmann-Hansen (2017) assessed the validity of quality in PhD processes questionnaire (QPPQ) scales with special attention to factorial, convergent and discriminatory validity. Results were promising concerning the scale's psychometric properties and indicators of validity. In other words, the QPPQ offered itself as a theoretically grounded and thoroughly tested instrument for the purpose of evaluating and developing PhD programs at a local level or for researching PhD process in general.

Ishii et al. (2012) developed and validated the Adult Hypopituitarism Questionnaire (AHQ) as a disease-specific, self-administered questionnaire for evaluation of quality of life (QOL). The AHQ showed good reliability and validity for evaluating QOL in adult patients with hypopituitarism. Yousef (2019) examined the reliability and validity of the learning style construct conceptualized by Honey and Mumford (1986) in educational settings in the United Arab Emirates. The outcomes suggested that the learning styles questionnaire (LSQ) had moderate internal consistency in both samples. The inter-correlations revealed positive (weak to modest) correlations among the four learning styles for both samples, implying a lack of support for the two bipolar dimensions proposed by Kolb (1984). Lugman and Khalid (2021) developed and validated LS scale for E-learners. The items of the scale were generated empirically and were administered to a sample of 360 participants. The 48-item scale based on eight distinctive and interpretable factors appeared through factor analysis. This was the simplest method that could predict the accuracy and comprehensible interpretation of each factor. In addition, each factor was observed based on the theoretical relevance of items and items content. The findings showed that the newly constructed scale was a significant addition to assess learning styles particularly of e-learners in the context of Pakistan.

Purpose of the Study

Kolb and Kolb (2006) believe that education has been interwoven with some kind of variation. In the past, learners were considered as passive recipients of knowledge that education was to provide for them (Guyton, 2000). Many contemporary scholars, by the contrary, believe that this method would be unable to improve students' knowledge as it ignores the individual differences and disregards the share of experience in learning (Bringle & Hatcher, 1999). A shift to experiential learning acknowledges various learning styles (Pedrosa et al., 2006). The individuals' learning styles fall into four distinct categories according to the previous versions of the KLSI Studies and feedback from various learners all over the world confirmed that such categorization was not convenient to them. The reason was that their learning styles might have been classified in a way that did not seem to be true / accurate. It means a person might enjoy two or - at times - more learning styles simultaneously, while these inventories failed to make a distinction between all of them. The nine learning style typology came into existence to address such a problem consequently. It is so while such inventory has not been validated by

other researchers – at least in an Iranian context. This study has been conducted to reduce the confusions introduced by borderline cases in the old four style typology, find out whether this new version is more effective than the previous ones and figure out how it works and suits with different individuals. In fact, the study was designed to conceptualize and validate KLSI v. 4.0 based on experiential learning theory and attempted to provide an adjusted, valid, and easy way to administer an instrument to determine students' learning styles. It also highlighted the fact that learners can possess more than one learning style at the same time. To this end, one main research question was proposed as follows:

Do the hypothesized new nine style types of KLSI v. 4.0 have an acceptable model fit in an Iranian context?

Method

Participants

The sample of participants consisted of 919 university male and female students from IAU East Tehran Branch who was selected through convenient sampling technique. To obtain representative outcomes, the participants of the study were relatively large and drawn randomly to meet the prerequisite for validation study as already confirmed by Bodnar et al. (2013). Nonetheless to say, the participants were homogenous with respect to their levels of English proficiency. Most of them were low intermediate as determined by a test of PET (Preliminary English Test) administered by the researchers at the beginning of the research process.

After checking the data, it was evident that some students left out some items. To remove the ambiguities arisen from the missing data, the researchers had to omit them from the study and 833 participants remained. Their age range was between 18-25 years old. The researchers gave them clear explanations / instructions on how to fill out the questionnaire. They were assured that their responses would be kept confidential and would be used for the research purposes only. The time allocated for completing the questionnaire was between 25-30 minutes. All the participants were requested to sign an ethics consent form.

Instrumentation

Based on ELT and KLSI 4.0, the researchers of this study designed a learning style questionnaire including sixty-six items based on nine style types suggested by Kolb and Kolb (2013). The scale was devised to detect / evaluate the Iranian EFL learners' LS in processing / organizing information, recognizing mode of thinking, remembering, or problem solving. Scale items were collected from two sources: the guide to the KLSI 4.0 (Kolb & Kolb, 2013) and semi-structured interviews with the Iranian EFL learners. The researchers used and adapted some items from the validated questionnaires that have been proved to have acceptable psychometric features. This procedure is strongly recommended by Dornyei and Taguchi (2010) as an important technique for item generation. Students' semi-

structured interview was another main source used for item generation in this study. The researchers followed Dornyei and Taguchi (2010) instructions and involved the learners in the item generation procedures to enhance the quality of item pool. Fifty students were chosen to have a 25-30-minute interview about their LS. Analysis of the transcription provided some information that aided the researchers to devise items for the new scale. The nine style types of LSI were developed with a 6-point Likert scale ranging from 1 (not at all) to 6 (always true).

Data Collection Procedure

Learning styles are assumed to guarantee learners' success and are usually associated with some dynamics. Students might adopt various learning styles under different circumstances. KLSI 4.0 (translated versions) was administered to the participants. The respondents were asked to answer the questionnaires at their own pace. They were permitted to ask for any ambiguities while replying the questionnaires. Once all the required data were collected in-person, they were transformed into codes and then entered into SPSS v. 24 program.

Data Analysis

Questionnaire validation is an important procedure used for assessing the usefulness of instruments as already confirmed by Dornyei and Taguchi (2010). In the following paragraphs, the researchers present relevant procedures to estimate Reliability and Validity of the nine style types of KLSI v. 4.0:

Reliability

The researchers estimated Cronbach's alpha as the basic criterion of reliability for the large sample of the participants (n = 833) as it could yield an accurate estimate of internal consistency according to Brown (2001).

Validity

To examine the validity of the questionnaire, the following procedures were met:

- To examine *Face Validity* (whether the questionnaire had an appropriate look to the respondents), the researchers asked some respondents who were quite similar to the participants to answer the questions and make judgements about them. An interview was also carried out by 15 Iranian EFL learners to assess whether the items were readable, clear and appropriate due to the length. Three items were paraphrased and one item was deleted at this step.

- To evaluate *Content Validity* (whether the content of the questionnaire lies compatible with the theoretical basis of what it was supposed to measure), the researchers asked some TEFL experts to go through all items and give technical

comments about them. They were supposed to evaluate wording, consistency of construct and item relevance as well as the theoretical rationale of the questionnaire.

- To assess *Construct Validity* (whether the questionnaire could measure whatever construct it was supposed to measure), Confirmatory Factor Analysis (CFA) was applied. As Mueller and Hancock (2008) propose, this is a statistical method that is used in the development of an instrument and / or approval of its subscales.

Results

The results of this study fall into two distinct parts as hereunder:

The Results of the Initial Piloting of the Questionnaire

At this stage, the KLSI 4.0 was administered to 350 participants to see how it worked in reality. The outcomes were analyzed and reported through two phases briefly discussed as below:

Confirmatory Factor Analysis

To investigate the degree to which the nine-factor LSI might fit the data, Confirmatory factor analysis (CFA) using Structural Equation Modeling (SEM) was utilized to evaluate the hypothesized nine-factor structure of LSI. In fact, the CFA is usually used to examine the relationships between the items and factors as well as the relationship among the factors themselves. Such relationships need to be empirically validated as already confirmed by Viswanathan (2005). The maximum likelihood method was applied to estimate the features involved in the nine-factor measurement model. The variance-covariance matrix was applied to carry out CFA. This CFA was conducted by exploiting Version 22 of IBM AMOS statistical program (Arbuckle, 2013). Before implementing CFA, all its statistical assumptions and considerations were taken into account. The assumption of normality was considered by investigating univariate normality and multivariate normality. The assumption of univariate normality was checked by examining all the skewness and kurtosis values of indicators of the nine constructs and all of them were between -3 and +3, and -8 and +8, respectively (Kline, 2016). Multivariate normality was inspected using Mardia's normalized multivariate value which was 2.42, showing the tenability of multivariate normality (Mardia, 1974). Also, as model estimation in SEM is very sensitive to missing values and outliers, the data was checked for these values and 12 missing values were deleted listwise (less than 1% of data). Further, no univariate or multivariate outliers were found in the dataset. The descriptive statistics of LSI scale was presented in Table 1.

Table 1
*Descriptive Statistics of Nine-Factor KLSI 4.0 (N = 350)*

	Mean	Std. D	Skewness		Kurtosis	
				Std. Error		Std. Error
i1	4.03	1.13	-0.64	0.08	0.13	0.17
i2	3.17	1.27	-0.05	0.08	-0.87	0.17
i3	4.02	1.19	-0.50	0.08	-0.08	0.17
i4	3.44	1.32	-0.15	0.08	-0.85	0.17
i5	4.58	1.06	-0.72	0.08	0.41	0.17
i6	4.61	1.04	-0.75	0.08	0.60	0.17
i7	3.99	1.01	-0.47	0.08	0.40	0.17
i8	3.89	1.23	-0.35	0.08	-0.36	0.17
i9	4.31	1.28	-0.70	0.08	0.12	0.17
i10	3.45	1.29	-0.09	0.08	-0.67	0.17
i11	4.19	1.19	-0.55	0.08	-0.17	0.17
i12	4.81	1.00	-1.08	0.08	1.52	0.17
i13	3.27	1.33	-0.05	0.08	-0.88	0.17
i14	4.48	1.10	-0.63	0.08	0.13	0.17
i15	4.90	0.98	-0.98	0.08	1.21	0.17
i16	3.80	1.38	-0.30	0.08	-0.60	0.17
i17	4.87	0.93	-0.91	0.08	1.09	0.17
i18	4.44	1.05	-0.50	0.08	0.25	0.17
i19	4.41	1.03	-0.53	0.08	0.20	0.17
i20	4.13	1.35	-0.39	0.08	-0.67	0.17
i21	4.13	1.10	-0.38	0.08	-0.03	0.17
i22	4.23	0.86	-0.76	0.08	1.89	0.17
i23	4.29	0.95	-0.57	0.08	0.69	0.17
i24	4.42	1.10	-0.57	0.08	0.20	0.17
i25	4.56	0.89	-0.71	0.08	1.12	0.17
i26	3.34	1.51	-0.11	0.08	-1.05	0.17
i27	3.28	1.32	0.12	0.08	-0.67	0.17
i28	4.44	1.01	-0.65	0.08	0.31	0.17
i29	4.80	1.15	-0.88	0.08	0.36	0.17
i30	4.29	1.11	-0.49	0.08	-0.04	0.17
i31	4.45	1.08	-0.58	0.08	0.06	0.17
i32	4.25	1.07	-0.68	0.08	0.38	0.17
i33	4.01	1.23	-0.52	0.08	-0.21	0.17
i34	4.32	1.17	-0.56	0.08	-0.08	0.17
i35	4.00	1.12	-0.57	0.08	0.16	0.17

	Mean	Std. D	Skewness	Kurtosis		
				Std. Error		Std. Error
i36	3.65	1.40	-0.18	0.08	-0.80	0.17
i37	3.21	1.35	0.11	0.08	-0.72	0.17
i38	3.55	1.56	-0.13	0.08	-1.03	0.17
i39	3.49	1.40	-0.14	0.08	-0.75	0.17
i40	4.27	1.05	-0.60	0.08	0.39	0.17
i41	4.61	1.03	-0.72	0.08	0.40	0.17
i42	3.14	1.44	0.23	0.08	-0.79	0.17
i43	2.94	1.31	0.17	0.08	-0.82	0.17
i44	4.16	1.18	-0.65	0.08	-0.10	0.17
i45	4.27	1.06	-0.72	0.08	0.44	0.17
i46	4.99	1.04	-1.14	0.08	1.27	0.17
i47	4.37	1.25	-0.65	0.08	0.00	0.17
i48	4.13	1.13	-0.37	0.08	0.08	0.17
i49	4.21	1.38	-0.70	0.08	-0.12	0.17
i50	3.73	1.20	-0.31	0.08	-0.32	0.17
i51	3.80	1.00	-0.33	0.08	0.11	0.17
i52	4.95	0.98	-0.99	0.08	1.14	0.17
i53	4.75	1.00	-0.73	0.08	0.66	0.17
i54	4.32	1.11	-0.61	0.08	0.25	0.17
i55	4.18	1.19	-0.36	0.08	-0.24	0.17
i56	4.27	1.17	-0.63	0.08	0.11	0.17
i57	4.21	1.01	-0.43	0.08	0.35	0.17
i58	5.01	0.92	-0.95	0.08	1.30	0.17
i59	4.36	1.01	-0.35	0.08	-0.08	0.17
i60	3.40	1.22	-0.33	0.08	-0.40	0.17
i61	2.52	1.36	0.54	0.08	-0.67	0.17
i62	4.47	1.24	-0.88	0.08	0.29	0.17
i63	2.48	1.50	0.61	0.08	-0.79	0.17
i64	4.29	1.19	-0.61	0.08	0.13	0.17
i65	3.76	1.20	-0.10	0.08	-0.50	0.17
i66	2.88	1.31	0.28	0.08	-0.68	0.17

Complete Structural Model

In order to specify the model fit and to determine the associations between the factors, the full structural model was drawn in Version 22 of IBM AMOS to yield results for the analysis. Figure 1 demonstrates the complete structural model:

Figure 1
Nine-Factor Correlated Model of KLSI 4.0
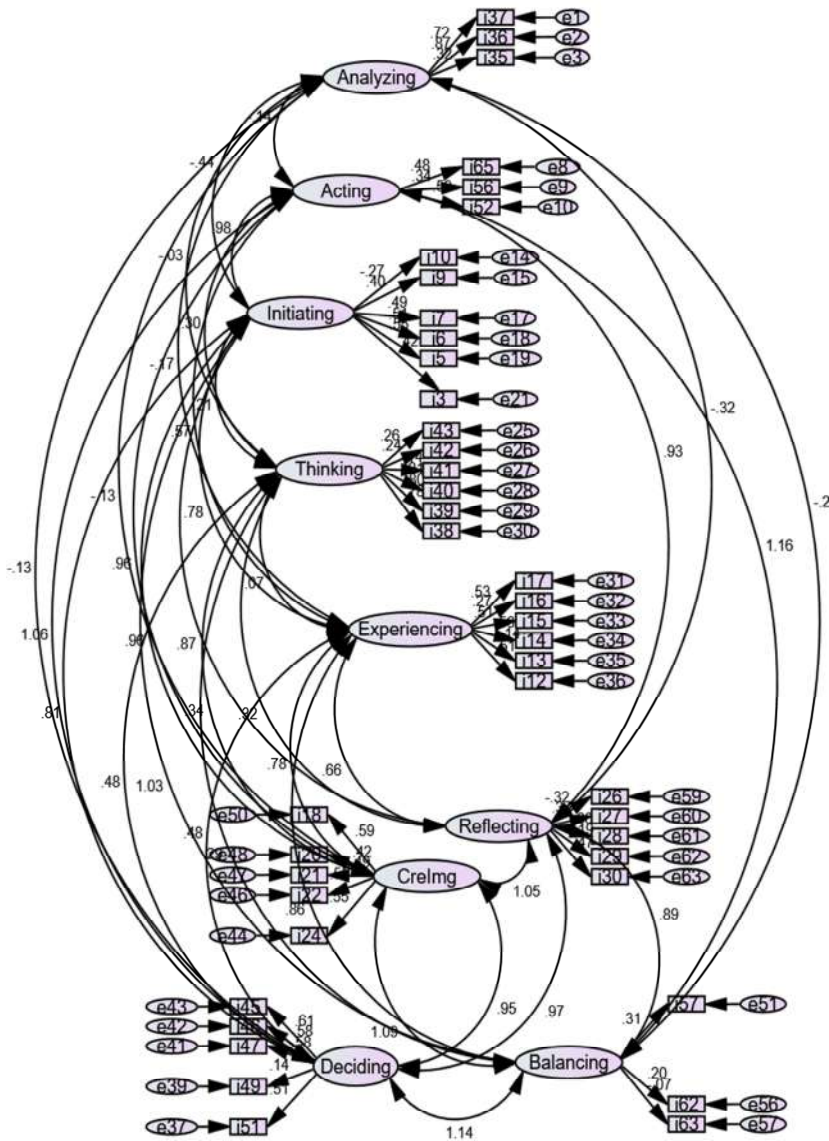
Non-surprisingly, the model did not indicate an acceptable fit according to criteria under examination including GFI, PGFI, RMSEA, and SRMR. It was not surprising as there was high correlation between some of the nine factors under the broad construct of LS. By re-checking the items of each factor, it was evident that

three factors had the capability to be combined as they evaluated almost the same traits. These three factors were detected by the researchers and some TEFL experts after careful examination of the analyzed data and in consultation with the authorized statistician in this field. The factors displaying high degree of correlation were *Initiating / Deciding, Experiencing / Acting,* and *Analyzing / Thinking.* As mentioned earlier, they showed great overlapping, high degree of correlation and in essence, they examined the same traits. The researchers under the supervision of the statistician in charge came to conclusion to merge these factors and run the model again.

The Results of the Adjusted Main Study of the Questionnaire

After careful investigation, some items were proved to have the same nature (assessing the same traits) and thus excluded from the KLSI 4.0. The modified KLSI 4.0 led to 30 items six-factor LSI. The modified six-factor LSI was administered to 833 participants of the main study. The findings are worth heeding within two statistical phases as below:

Confirmatory Factor Analysis (CFA)

To investigate the degree to which the modified six-factor LSI might fit the data, confirmatory factor analysis (CFA) using structural equation modelling (SEM) was utilized. As mentioned earlier, the CFA is usually used to examine the relationships between the items and factors as well as the relationship among the factors themselves. Such relationships need to be empirically validated as already confirmed by Viswanathan (2005). The maximum likelihood method was applied to estimate the features involved in the six-factor measurement model. The variance-covariance matrix was applied to carry out CFA. This CFA was conducted by exploiting Version 22 of IBM AMOS statistical program (Arbuckle, 2013). Before implementing CFA, all its statistical assumptions and considerations were taken into account. The assumption of normality was considered by investigating univariate normality and multivariate normality. The assumption of univariate normality was checked by examining all the skewness and kurtosis values of indicators of the nine constructs and all of them were between -3 and +3, and -8 and +8, respectively (Kline, 2016). Multivariate normality was inspected using Mardia's normalized multivariate value which was 2.42, showing the tenability of multivariate normality (Mardia, 1974). Also, as model estimation in SEM is very sensitive to missing values and outliers, the data was checked for these values and 12 missing values were deleted leastwise (less than 1% of data). Further, no univariate or multivariate outliers were found in the dataset. The descriptive statistics of LSI scale was presented in Table 2.

Table 2

Descriptive Statistics of Modified Six-Factor KLSI 4.0 (N = 833)

| Indicator	Mean value	Std. D value	Skewness value	Std. Error	Kurtosis value	Std. Error
i1	2.94	1.31	0.17	0.08	-0.82	0.17
i2	3.14	1.44	0.23	0.08	-0.79	0.17
i3	4.61	1.03	-0.72	0.08	0.40	0.17
i4	4.27	1.05	-0.60	0.08	0.39	0.17
i5	3.49	1.40	-0.14	0.08	-0.75	0.17
i6	3.55	1.56	-0.13	0.08	-1.03	0.17
i7	4.87	0.93	-0.91	0.08	1.09	0.17
i8	3.80	1.38	-0.30	0.08	-0.60	0.17
i9	4.90	0.98	-0.98	0.08	1.21	0.17
i10	4.48	1.10	-0.63	0.08	0.13	0.17
i11	3.27	1.33	-0.05	0.08	-0.88	0.17
i12	4.81	1.00	-1.08	0.08	1.52	0.17
i13	4.44	1.05	-0.50	0.08	0.25	0.17
i14	4.13	1.35	-0.39	0.08	-0.67	0.17
i15	4.13	1.10	-0.38	0.08	-0.03	0.17
i16	4.23	0.86	-0.76	0.08	1.89	0.17
i17	4.42	1.10	-0.57	0.08	0.20	0.17
i18	3.34	1.51	-0.11	0.08	-1.05	0.17
i19	3.28	1.32	0.12	0.08	-0.67	0.17
i20	4.44	1.01	-0.65	0.08	0.31	0.17
i21	4.80	1.15	-0.88	0.08	0.36	0.17
i22	4.29	1.11	-0.49	0.08	-0.04	0.17
i23	3.80	1.00	-0.33	0.08	0.11	0.17
i24	4.21	1.38	-0.70	0.08	-0.12	0.17
i25	4.37	1.25	-0.65	0.08	0.00	0.17
i26	4.99	1.04	-1.14	0.08	1.27	0.17
i27	4.27	1.06	-0.72	0.08	0.44	0.17
i28	4.21	1.01	-0.43	0.08	0.35	0.17
i29	4.47	1.24	-0.88	0.08	0.29	0.17
i30	2.48	1.50	0.61	0.08	-0.79	0.17

Note: i = Indicators of Constructs

Complete Structural Model

In order to specify the model fit and to determine the associations between the factors, the full structural model was drawn in Version 22 of IBM AMOS to yield results for the analysis. Figure 2 demonstrates the complete structural model:

Figure 2

Six-Factor Correlated Model of Modified KLSI 4.0
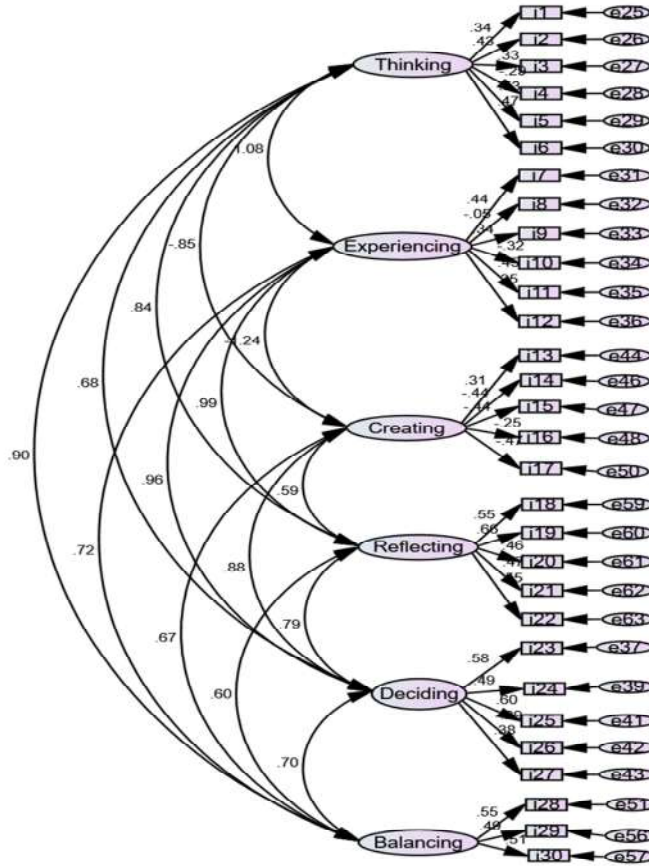
Note. All item parameter estimates and latent variables correlations were significant (P < .001)

Table 3 demonstrates the fit indices for the full structural model:

Table 3

Fit Statistics of the Structural Model

	x^2 (CMIN/DF)	df	RMSEA	GFI	PGFI	SRMR
KLSI v. 4.0	4.05	380	060	90	45	0.07

While there is no fixed and / or agreed-upon guidelines with respect to which fit indices are necessary to be reported (Kline, 2013), the researchers reported the following fit indices to examine the model fitness:

- Chi squared (x^2) test (CMIN / DF)
- The Goodness-of-Fit Index (GFI)
- The Parsimony Goodness-of-Fit Index (PGFI)
- The Root Mean Square Error of Approximation (RMSEA)
- The Standardized Root Mean Square of Residual (SRMR)

The structural model showed good fit to the data:

- Chi square = 1540.19, df = 380, p = .000 (CMIN / DF = 4.05)
- GFI = 0.90
- PGFI = 0.45
- RMSEA = 0.060 (90% CI: 0.055-0.064)
- SRMR = 0.07

As was quoted above, the first fit indices were the ratio of Chi-square (X^2) to the degree of freedom (*df*). As Chi-Square test of model fit is very sensitive to the sample size and it yields a significant result when a sample size is big, X^2 / *df* was reported to address that drawback of Chi-square test, with values between 2 and 5 indexing an acceptable model fit (Meyers et al., 2013). Such value was 4 in this study, signifying an acceptable fit. Then two residual fit indices which investigate the extent to which a model is successful in reproducing observed correlation / covariance matrix including root mean square error of approximation (RMSEA), and standardized root mean square of residual (SRMR) were reported. The RMSEA of above model was .06, indicating a good fit with regard to the model parsimony when model complexity is considered. This showed, to some extent, that a good model setup was established, and there was a good balance between model parsimony and model complexity. SRMR value which was also indicative of a good model fit was .07, which was lower than the benchmark value of .08 (Hu & Bentler, 1999). Two absolute fit indices including Goodness-of-Fit (GFI) and Parsimony Goodness-of-Fit (PGFI) which are useful in justifying the model complexity (i.e., the number of estimated parameters) were also examined. As was observed, GFI (it is conceptually similar to R^2 value in multiple regression) which shows to what extent variance in observed correlation / covariance matrix is accounted for by the

imposed model, was a close to the recommended value of .95 (Byrne, 2016), and PGFI approximated the recommended value of .50 (Byrne, 2016; Meyers et al., 2013).

To recap, the modified six-factor correlated model of KLSI v. 4.0 revealed an acceptable model fit (X^2 = 1540.19, *df* = 380; *p* < .001; X^2 / *df* = 4.05; GFI = .90; AGFI = .45; RMSEA = .06 [.05, .06]; SRMR = .07). The pictorial representation of the model accompanying with all the standardized regression weights generated using maximum likelihood estimation method (ML) were given in Figure 2. In addition, the Cronbach's alpha coefficient values of all the latent constructs were estimated (Analyzing / Thinking α = .83; Experiencing / Acting α = .72; Creating α = .76; Reflecting α = .77; Initiating / Deciding α = .80; Balancing α = .74) and all of them were greater than the benchmark value of .7, indicating a fairly acceptable internal consistency of the modified six-factor of KLSI 4.0.

Discussion

To enhance experiential learning in a way admitting the distinctive LS of individuals, the instructors need to measure their students' learning styles as efficiently as possible. However, the scales that have been used in the past enjoyed some restrictions. Although the initial version of KLSI was somehow brief and to the point, lack of reliability and validity limited the implications. By developing a new LSI, this study was intended to improve the previous version of KLSI. The assessment of learning style based on the new version allowed the students to choose more than one learning style at the same time. To this end, the validation procedures of CFA with reliability and validity estimates were examined. In devising the questionnaire, utmost care was given to avoid long / ambiguous sentences, complex / confusing wordings, double-barreled / unclear items, etc. This is the first instrument devised to allow the educators to collect information from respondents about their LS on modified-six-style typology in an Iranian context to the researchers' knowledge. CFA confirmed that the subscales of the new six style type of KLSI v. 4.0 were conceptually related to each other under the broad construct of LS. In this study, reliability tested by internal consistency and validity examined through face, content, and construct validity were satisfactory. With respect to face validity, the researchers asked some respondents who were quite similar to the participants to answer the questions and make judgements about them. By testing face validity, it was found out that the items were quite important for producing meaningful results. The content validity deals with the representativeness of the subject matter. TEFL experts were asked to test whether the items assess the relevant content. They came to the conclusion that content validity evaluation was positive. Content validity yielded more rigorous statistical justifications than does the face validity. Construct validity displaying the ability of an instrument to test an abstract concept (construct) was also evaluated through CFA.

Reliability which denotes to the degree to which an evaluating instrument creates stable and consistent outcomes over time / occasion was also examined. In

testing the reliability, the new six style types of KLSI v. 4.0 were found to have high internal consistency. The values of Cronbach alpha showed all the items in the factor were highly correlated with each other confirming the fact that random errors were minimized in the factor. In other words, the research instrument proved to comprise acceptable internal consistency. In essence, as confirmed by Kumar et al. (2011), while there is a predominant LS, learners must be emphasized to incorporate alternative styles under given circumstances. Newly-developed KLSI aimed at encouraging the students to use other LSs simultaneously. It allows them to be familiar with different LSs and it might reinforce and facilitate their learning. The results of this study are consistent with those reported by Manolis et al. (2013). They emphasized the revolutionary concept of LSs and the fact LSs move along a continuum. The outcomes are also in line with Pfeifer and Borozan (2011) that postulated LSs are not static rather they are dynamic and are inclined to constant variation. The findings are also compatible with those quoted by O'Connor and Yballe (2007). They viewed LSs as unstable properties that are vulnerable to change.

Conclusion and Implications

The results of the study indicated that there was a significant correlation among six subscales / factors which measured the construct of LS. Thus the factors correlated significantly with each other. This confirms that the instrument has good construct validity. The findings also show that the questionnaire can be a clear and valid research tool. Devising the questionnaire will provide new data in this area and thus contributes to education. An important pedagogical implication is that LSI is applicable to other fields of study as well. These data are useful to extend teachers' understanding of their students' confidence as they may be aware of their right LS. Educators must know about the students' learning styles in order to adjust their own teaching methods and enhance the students' learning as much as possible (Kolb & Kolb, 2006). Having assured students are aware of their true LS, EFL practitioners are also encouraged to design instructional activities as per students' true LS. The EFL instructors will be able to know about LS that is preferred by the learners and allow them to customize the style of teaching / learning according to their students' tastes. Analysis of each item appearing in KLSI 4.0 having the high reliability shows KLSI 4.0 can identify students' LS appropriately. EFL teachers will be also motivated to devise new teaching methods for detecting, challenging, and alerting less knowledgeable students to transform them to more competent and self-confident ones (Teng, 2016). In spite of the satisfactory outcomes generated from this study, some limitations were also recognized as follows:

- The instrument did not cover all the proposed dimensions of LS arisen from ELT due to the fact that integration of all dimensions could result in developing an instrument with many items, making it difficult to be used / administered.

- Validity and reliability of the instrument were evaluated just in one Iranian university. Thus the generalization of the findings should be done with outmost care.

Further studies are still required to adapt items and extend the results to other context with other participants with different backgrounds, proficiency levels and occupations. Comparing LSI to similar tools to determine the concurrent validity would be also recommended for future research studies. Bias analysis among participants was not taken into account in this study either, which is recommended as well.

References

Abante, M. E. R., Almendral, B. C., Manansala, J. E., & Manibo, J. (2014). Learning styles and factors affecting the learning of general engineering students. *International Journal of Academic Research in Progressive Education and Development, 3*(1), 16-27. https://doi.org/10.6007/IJARPED/v3-i1/500

Alvarado, F. C., Leon, M. P., & Colon, A. M. O. (2016). Design and validation of a questionnaire to measure research skills: Experience with engineering students. *Journal of Technology and Science Education, 6*(3), 219-233. http://dx.doi.org/10.3926/jotse.227

Arbuckle, J. L. (2013). *IBM SPSS Amos 22 user's guide*. Amos Development Corporation. URL: http://amosdevelopment.com.

Bodnar, M., Namiesnik, J., & Konieczka, P. (2013). Validation of a sampling procedure. *Trends in Analytical Chemistry, 51,* 117-126. https://doi.org/10.1016/j.trac.2013.06.011

Boyatzis, R. E., & Mainemelis, C. (2000). *An empirical study of pluralism of learning and adaptive styles in a MBA program.* (Working paper). Department of Organizational Behavior, Case Western Reserve University, Cleveland, OH.

Bringle, R. G., & Hatcher, J. A. (1999). Reflection in service learning: Making meaning or experience. *Educational Horizons, 77*(4), 179-85. https://digitalcommons.unomaha.edu/slceeval/23

Brown, J. D. (2001). *Using surveys in language programs.* Cambridge University Press.

Byrne, B. M. (2016). *Structural equation modelling with AMOS: Basic concepts, applications, and programming (3rd ed.)*. Routledge. https://doi.org/10.4324/9781315757421

Dornyei, Z. & Taguchi, T. (2010). *Questionnaires in second language research: Construction, administration, and processing*. Routledge.

Eickmann, P., Kolb, A.Y., & Kolb, D. A. (2004). Designing learning. In F. Collopy & R. Boland (Eds.), *Managing as designing: Creating a new vocabulary for management education and research* (pp. 241-247). Stanford University Press.

Fletcher, S., Potts, J., & Ballinger, R. (2008). The pedagogy of integrated coastal management. *The Geographical Journal, 174*(4), 374–386. https://www.jstor.org/stable/40205256

Guyton, E. (2000). Social justice in teacher education. *The Educational Forum, 64,*108–114. https://doi.org/10.1080/00131720008984738

Gyeong, J. A., & Myung, S. Y. (2008). Critical thinking and learning styles of nursing students at the baccalaureate nursing program in Korea. *Contemporary Nurse, 29*(1), 100–109. https://doi.org /10.5172/conu.673.29.1.100

Herrmann, K. J., & Wichmann-Hansen, G. (2017). Validation of the quality in PhD processes questionnaire. *Studies in Graduate and Postdoctoral Education, 8*, 2, 189-204. https://doi.org/10.1108/SGPE-D-17-00017

Honey, P. & Mumford, A. (1986). *Using your learning styles, 2nd ed*. Peter Honey.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. http://dx.doi.org/10.1080/10705519909540118

Ishii, H., Shimatsu, A., Okimura, Y., Tanaka, T., Hizuka, N., Kaji, H., Hanew, K., Oki, Y., Yamashiro, S., Takano, K., & Chiharak, K. (2012). Development and validation of a new questionnaire assessing quality of life in adults with hypopituitarism: Adult hypopituitarism questionnaire (AHQ). *PLoS ONE, 7*(9), 1-9. DOI: 10.1371/journal.pone.0044304

Kayes, D. C. (2005). Internal validity and reliability of Kolb's learning style inventory version 3 (1999). *Journal of Business and Psychology, 20*(2), 249–257. https://doi.org/10.1007/s10869-005-8262-4

Kline, R. B. (2013). *Beyond significance testing: Statistical reform in the behavioral sciences (2nd ed.)*. American Psychological Association.

Kline, R. B. (2016). *Principles and practice of structural equation modeling (4ᵗʰ ed.)*. Guilford.

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

Kolb, A. Y., & Kolb, D. A. (2005a). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning and Education, 4*(2), 193-212. https://doi.org/10.5465/amle.2005.17268566

Kolb, A. Y., & Kolb, D. A. (2005b). *The Kolb learning style inventory 3.1: Technical specifications*. Hay Resources Direct.

Kolb, A. Y., & Kolb, D. A. (2006). Learning styles and learning spaces: A review of the multidisciplinary application of experiential learning theory in higher education. In R. R. Sims, & S. J. Sims (Eds.), *Learning styles and learning: A key to meeting the accountability demands in education* (pp. 45–92). Nova Science Publishers.

Kolb, A.Y., & Kolb, D. A. (2013). *The Kolb learning style inventory 4.0: A comprehensive guide to the theory, psychometrics, research on validity and educational applications*. Experience Based Learning System.

Kumar, L. R., Voralu, K, Pani, S. P., & Sethuraman, K. R. (2011). Association of kinesthetic and read-write learner with deep approach learning and academic achievement. *Can Med Educ Journal, 2*, 23–27. https://doi.org/10.36834/cmej.36538

Laguador, J. M. (2013). Developing students' attitude leading towards a life-changing career. *Educational Research International, 1*(3), 28-33.

Lohri-Posey, B. (2003). Determining learning style preferences of students. *Nurse Educator, 28*(2), 54-64. https://doi.org /10.1097/00006223-200303000-00002

Lucas, M., & Corpuz, B. (2007). *Facilitating learning: A meta-cognitive process.* Lorimar Publishing.

Luqman, N. & Khalid, R. (2021). Development and validation of LS scale for E-learners. *SAGE Open, 11*(2), 1-15. https://doi.org/10.1177/21582440211022324

Manolis, C., Burns, D., Assudani, R., & Chinta, R. (2013). Assessing experiential learning styles: A methodological reconstruction and validation of the Kolb learning style inventory. *Learning & Individual Differences, 23*(1), 44-52. DOI: 10.1016/j.lindif.2012.10.009

Mardia, K. V. (1974). Applications of some measures of multivariate skewness and kurtosis in testing normality and robustness studies. *Indian Journal of Statistics, 37*(2), 115–128. https://www.jstor.org/stable/25051892

Meyers, L. S., Gamst, G., & Guarino, A. J. (2013). *Applied multivariate research: Design and interpretation (2nd ed.).* SAGE Publications.

Mohamad, M. M., Sulaiman, N. L., Sern, L. C., & Salleh, K. M. (2014). Measuring the validity and reliability of research instruments. *Procedia-Social and Behavioral Sciences, 204*, 164-171. https://doi.org/10.1016/j.sbspro.2015.08.129

Mueller, R. O., & Hancock, G. R. (2008). Best practices in structural equation modeling. In J. W. Osborne (Ed.), *Best practices in quantitative methods* (pp. 488–508). SAGE Publications. https://doi.org /10.4135/9781412995627

O'Connor, D., & Yballe, L. (2007). Team leadership: Critical steps to great projects. *Journal of Management Education, 31*(2), 292–312. https://doi.org /10.1177/1052562905282158

Pedrosa de Jesus, H. T., Almeida, P. A., Teixeira-Dias, J. J., & Watts, M. (2006). Students' questions: Building a bridge between Kolb's learning styles and approaches to learning. *Education and Training, 48*(2/3), 97–111 https://doi.org /10.1108/00400910610651746

Pfeifer, S., & Borozan, D. (2011). Fitting Kolb's learning style theory to entrepreneurship learning aims and contents. *International Journal of Business Research, 11*(2), 216–223. URL: http://www.aibe.org/1555-1296, 1554-5466

Rogers, K. (2009). A preliminary investigation and analysis of student learning style preferences in further and higher education. *Journal of Further and Higher Education, 33*(1), 13-21. https://doi.org/10.1080/03098770802638234

Santrock, J. (2005). *Psychology essentials 2*. McGraw-Hill.

Shuell, T. J. (1986). Cognitive conceptions of learning. *Review of Educational Research, 56*, 411-436. https://doi.org/10.3102/00346543056004411

Teng, L. S. (2016). Changes in teachers' beliefs after a professional development project for teaching writing: Two Chinese cases. *Journal of Education for Teaching, 42*(1), 106–109. https://doi.org/10.1080/02607476.2015.1135228

Viswanathan, M. (2005). *Measurement error and research design*. SAGE Publications. https://dx.doi.org/10.4135/9781412984935

Turesky, E. F., & Gallagher, D. (2011). Know thyself: Coaching for leadership using Kolb's experiential learning theory. *Coaching Psychologist, 7*(1), 5–14. URL: http://www.bps.org/1748–1104

Yahya, I. (1998). Wilcoxson and Prosser's factor analysis on Kolb's (1985) LSI data: Reflections and re-analysis. *The British Journal of Educational Psychology, 68*, 281-286. https://doi.org/10.1111/j.2044-8279.1998.tb01290.x

Yasar, S., & Cogenli, A. G. (2013). Determining validity and reliability of data gathering instruments used by program evaluation studies in Turkey. *Procedia-Social and Behavioral Sciences, 131*, 504-509. https://doi.org/10.1016/j.sbspro.2014.04.156

Yousef, D. A. (2019). Exploring the reliability and validity of the learning styles questionnaire (LSQ) in an Arab setting. *Quality Assurance in Education, 27*(4), 446-464. https://doi.org/10.1108/QAE-10-2018-0113

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