Reliability and construct validity of alternate forms of the CLS Inventory

Learning style assessment measures the preferences for specific ways of learning in selected teaching-learning situations. The Learning Styles Inventory, which was constructed based on the Canfield model of learning style, assesses learning preferences that focus on selected motivational and environmental factors present in formal instructional situations. The study presented here was designed to determine the reliability and construct validity of Canfield's ipsative inventory, and an alternate normative form developed by the authors. Results suggest that the alternate form is at least as reliable as the original ipsative inventory, with a factor structure that is congruent with the Canfield learning styles model.

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D URING THE PAST decade, studies have appeared in educational literature that were concerned with determining which attributes of individual learners affected achievement when different instructional methods were used.[1] Personality and ability variables have been the characteristics typically used to examine student learning under different teaching methods.[2] Recently, attention has been paid to learning styles, the affective response of learners to the teaching-learning situation. Learning style assessment is concerned with determining learners' perceptions of their preferences for specific ways of learning.

Canfield defined a model for describing learning styles that focuses on some motivational and environmental factors present in formal instructional situations.[3] The Canfield Learning Styles Inventory (CLS) was developed to assess learning preferences defined by this model. This article discusses a study intended to determine the reliability and construct validity of a short-

ened form of the original inventory, and these same properties for an alternate form of this instrument.

CANFIELD'S MODEL OF LEARNING STYLE

Canfield defined a model of learning style that is concerned with determining selected attitudinal values people have toward the teaching-learning situation.[3] He focused on describing individual differences in learners' preferences for various aspects of the conditions under which learning takes place—content domains, sensory learning modalities, and learners' own performance expectations. Two aspects, the conditions and sensory modes of learning, were of interest to the investigators in this study.

The conditions of learning deal with learner-environment interaction as it influences individuals' responsiveness to the teaching-learning situation.[3(pp21-30,34-39)] Hence, the conditions of concern are largely motivational aspects of instruction which are seen as having an influence on the effectiveness of the learning situation. The four major categories are subdivided to assess learner preferences as follows: *affiliation* includes learner preferences for friendly relations with peers, and personally knowing the instructor; *structure* includes preferences for having content presented in an organized, well-structured manner, and being given detailed information about course requirements; *achievement* includes preferences for opportunities to define and pursue personal goals, and to study independently; and *eminence* includes preferences for learning from expert fac-

ulty who control the learning environment, and for opportunities to compete with and compare performance with that of other students. The modes of learning incorporate four different learning modalities, or sensory system preferences, as follows: *listening* includes learning through hearing content presented; *reading* includes learning through examining print media; *iconics* includes learning through graphic and pictorial presentations; and *direct experience* includes learning through handling content-related materials or active participation in exercise. The conditions and modes made up the 12 learning style assessment scales examined in this study.

CANFIELD'S LEARNING STYLES INVENTORY

Canfield's model of learning style and the CLS have been used to examine differences of community college students based on sex[3] and on age[4,5]; to describe the preferences of students enrolled in allied health curricula[6,7]; and to diagnose preferences for the purpose of individualizing instruction.[8] Nonetheless, the available information on the construct validity of the Canfield model or the reliability of this instrument is limited.

The CLS is a self-administering instrument. Respondents are asked to rank their preferences for the four options presented for each of several different instructional situations. Using both the conditions and modes scales resulted in 18 situations being examined in this study. Scores are obtained by summing the values (from 1 for most preferred to 4 for least preferred) assigned

80   the various options within each of the instructional situations that are presented.

Canfield[3(pp60-64)] reported a number of studies within which significant differences in preferences had been found between groups of students enrolled in various majors as compared with the general college population. These studies provided data that were used to defend the construct validity of the instrument.

Two methods were reported as being used to assess the reliability of the instrument.[3(pp50-51)] Using the Forelich method, scale reliabilities ranging between .60 and .90 were reported. Odd-even, and first half-second half reliabilities all ranged at about the .90 level.

The measurement format used by Canfield requires that the instrument be classified as an ipsative measure.[9] This method of assessment is designed to maximize differences among learning style preferences *within* the individual. Statistically, it results in a *between-subjects* sum of squares of zero; consequently, the relative strengths of an individual's learning style preferences cannot be compared with the preferences expressed by other respondents. Additionally, there is some legitimate question as to the meaningfulness of statistical analyses of ipsative measures where the scale scores are based on the norm of each individual, and, therefore, have no overall comparability. Because the use of ipsative scales in the Canfield instrument poses difficulties for researchers when *between-subjects* analysis is conducted, two validation studies were undertaken (1) to determine the reliability and construct validity of the conditions and sensory modes scales of the CLS, and (2) to examine these same properties for an alternate assessment form.

THE STUDIES

Instrumentation

A questionnaire was developed which contained Canfield's original condition and mode scale items, and an alternative normative form of the CLS. The alternate version was constructed using the same situations and options from the original instrument. On this form, however, respondents were asked to rate each option separately rather than rank them as was requested on the original form. For the first study, half of the questionnaires contained the ipsative form of the CLS first and the other half contained the alternate form first.

Study I

The general method was to administer both forms of the CLS to a single sample of subjects to determine the alpha reliabilities of the scales, the interrelations of the scales between the ipsative and normative forms, and the factor structures for both forms.

The subjects were 187 nursing students enrolled in a generic baccalaureate program at a midwestern state university. The sample included 106 basic and 81 registered nurse BSN students. The age distribution for the sample was 37% under 23, 32% between 23 and 28, and 31% over 28; 95% were female; and about half were married.

Estimates of the internal consistency reliabilities were determined using alpha coefficient.[10] The ipsative reliabilities ranged from 0.542 to 0.824 (Table 1). The normative scale reliabilities ranged from 0.564 to 0.850. For 11 of the 12 scales the

Means, standard deviations, reliabilities, and scale correlations for ipsative and normative forms of the
[Le]arning Styles Inventory

[S]cale	Mean[a]			Standard deviation[a]			Alpha reliability[a]			Correlation coefficient[b]	Corrected for attenuation coefficient[c]
	Ip (I)	Nor (I)	Nor (II)	Ip (I)	Nor (I)	Nor (II)	Ip (I)	Nor (I)	Nor (II)		
[...]n											
[...]ion	29.454	24.802	18.636	6.087	6.994	4.080	0.734	0.848	0.686	0.631**	0.800
[...]	15.995	13.594		3.285	3.731		0.542	0.695		0.568**	0.925
[...]uctor	13.460	11.209		3.879	3.874		0.705	0.797		0.610**	0.813
[...]re	20.128	17.070	15.971	5.506	4.628	3.492	0.806	0.798	0.712	0.595**	0.742
[...]nization	9.852	8.866		2.751	2.380		0.639	0.564		0.539**	0.898
[...]il	10.556	8.203		3.367	2.740		0.736	0.759		0.522**	0.699
[...]ement	32.070	26.631	20.638	6.154	7.272	4.896	0.806	0.880	0.785	0.462**	0.549
[...]ls	14.818	12.882		3.302	3.552		0.661	0.752		0.446**	0.633
[...]pendence	17.251	13.749		3.580	4.264		0.731	0.837		0.414**	0.531
[...]nce	38.091	30.968	25.012	5.184	8.751	5.372	0.667	0.885	0.692	0.296**	0.385
[...]petition	19.497	16.390		2.957	4.405		0.560	0.781		0.318**	0.481
[...]ority	18.594	14.578		3.280	4.967		0.555	0.828		0.304**	0.448
[...]ning	11.428	9.834	18.956	3.793	3.352	5.392	0.741	0.769	0.715	0.628**	0.832
[...]ding	18.396	15.246	26.181	4.320	4.504	7.893	0.824	0.835	0.811	0.594**	0.717
[...]ics	15.647	12.551	19.254	3.785	4.343	6.186	0.767	0.849	0.801	0.495**	0.613
[...]ct experience	14.246	11.241	17.219	4.530	4.781	5.431	0.744	0.850	0.704	0.478**	0.603

[...] < .01.
[...]ive Form Study I; Nor (I) – Normative Form Study I; Nor (II) – Normative Form Study II. The lower the score the higher the preference for a particular scale.
[...]oefficients between scales for the ipsative and normative forms were calculated in Study I only.
[...] attentuation coefficients between scales for the ipsative and normative forms were calculated in Study I only.

82   reliability for the normative form was higher than the reliability for the ipsative form. The mean scale reliability for the normative form was 0.790 compared with 0.690 for the ipsative form.

Equivalence was determined by correlating the scales for the two forms. The correlations ranged from 0.304 for the Authority (Eminence) scale to 0.620 for the Instructor (Affiliation) scale (Table 1). After correction for attenuation, the adjusted scale correlations[11] ranged from 0.448 to 0.925, with 10 of the 12 coefficients above 0.500. The scale means for the normative scales were typically about two points below the means for the ipsative scales. The standard deviations were similar for the two forms.

Principal axis factor analysis with varimax rotation was used to determine the congruence of the CLS forms with the psychological constructs defined by the inventory's author.[9,11] The factor structure for the ipsative form yielded 8 identifiable factors rather than the 12 factors specified by the author (Table 2). The organization and detail scales under the condition structure formed a single factor as did the competition and authority scales under eminence. The peer (affiliation) scale and goals (achievement) scale seemed to form a bipolar factor. Under the modes, the scales listening and iconics formed a single bipolar factor. In all instances the media within-scale factor loadings were above 0.30; at least four of the six items on each scale weighted on a particular scale with loadings of 0.25 or greater. The item congruence was about 79%.

The factor structure for the normative form demonstrated greater clarity than the ipsative factor structure. Again, eight factors were identified. For each of the four conditions, no differentiation could be made between the scales within each condition. For example, the peer and instructor scales formed one factor, affiliation. The other factors were those identified by the author as structure, achievement, and eminence. The four modes scales formed the four expected factors. The median factor loadings within scale were all above 0.50. Typically, five to six of the six expected items within the scales loaded at 0.25 or above. The item congruence was 92%.

The results of this study suggested that the CLS generally fits the learning styles model proposed by Canfield. Of the two forms, the normative one seems to have the greater construct validity. However, the structure seems to consist of 8 factors rather than the 12 proposed by Canfield. In this study, there was no evidence to support the validity for subdividing the affiliation, structure, achievement, and eminence scales.

Study II

The purpose of the second study was to cross-validate[12] the normative form of the CLS. The general method was to administer the instrument to a second sample of subjects to determine the alpha reliabilities of the scales and the factor structure.

The subjects were 343 nursing students enrolled in generic baccalaureate programs from six universities in a midwestern state. The sample included 216 basic and 153 registered nurse BSN students. The age distribution for the sample was 71% under 23, 21% between 23 and 28, and 8% over 28;

Table 2. Scale factor loadings for the ipsative and normative forms of the Canfield Learning Styles Inventory

	Study I						Study II		
	Ipsative			Normative			Normative		
Scale	Factor no.	Coefficient >|0.25|	Median	Factor no.	Coefficient >|0.25|	Median	Factor no.	Coefficient >|0.25|	Median
ndition									
Affiliation									
Peer	4	4	0.446	4	4	0.593	6	6	0.421
Instructor	8	5	0.387	4	5	0.502	6	3	0.327
tructure									
Organization	7	5	0.333	2	5	0.525	1	4	0.322
Detail	7	6	0.566	2	6	0.632	1	6	0.540
Achievement									
Goals	4	4	−0.376	1	5	0.640	3	5	0.529
Independence	3	4	−0.360	1	6	0.644	3	6	0.550
minence									
Competition	1	5	0.530	6	6	0.622	7	1	0.098
Authority	1	6	0.548	6	6	0.562	7	5	0.473
de									
Listening	6	6	0.582	8	5	0.651	8	6	0.610
Reading	2	5	0.707	7	6	0.727	2	6	0.685
Iconics	6	5	−0.526	5	6	0.788	4	6	0.714
Direct experience	5	6	0.658	3	6	0.656	5	6	0.563

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92% were female; and 19% were married. The subjects for this study represented a generally younger population than had the subjects in the first study. The reliabilities for the eight scales generally were slightly lower than those found in the first study; the values ranged from 0.686 to 0.811 (Table 1). The mean coefficient was 0.776. The scale means and standard deviations for the conditions were lower than those obtained in the first study. For the mode scales, the opposite effects were apparent.

To cross-validate the construct validity of the normative form of the CLS, the factor structure again was examined.[12] The results obtained were similar to the findings in the first study; 86% of items loaded at 0.25 or above on the appropriate factors as defined by the Canfield learning style model (Table 2). Most of 14% noncongruence occurred in one factor, the eminence subscale competition.

In general, the scale reliabilities were about the same between the cross-validation study and the first study. The item congruence was less than in the first study, primarily attributable to one subset of the eminence factor which did not hold up in cross-validation.

Discussion

This investigation was a two-phase study (1) to *validate* the ipsative instrument and an alternate normative version of the CLS against Canfield's model for learning styles; and (2) to cross-validate the normative form. Alpha coefficient was used to determine the scale *reliabilities*; principal axis factor analysis with varimax rotation was used to determine the factor struc-

tures. The structure of the initial ipsative form of the CLS was generally verified with moderately high reliabilities. Some of the scales showed a lack of clear designation. The structure of the normative form was congruent with the theoretical model, with scale reliabilities generally higher than the original ipsative form. The eight theorized condition subscales actually formed only four factors. These corresponded with the four major condition divisions specified in Canfield's model. In addition, the scale intercorrelations between the ipsative and normative forms were moderately high when corrected for attenuation. In cross-validation, the scale reliabilities of the normative instrument remained high. The factor structure demonstrated congruence to the theoretical model with the exception of one subset of items in one factor. The distinguishing factors were:

Conditions:
- affiliation
- structure
- achievement
- eminence

Modes:
- listening
- reading
- iconics
- direct experience

It seems that the subscales defined by Canfield within each condition do not form independent, usable factors. Therefore, the model is best collapsed into the above 8 factors rather than the 12 factors specified by this author.

The data collected in these studies provided evidence about the reliability and construct validity of the CLS. Refinement of the model was suggested by the factor

structures in both studies, which demonstrated that the original eight condition subscales might be more appropriately combined into four overriding scales. The alternate form tested in these studies pro- vides an instrument which can be used by researchers who are interested in examining between-subjects learning style preferences as defined by the Canfield model of learning style.

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