

# The development of PILS scoring system for the assessment of teaching techniques.

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## Abstract

**Objectives:** To determine learning-style scores of final-professional pharmacy students before and after various teaching experiences and to evaluate the relationships between scores and teaching practice variables. The outcome of study was aimed to determine better teaching experiences to improve learning skills.

**Method:** The study was an observational cohort study design used for final professional pharmacy students. The Pharmacy inventory and learning style (PILS) model was employed for pre and post score after every teaching practice. Problem-construction practice (PCP) technique was developed and analyzed against other teaching practices.

**Results:** Research findings show significant increase in level of knowledge after each module of teaching the majority of students fall in high level of clinical knowledge with Problem-base learning (PBL) and Problem construction practice (PCP). Two domains of PILS (Enactor and Producers) significantly cross-over the other two domains with 17.6% and 5.9% of increase in post-result score. Findings also showed the increase characteristics of Enactor and Producers with PCP, compared with Producer and director in PBL practice.

**Conclusion:** The external environment (teaching style) has influence on the individual student learning behavior. For effective learning a variety of techniques were employed for the identification of EPI (educational personnel intellectuality).

**Recommendations:** PILS scoring model is a unique model comprises both cognitive (constructivism) and psychological concept.

**Limitations:** Currently the only limitation found in this research was absence of benchmark for teacher assessment.

**Keywords:** *Problem-base learning, learning style, case-construction study, self-learning and assessment.*

## Background

There are many learning theories, such as socio-cultural theories, cognitive theories etc. However Learning and development are a core dimensions of the human experience, yet professional educators are often disconcerted when asked the question, "how do people learn?" (Austin Z. 2002). Sociologists, educationalist, psychologists, and economists will all offer differing explanations about the process of learning.

Belkin and Gray (1977) define learning a change in the individual as a result of some intervention. It may be viewed as an outcome or as a process. Smith (1982) views learning as a product (the acquisition of a particular set of knowledge), process (how learners seek to meet needs and reach goals),

and a function (how learners are motivated, what brings about change). A generally accepted definition of learning is any relatively permanent change in behavior that occurs as a result of experience (Robbins, 1998). This means that an external observer has to recognize that learning has taken place (e.g., acquiring a vocabulary, learning to drive a car). Rogers (2003) views learning as a task-conscious or acquisition learning (such as learning involved with parenting or with running a home). On the other hand formalized learning arises from the process of facilitating learning. It is educative rather than accumulation of experience. Formalized learning makes learning more conscious in order to enhance it.

An important stream of inquiry in learning theory is the notion of learning styles. Litzinger and Osif have described

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learning styles as "...the different ways in which children and adults think and learn" (Litzinger and Osif, 1993). While the value of aligning learning and teaching styles had been broadly discussed, Felder in 1993 has noted that such alignment does not imply that each student is to be taught exclusively to their personal learning preference; rather instructors must work towards balancing numerous teaching styles. When this balance is optimized, students will have an opportunity to learn in a style that they find most comfortable, thereby optimizing their willingness to learn (Kolb, 1981).

The learning process underlying individual characteristics are viable to teaching-style. So each individual contains his/her own relative response, however what is the impact of different teaching style on the individual learning characteristics of students? Numerous viewpoints concerning learning process exist today. As a context for better understanding the many theories of learning, learning theories were classified into four paradigms. These are (a) behaviorism, (b) constructivism, (c) cognitivism, and (d) social learning theories.

Constructivism is recognized as a unique learning theory in itself and promotes a more open-ended learning experience where the methods and results of learning are not easily measured and may not be the same for each learner (Mohammed & Monroe, 2006). The individual differences regarding learning processes are self-evident and a source of curiosity, frustration, and interest for most people. Learning by doing, learning by seeing, auditory learning, visual learning, and a host of other terms have been introduced to encapsulate the complexity of this phenomenon. The ways in which learning occurs have spawned significant interest in a wide variety of disciplines and generated numerous theories and models. (Norman & Schmidt 1992). Various perspectives have been put forth that alternatively emphasize social structures, classroom dynamics, individual psychological factors, and power dimensions. (Duncan 1994). This paper is based on a constructivism framework of learning theory.

Constructivists believe that all humans have the ability to construct knowledge in their own minds through a process of discovery and problem solving. The extent to which this process can take place naturally without structure and teaching are the defining factors amongst those who advocate this learning theory. Jean Piaget (1970) observed human development as a progressive stage of cognitive development. In this sense, Piaget's theory is similar to other constructivists' perspectives of learning (eg. Vygotsky). Fundamentally, constructivism is a cognitive learning theory because of its focus on the mental processes that construct meaning. Other important learning theories equated with cognitive psychology are Scaffolding theory of Lev Vygotsky, and Bruner's Constructivist theory. Vygotsky's theoretical framework is that the culture we live in influences our social and cognitive development. Vygotsky (1978) writes: "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first between people (interpsychological) and then inside the child (intrapsychological)". The implication of his theory for training purposes is that the job of an educator has to identify these characteristics and to find out where the child was situated and build upon their specific level through

a "scaffolding process". Building from what the learner knows is in essence anchoring the learning on past experience.

A major theme in theoretical framework of Bruner is that learning is an active process in which the learner constructs new ideas or concepts based upon their inherent or past knowledge. Much of the theory is linked to child development research (especially Piaget). In his most recent work, Bruner (1986, 1990) has expanded his theoretical framework to encompass the social and cultural aspects of learning. Under the theory of constructivism, trainers can focus on making connections between facts and fostering new understanding in trainees. Trainers can tailor their strategies to the trainee's responses and encourage trainees to analyze, interpret, and predict information.

However medical school students have to learn basic science before they study clinical subjects. Student motivation towards learning basic science is often enhanced through understanding the link to clinical medicine (Sweeney, 1999; O'Neill et al., 2002). Problem-based learning (PBL) is used as an educational modality to link basic science to clinical medicine for medical school students (Kaufman & Mann, 1997; Thomas, 1997; O'Neill, 2000).

### Objectives of the study

To identify the teaching technique with highest influence on the students' individual learning characteristics, we need to look over on different teaching techniques and employ them in field work. Our research project and outcomes was based on the following theories.

Outcomes of process/learning intervention lead to behavior change (Belkin and gray, 1977), the related process is that an environment or teaching technique confers to the learning process at individual level. So variety of teaching techniques is required among diversity of students to achieve effective learning goals.

Smith (1982) defined three elemental categories of learning change, i.e., product, process and function. Set of knowledge (product) delivered by specific teaching technique (process) and evaluate the student's final outcome (function).

Behavior change through experience (Robbin, 1998), so external environment or evaluator is accountable for observed change.

Task-conscious and acquisition learning was introduced by Roger (2003) and dedicated to the concept of educative rather than accumulation of experiences.

### Objectives

1. To determine learning-style scores of final-professional pharmacy students before and after with various teaching experiences and to evaluate the relationships between scores and teaching style variables.
2. Pharmacy inventory & learning style (PILS) was employed to evaluate all of the four sub-domains of PILS, i.e., Enactor, Creator, Director, Producer.
3. To find out the specific proportions of Educational

personnel intellectuality (EPI\*) across PILS.

(\* **EPI – educational personnel intellectuality is a self-introduced term**).

The outcome of the study was aimed to determine the better teaching experience account to improve learning skills of individual characteristics.

### Method

A multilink research method was designed for this research, following sequence of:

1. Study Sample, Design & Frame
2. Teaching style & distribution
3. Outcome Evaluation / Assessment design
4. PILS scale and scoring tool
5. Statistical analysis

### Study Sample, Design and Frame

The study was conducted on final professional pharmacy students of private college (Island College of Technology), as ICT is part of the educational franchise programme of Universiti Sains Malaysia (USM). USM is a first Malaysian Apex-status Public University; so far curriculum development was not a limitation. A cohort of eleven (11) students was taken under the study for two months; evaluation was made individually on the end of each teaching style whilst PILS categorization was done before and after of each module. Duration of study was from July - August, 2009.

### Teaching style and distribution

Our current model of investigation acquired four (4) distinct techniques. Each technique elaborated further with certain curriculum development as mentioned in Table I. Emphasis

should be given on the duration of each teaching style; as a single entity each style covered a period of fifteen (15) days from initial assessment to final assessment.

Tutorials were totally based on class-book lectures, PBL alone was based on Problem-base practice tutorials for the respective organ disorder or disease while tutorial with Problem-construction Practice (PCP) was a method used to teach student with half of credit hours in tutorial class and remainder credits from information about respective disorder, disease or current clinical issues from which was generated a case study with possible solutions, and lastly a whole class presentation.

The major difference between PBL & PCP is in the use of tutorial-support pattern of teaching and also evidence base practice on latest issues of specific disease or disorder.

### Outcome Evaluation and Assessment Design

The assessment tool was based on three intellectual domains; each domain classified with ten subsequent questions. Key headings were risk assessment (initial sign-symptoms / clinical presentation of the disease) and treatment, emergency treatment (acute case of treatment) and late management (chronic treatment) of the specific disorder or disease. However our domains are independent of the monitoring tools. Total maximum score for each domain and ranges are classified in Table II. Moreover all the assessments / evaluations were done by Investigator lecturer by using evaluation form no questionnaire-type survey was done. Score was deduced by sum up all the score of each single domain and then divided by its total items, thus the range of score was 1.0 – 5.0 (Low – High). Separation of domain was to identify the informative change with perceived teaching style (table 3). Evaluation form consists of questions being asked by student (individually) and rating from 1 – 5 likert scale.

**Table I:** Therapeutic course distribution underlying teaching practices.

Characteristics	Teaching Techniques			
	ATT*	ATT & PBL**	PBL alone	ATT & PCP***
Clinical management	Cardiac diseases	Renal diseases	Endocrine disorders	Respiratory disorders & Neurological disorders

\*ATT – Applied therapeutics tutorials

\*\* ATT & PBL – Applied therapeutics tutorials then Problem-based learning

\*\*\* ATT & PCP - Applied therapeutics tutorials then Problem-construction practice

**Table II: Tool characterization**

Characteristics	Items (n)	Response range*	Score range
			<b>For all three domains</b>
Risk assessment & treatment	10	1 – 5 (likert scale)	Low 1.0 – 2.3
Emergency treatment	10	1 – 5 (likert scale)	Moderate 2.4 – 3.7
Late management	10	1 – 5 (likert scale)	High 3.8 – 5.0

\* 5 = most appropriate answer, 1 = least appropriate answer.

**PILS scale & scoring tool**

The Pharmacy inventory & learning style model with seventeen items was employed in this study. We accompanied the PILS model with an emphasis on a concept of four-nation theory; it contains the same four domains of the PILS model but with harmonization of four cultural environments identified in PILS model. i.e., unstructured *versus* structured and Doing *versus* Reflecting.

Enactors and Producers were scored 3, while Creator and Director with 2 (see figure 1). We determined two dominant characters, Enactor and Producer and the other two were secondary learning characteristics. To harmonize each domain score equity was kept in account. Our concept was based on the influence of each domain on the learning ability of individual and named Educational – Personnel – Intellectuality (EPI). Scoring and characteristics are shown in Table III.

**Statistical analysis**

Student responses were analyzed by using both descriptive and inferential statistical techniques. The means and standard deviations of pretest and posttest learning-style scores were calculated

for the 4 learning characteristics domains. Paired samples t-tests and ANOVA were then used to compare the means of pre and post test scores for each teaching style. Independent samples t tests were used to determine whether relationships existed between learning-style scores (pre and post test). A priori level of significance for all statistical analyses was  $p \leq 0.05$ . SPSS version 12.0 for Windows was used for all statistical analyses.

**Results**

Study findings reflect the increase of knowledge levels ascertained with the specific techniques. Table IV identifies that both PBL and ATT, with PCP practice, are worked as single entity and produce a high level of knowledge in the end of module.

Deeper analysis was to find which of the teaching techniques was most suitable with the environment and had most influential effect on students. Table V represents the comparison between the knowledge level of the students after the model (ANOVA). We find that PBL and ATT with PCP were again the most influential tools among the students for improvement of external environment.

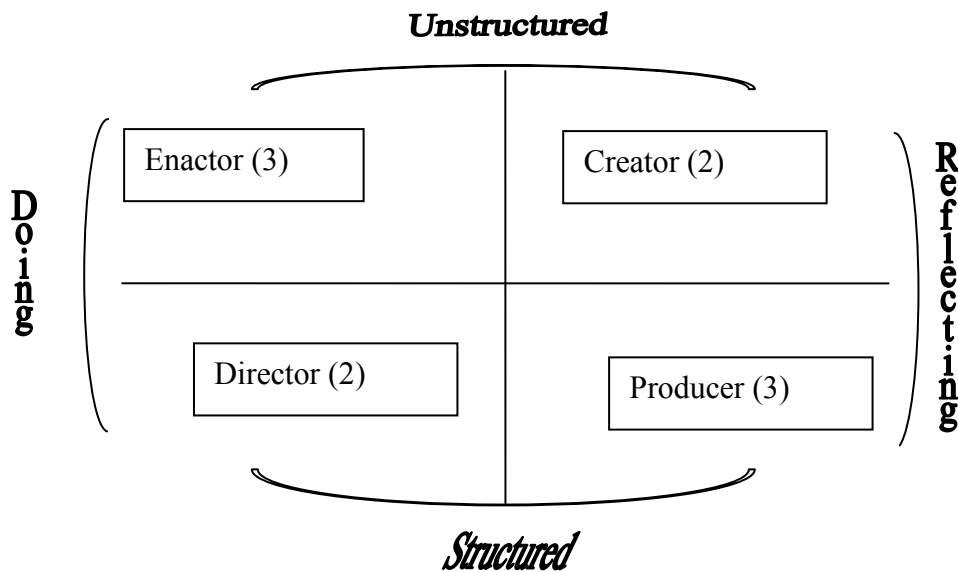


Figure 1. 4-nation concept

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Table III. PILS scoring tool.

Score Range	Characteristics learning ability
(34 – 51)	Least to extreme range of score.
34 – 38	Motivated learning style – more secondary learning abilities
39 – 42	Conventional learning style – increase of dominant learning abilities
43 - 45	Influential learning style – partly influence of both dominant abilities
46 - 48	Developmental learning style – intermediate state teaching style can lead to either influential learning style or supra-motor learning style.
49 – 51	Supra-motor learning style – strongly influenced under dominant learning variables

**Table IV:** Mean score distribution within the perceived teaching techniques.

Characteristics	Perceived Teaching Techniques			
	ATT*	ATT & PBL**	PBL alone	ATT & PCP***
Risk assessment & treatment	2.2	2.5	3.8	3.9
Emergency treatment	3.5	3.3	3.9	4.0
Late management	2.5	3.0	4.1	4.4
Total Mean score	2.7	3.0	3.5	4.2

\*ATT – Applied therapeutics tutorials,  
 \*\* ATT & PBL – Applied therapeutics tutorials then Problem-based learning,  
 \*\*\* ATT & PCP - Applied therapeutics tutorials then Problem-construction practice

**Table V:** Probability functions (p) comparison of assessment tool with perceived teaching techniques.

Characteristics	ATT	AAT & PBL	PBL	ATT & PCP
Risk treatment	0.72	0.61	0.021	0.017
Emergency treatment	0.51	0.035	0.018	0.001
Late management	0.64	0.027	0.020	0.001

Analysis also looked at each domain score before and after the characterization of teaching technique. Table VI represents this information regarding PILS categorization and percentage increase/decrease after the teaching techniques; this is baseline information for us to provide preliminary information that with the change of external environment, the student’s individual learning personality is also affected.

**Table VI:** Change in learning attitude Pre and Post level of Study.

Mean scores	Pre-test mean score (SD)	Post-test mean score (SD)	Percentage % increase of tool	p-value*
<b>Enactor</b>	14.9 (2.47)	22.9 (1.51)	17.6%	0.001
<b>Producer</b>	14.3 (2.45)	19.4 (2.46)	5.9%	0.027
<b>Director</b>	11.72 (2.10)	4.0 (1.35)	- 11.7%	0.003
<b>Creator</b>	10.1 (2.02)	4.7 (1.86)	- 5.9 %	0.022

PILS – Pharmacy inventory learning style  
 \* P < 0.05 (paired sample t- Test)

Our last objective was to find out the relationship between PILS domains with certain teaching techniques. These findings need to be compared regarding the external environment that has/has not influence on the characteristics of the PILS model and to what extent each domain is crossing over to next domain. Table VII identifies the change pattern of PILS scores with respect to perceived teaching style.

**Discussion**

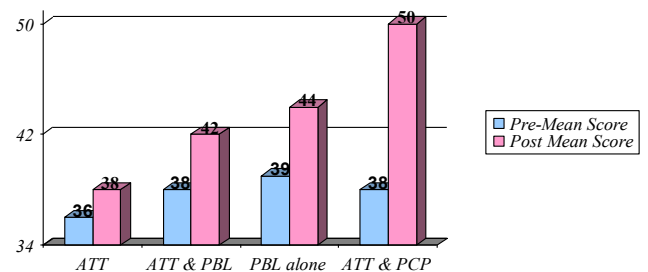
The study design was based on two characteristics, ie. the EPI term of educational personnel intellectuality and the 4-nation theory concept of the PILS model. As per the concept that the EPI reflects individual behavior identified by characteristic change of learning behavior with the substantial change of external environment (regardless of the use of different

**Table VII:** Characteristics changes apprehend to practice

Characteristics	ATT	AAT & PBL	PBL	ATT & PCP	p-value*
<b>Enactor</b>					
Pre-score mean	15	18	18	18	0.015
Post-score mean	15	21	18	24	
<b>Producer</b>					
Pre-score mean	18	16	15	16	0.000
Post-score mean	21	18	21	21	
<b>Director</b>					
Pre-score mean	10	7	8	9	0.71
Post-score mean	10	7	12	2	
<b>Creator</b>					
Pre-score mean	8	10	10	8	0.001
Post-score mean	5	5	0	6	

\*Independent sample T-test.

**Figure 2:** Pre-Post –test mean score



teaching techniques), this concept was revealed by Belkin and Gray (1977) and Robbins (1998).

To identify the student response (either EPI or Knowledge evaluation level) a set of configurations is required on research methodology, in order to follow Smith’s (1982) concept of product, produce and function; we administered different clinical presentations with different teaching techniques and then evaluated with our tool. We found that our assessment tool was best defined with both PBL and PCP types of practice. Each level of assessment (risk assessment & treatment, emergency treatment and chronic management) has a change with specific external environment and with tutorial-base teaching and tutorial with PBL; students fall among the range of low-moderate level of knowledge (table IV).

However we tried to compare the tool assessment score with the PILS four-nation theory concept; observations were made that in both tools of assessment (PILS & tool score) significant increases were reflected under the cumulative practice of PBL and PCP and we reasoned to find out the change of PILS domain learning change. Our findings reflect the significant cross-over of Enactor and Producer to Director and creator (table IV, V, VI). At this point we see that with change of external environment there are two changes at the individual level; one reflects the change of learning behavior and the second on EPI (educational personal intellectuality) as reflected by Kolb (1981) on enhancing the personal-learning entity. Roger (2003) dedicated the concept of educative rather than accumulation of experiences and produced the concept of task-conscious and acquisition learning. Whilst both Robbin (1998) and Belkin & Gray (1977) worked on the same basic

concept of behavior change with experience of learning intervention, but the only gap was the evaluation of learning behavior change to that of external environment with diversity of learning goals. To fill this gap we tried an assessment tool and further furnished it with validation scoring of PILS model and the concept of EPI; as educational-personnel-intellectuality lies somewhere in the gap of Belkin & Gray (1977) and Roger's (2003) concept of learning frameworks.

On working with PILS scoring and the four-quadrant ('nations') concept, our findings showed that an unstructured environment has a direct influence on Reflecting behavior, whilst a structured environment represents Doing behavior. Our findings revealed as scores increase in the sub-domain of Unstructured characteristics (Enactor & Creator) physical learning moves towards more Reflecting behavior; likewise as increases Structure characteristics (Director & producer) will lead to more Doing behavior. Such findings challenge the concept of Felder (1993) on the harmonization of learning and teaching style for the adaptation of balance by optimizing personnel willingness to learn.

Whilst discussing the quadrants of the PILS model, we find significant change in the learning behavior of the student with PBL and PCP teaching practice as in figure 2. These findings reflect a change in Pre-test score of 38 to 50 in the post-test score; this shows a shift of learning behavior from conventional learning style to supra-motor learning style and this change of behavior approaches an effective learning process with a strong influence of dominant learning variables. On the psychological base concept we are fulfilling the concept of Grasha (1996), who proposed that learning style is a personal quality which influences a student's ability to acquire information, interact with peers and teachers or otherwise participate in learning intervention/experience. Our four-nation concept revealed a full characterization of PILS sub-learning domain and scoring leads to the psychological behavior and interventional change on individual level. The assessment tool was deemed fit for the determination of effective teaching style so as to optimize the learning balance among a diversity of students.

### Conclusion

The PILS scoring model is a unique model comprising both cognitive (constructivism) and psychological concepts. Our assessment tool was deemed fit for practicing a variety of teaching techniques among a diversity of students. Problem-construction practice was found to be more effective and viable to boost the learning behavior of students. Lastly our findings were introduced the term EPI (educational personnel intellectuality) on the quadrant four-nation theory of the PILS model.

### Acknowledgement

We would like to acknowledge the work of Zubin Austin regarding the development of PILS, as the author stated that the PILS "can be an effective tool for promoting discussion about teaching, learning, and personal and professional

development" thus this statement was probably the impetus for our work.

### Authorship contribution

**Syed Wasif Gillani:** Prime investigator / researcher, data collection – manuscript writing.

**Syed Azhar Syed Sulaiman:** Manuscript editing and reviewing of contents.

**Norhayati Ismail:** Field supervisor, problem-solving and data collection.

**Azmi Sarriff:** Methodology review and editing on analysis stage.

**Yelly Oktavia Sari:** research assistant to the prime investigator.

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