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Problem-based learning (PBL): Assessing students' learning preferences using vark

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KEYWORDS

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Jordan;
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VARK;
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Summary

Objective: This study was conducted to describe learning styles of third year nursing students.

Design: An interventional study Setting: a public university in Jordan.

Subjects: Used a purposive sample of 92 nursing students who were enrolled in maternity nursing course.

Main Outcome measures: Measure the difference in learning styles of nursing students after introducing an intervention of PBL as a teaching methodology.

Results: The dominant learning preference of the students was the read/write preference followed by the kinesthetic, still most of the students represented a multimodal learning preference. No significant difference was found between males and females. A significant difference in the learning preferences of the students in the pre-post test was found. In the pretest the mean of the total VARK score 13.9 (SD = 2) where as in the post test the mean of the total VARK score = 16.5 (SD = 3.5). In the pre-test 54% of students had a multimodal preference whereas 68% of students have a multimodal preference post-test.

Conclusions: Most students are able to learn effectively as long as the instructor provides different learning activities in the areas assessed in VARK. Active learning might be enhanced in large classrooms by presenting models and demonstrations, discussions, debates, answering questions, and role playing.

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Introduction

Improving students' satisfaction with traditional curricula and learning environments is challenging.

As today's students are non-traditional in many aspects of their lives. This is particularly so in medical science education, compounded by factors such as students finding little opportunity to acquire a sense of connectedness between clinical experiences (Fang, 2002). It follows that traditional teaching such as lecturing, an essentially passive learning method (Felder and Brent, 2005), is arguably less of a valid option now. Moreover, the modern curricula need to explore other methods in effectively delivering curricular goals and meeting the expectations of students.

In Jordan, the education system is a mix of public and private universities (Ministry of Higher Education, 2005). Traditionally teaching students is in English using lectures and tutorials in curricula that focus on the content of teaching, rather than the process of learning. Clearly, this had to modernize both from the perspectives of addressing students' differing needs and from curricular design. One could not happen without the other.

In order to address different learning styles, it is necessary to adapt teaching strategies and evaluate their effectiveness (Suskie, 2003; Felder and Brent, 2005). One non-traditional curricular approach is problem-based learning (PBL), which in contrast to traditional teaching focuses on the process of learning rather than the content of teaching. PBL requires educators to change their educational roles and helps to increase students' self motivation by focusing on their learning needs, rather than merely acquiring facts (Kilroy, 2004). In Jordan, it is anticipated that the use of PBL will result in students performing well in national exams and be better prepared for life-long learning. However, PBL is known to be accepted by some students, but not by others. Learning preference is important to be explored in more detail, whereby there are readily available tools to facilitate this, one of these tools is VARK.

VARK, an acronym for Visual, Aural, Read/Write, and learning styles in one such tool. *Visual learners* are said to prefer explanation of concepts diagrammatically or through pictures. *Read/Write learners* prefer printed words and text as a means of information intake. These learners prefer, for example, to arrange class lecture notes into outlines, and study through past-papers. *Aural learners* concentrate on what lecturers say. Moreover, aural learners may talk out their answers or listen to taped discussions about exam topics. *Kinesthetic learners* use experience and practical examples in order to learn (Fleming, 2004).

For the purpose of the current study, the terms learning style and learning preference were used interchangeably. However, it is important to

remember that learning styles do not tell educators about students' abilities or intelligence, but they can help educators understand why students find some tasks easier than others.

Purpose and significance

The purposes of this study were to: (1) identify learning preference of third year nursing students at a public university, (2) to assess gender differences, (3) to assess the impact of PBL on students' learning preferences, and finally (4) to compare learning preferences with students' grades at the end of the course. This study used "VARK" to assess students' learning preferences, which never been used among Jordanian students or faculty. To the researchers' knowledge, few Jordanian studies had addressed PBL as a teaching method. It was introduced recently introduced to Jordan as a result of a British Council Higher Education Link with Glasgow Caledonian University and Hashemite University, 2000–2002.

Context of this study – maternal-family health nursing course

This research originated in one public university in Jordan, in one of 11 nursing schools. The nursing program was established there in 1999 within which the "Maternal-Family Health Nursing" course is core to the curriculum, including both theoretical and clinical experience. The theoretical element of the course focuses on women's health care during antenatal, intrapartum, and postpartum stages. The clinical practice takes place within maternal health wards; maternal child health centers (MCHC); and simulated maternity environments at the Faculty of Nursing. The study explores student experiences as they are introduced to learning methods such as simulated labs, interactive learning, peer and self-evaluation.

In the traditional culture of Jordan, it has been a challenge to motivate and engage male students in maternity issues. Teaching male students has not always been successful in the traditional way. Exploring gender as a variable may shed light on this issue.

Research questions

The current study aimed at answering the following research questions:

1. What were the learning styles of Jordanian nursing students?

2. Were there significant differences between female and male nursing students in their learning styles?
3. Did PBL have an impact on student's learning styles?
4. What is the relationship between student's learning preference and the course grade?

Literature review

There is little published research directly relating learning styles to PBL, however, there is much written about these concepts independently. What now follows is a review of each concept in apposition, identifying areas of congruence and divergence.

Students' learning styles

Learning styles, as a group of cognitive, affective, and physiological characteristics, are used as indicators of how a learner perceives, interacts with, and responds to the learning environment. Learning styles have been defined as "personal qualities that influence a student's ability to acquire information, to interact with peers and the teachers, and otherwise participate in learning experiences" (Grasha, 1996, p. 41). An individual's learning style describes how new information is processed, internalized, and retained (Fang, 2002). Most of the published literature either focuses on the relationships between students' learning styles and, for example, attitudes about learning or on the achievement of outcomes, or completion and drop-out rates (Felder and Brent, 2005).

Types of learning styles

As students vary in their learning preferences, our conceptualization of learning needs to accommodate this variation. Students take in and process information in a variety of ways: by seeing and hearing, reflecting and acting, reasoning, analyzing and visualizing (Mills, 2002; Felder and Brent, 2005). Students learning styles are thus described as auditory (learning by hearing), and visual (learning by seeing) kinesthetic, (Mills, 2002; Fleming, 2004). These preferences are not absolute, but complementary, with individuals demonstrating one or a combination.

Teaching methods and learning styles

It is accepted that individuals differ in their learning preferences, and that teaching methods also

vary. Some instructors preferring to provide information through lectures, some focus more on memorization, others try to actively develop understanding. The content of the syllabus and the philosophy of the programme can indicate the approach to use, with some subjects lending themselves more to one approach than to another. Adults generally have an awareness of their learning styles and often seek to collaborate with their instructors (Endorf and McNeff, 1991). With mutual benefit as educators' understanding of students' learning styles, it can help to improve their choice of instructional delivery (Fang, 2002) in environments conducive to learning (Suskie, 2003). Interestingly, Cassidy and Eachis (2000) reported that learning styles can also adapt to changes in the environment.

It would seem logical that if mismatches exist between teaching method and learning style then students may become inattentive in class, fail exams, and drop out of school. Similarly, educators using insufficiently responsive teaching methods can be faced with bored, unresponsive students, low test grades, poor attendance and dropouts. In nursing education the result could be a serious loss to society of potentially excellent professionals. Thus, it is very important that educators strive for a balance of instructional methods to meet students' learning needs, based on knowledge and understanding of the learning styles concept.

Measurement of learning styles

As definitions of learning styles were different, a standardized approach to measurement has been slow to emerge. Markham (2004), in a critical review of commonly available tools found that none could be used with confidence. The Canfield Learning Styles Inventory had too little published research to judge its validity and reliability: the Felder-Solomon Inventory of Learning Styles (Felder and Silverman, 1988) was found to have little support for its use as a measure of learning styles, similarly with Kolb Learning Styles Inventory (Kolb, 1984) and the Myer-Briggs Type Indicator (Briggs-Myers and McCaulley, 1992). Finally there was few evaluative research on the Vermont Inventory of Learning Styles, as reported by Boyle et al. (2003), to judge its usefulness. The above reported instruments have varying degrees of reported reliability. With most reported data below the accepted 0.7.

In the absence of a gold standard, the VARK survey tool was created in 1998 as a means of assessing learning style preferences to inform the

dialogue between students and educators. VARK is based upon cognitive development work by Bruner (1967) and Piaget (1990) who argued that humans assimilate environmental knowledge through four sensory modalities: visual (observing pictures, symbols, or diagrams), auditory (listening, discussing instructional material), visual/iconic (reading and writing), and kinesthetic (using tactile sensory abilities such as smell and touch). VARK is an acronym for Visual, Aural, Read/Write, and Kinesthetic (Fleming, 2004). VARK is an instrument that is quick and easy for students to use and understand. It creates an awareness of learning styles and provides motivation to seek improvements in their learning performance. Therefore, the VARK instrument was selected for the purposes of this study.

The development of PBL

The development of PBL is attributed to the medical school at McMaster University in Canada, in the early 1970s. It was derived from *information processing* theory which explains the need for effective retrieval and re-processing of information within realistic contexts. New knowledge is obtained through building new information onto existing knowledge, and has its roots in constructivist educational theory (Kilroy, 2004).

PBL is both a curriculum and a process. The curriculum consists of carefully selected and designed problems that arise from the learner's acquisition of critical knowledge, problem-solving proficiency, self-directed learning strategies, and teamwork. The process replicates the commonly used systematic approach to resolving problems or meeting life's challenges (Kilroy, 2004).

PBL begins through the analysis of a clinical scenario, discussing pre-existing knowledge of identified issues, formulating and prioritizing learning objectives, and collecting additional information needed to address these needs. Students assume increasing responsibility for their learning. Implicit within this is the element of choice, enabling students to learn in their preferred style. The educators in turn become facilitators and evaluators (Queen's University, 2006). The use of PBL in learning helps to structure knowledge for use in a clinical context; develops clinical reasoning processes; and self-directed learning skills (Kilroy, 2004).

PBL in developing countries

As a teaching methodology, PBL has not been used widely in developing countries. In Linnethe Indian study (2002), the students in the PBL group gained

significantly higher scores than those who used traditional teaching methods. Habib et al. (1999) assessed the effectiveness of a community oriented problem-based learning (COPBL) approach and compared this to traditional lecture-based teaching in a baccalaureate level university nursing program in Egypt. A quasi-experimental design sampled third year nursing students enrolled in a maternal-child nursing course. When compared to traditional lecture-based classes, findings revealed higher faculty performance, knowledge acquisition and satisfaction with the curriculum. This study is significant because Egypt is similar to Jordan culturally and contextually.

In summary, it would appear that students involved in PBL acquire knowledge and become proficient in problem-solving, self-directed learning, and develop teamwork skills. PBL as a liberal approach to education encourages choice and the expression of different student learning styles. It would seem appropriate to examine this relationship in some depth in this study.

Methods

Sample and setting

Quantitative research using a single group, pre and post-intervention design; convenience sample was used within the cohort of third year nursing students undertaking the Maternal Health Course in one university. All students were eligible to participate. Permission was obtained from the Institutional Review Board (IRB) at the University. The primary investigator collected the data and one research assistant was hired and trained to enter data.

Data collection procedures

Once the permission from the IRB at the university was obtained the primary investigator explained to the student the purpose of the study and assured for the students that their participation was voluntary, would not affect their grads, and that they can withdraw at any time. Once the students agreed to participate, the primary investigator obtained the consent form and collected the data.

Cultural sensitivity of the VARK questionnaire was assessed by two nursing faculty, using a pilot of 10 students to determine difficulties and cultural sensitivities; there were none. Reliability was measured ($\alpha = .85$), and found to be acceptable for such an instrument. The instructions for answering

the VARK questionnaire, (www.vark.learn.com/ instructions for users), were found to be easily understood and did not need to be adapted.

Data was collected during spring of 2006. Care was taken to avoid contamination with the pilot group, who were in a different part of the program. The VARK questionnaire was completed on two occasions: before introducing teaching activity on the first day of the PBL course, then again on the last day of the course.

Measurement

The VARK questionnaire consists of 13 multiple choice questions. Ten questions have four choices and three questions have three choices; All choices correspond to the four sensory modalities measured by VARK. The students can select one or more choices.

PBL was introduced through scenarios, simulated labs, role play, case presentation, and self evaluation. The students learn in three settings: classroom for discussions, simulated labs for role play, and clinical placements. Kilroy (2004) recommendations for implementing PBL were followed. In the simulated labs, students have two assignments and in the first three labs the students discussed scenarios related to different topics of the course. Reality based scenarios representative of health care practices and processes in Jordan were developed by the course instructor and the teaching and research assistants involved in the lab.

At the beginning of the semester students were given the task of developing a scenario to role play, based on a problem or incident in their clinical experience. In the final two days of the lab, the students enacted their role play exercise, and then led a discussion.

In the first lab, the students were asked to clarify terms and decide on the issues generated by the scenario. Students were then given an hour to search, read and analyze these in some detail. Crucial to this was the need to identify study priorities, build learning objectives, divide tasks within the group and identify learning resources. In the second PBL session, the students discussed their findings together facilitated by the course instructor and the teaching and research assistant.

In order to improve the quality of discussions in these PBL activities, students were challenged to find and review at least four scientific articles related to the topics of their role play, case scenarios, and presentations. In the classroom, students were encouraged to bring at least two scientific articles talking about evidence related to the topic

of the class, and present the study then to discuss its implications in relation to their practice.

Data analysis

Data were analyzed in SPSS (social package for social science). Specific aims were analyzed using descriptive statistics, chi square, and cross tabulation appropriate to the level of measurement.

Students' answers were scored to represent their learning preferences, which were then ranked according to VARK guidelines. Scores were computed by calculating the total number of each response, V (Visual), A (Aural), R (read/write, and K kinesthetic).

To answer the first research question "What were the learning styles of Jordanian nursing students?" Total responses for each category with standard deviations were computed. The second research question "Were there significant differences between female and male nursing students in their learning styles?" Was answered using chi square for independence. The third research question "Did PBL have an impact on student's learning styles?" Was answered by using a paired sample *t*-test of student's learning preferences. The fourth research question "What is the relationship between student's learning preference and the course grade?" was answered by using cross tabulation.

Total grade in the course = 100, however a letter grade was given to students. Letter grades were categorized according to university policies as category A+, A, A-, B+, B, B-, C+, C, C-, D+, D. Grades ranged from 88 to 95 fall in the A category, grades ranged from 76 to 87 fall in the B category, grades ranged from 60 to 75 fall in the C category, grades ranged from 50 to 60 fall in the D category, and grades less than 50 fall in the H category meaning unsatisfactory.

Results

Sample characteristics

The sample consisted of 92 students, 31 females and 61 males. 97% of the students were around 21 years old. The mean of students' grade was = 75.8, SD = 9.9.

Learning styles of students

The dominant learning preference was compared based on means, in the pre-test both the read/

Table 1 Nursing students' mean VARK scores pre- and post-test (class size = 92)

Learning preference	Pre-test		Post-test	
	Minimum–maximum	Mean (SD)	Minimum–maximum	Mean (SD)
V	0–7	2.7 (1.46)	0–8	3.4 (1.74)
A	0–8	3.0 (1.72)	0–8	3.7 (1.88)
R	1–10	4.2 (1.81)	1–10	4.9 (1.98)
K	0–8	3.9 (1.64)	0–9	4.4 (2.02)
Total	8–22	13.9 (2.11)	13–28	16.5 (3.45)

Table 2 Differences in students, pre- and post-test VARK score

Learning preference	Mean difference between pre-test and post-test score	P value ^a
V	0.6630	<0.01
A	0.6848	<0.01
R	0.6739	<0.01
K	0.5761	<0.05
Total	2.60	<0.001

n = 92
^a Paired sample t-test.

Table 3 Relationship between students' learning preference and letter grade

Learning preference	Letter grade				Total n (%)
	A n (%)	B n (%)	C n (%)	D n (%)	
V	0 (0)	1 (3)	0 (0)	0 (0)	1 (1)
A	1 (4)	1 (3)	1 (2)	0 (0)	3 (3)
R	3 (12)	2 (7)	6 (16)	0 (0)	11 (12)
K	4 (16)	6 (23)	4 (11)	1 (20)	15 (16)
Multi	17 (68)	16 (62)	25 (70)	4 (80)	62 (68)
Total	25 (100)	26 (100)	36 (100)	5 (100)	92 (100)

write (M = 4.2, SD = 1.8), followed by kinesthetic (M = 3.9, SD = 1.6) were the most dominant learning preferences. Table 1 represents means and standard deviations of each learning preference. A significant difference in learning preferences of nursing students in four categories of the VARK was observed in the pre-post test. Mean scores on the post-test within all four categories significantly greater at the $p < .05$ than the mean scores on the pre-test. Results of t-test are displayed in Table 2. In the pre-test the mean scores of the four categories of the VARK = 13.9 (SD = 2); in post test the mean scores of the four categories of the VARK = 16.5 (SD = 3.5). Multimodal preference was more obvious after the use of PBL as a teaching method. Chi square showed no significant difference in learning preferences between males and females ($\chi^2 = 4.3$, D.F. = 4, $p = .37$). Cross tabulation showed a significant relationship between stu-

dent's letter grade and their learning preferences. Multimodal students achieved highest grades in the course; 25 students scored A in the course of those 17 students have a multimodal learning preference, three have a kinesthetic preference, three have the read/write preference, one had an auditory preference and none with a visual preference scored an A grade. Results of cross tabulation are displayed in Table 3.

Discussion

Although the dominant learning preference of the students was the read/write preference followed by the kinesthetic, still most of the students represented a multimodal learning preference, 58% (n = 53) of the students represented a multimodal preference. The remaining 42% (n = 39) showed a

single dominant preference. The findings of the current study were consistent with findings of [Murphy et al. \(2004\)](#) in which researchers reported the read/write preference to be ranked as the highest preference. Moreover, researchers reported that the multimodal preference is consistent with characteristics of adult learners. In another study [Lujan and Dicarlo \(2005\)](#) stated that 64% of their medical students have multimodal learning preference.

Multimodal learners can be more flexible in taking in the information than learners with a single preference. They are more likely to be able to match their preferences with whatever mode(s) are being used. However, multimodal learners can be challenging for the educators since they need to have at least two, three or four modes involved in learning before they are satisfied. For example, someone with an ARK preference would want to read about it and talk about it with others and receive examples before they would accept the incoming information. A single preference learner would understand the information from just their preferred mode – if it was available in that form. Such finding should notify educators to the significance of using multi-teaching modalities in their classes.

Findings of the current study presented similarities between Jordanian students investigated in the current study and students from other nationalities as mentioned earlier, therefore, this study might help educators interested in tailoring courses that suits learning interests on students from different cultural backgrounds. The strategy of using multiple teaching methods can help students develop different learning preferences and enjoy their learning experience.

Few studies have examined differences based on gender. Consistently with the current study [Murphy et al. \(2004\)](#) reported lack of significant difference in learning preferences between male and female students. In previous traditional maternity courses male students demonstrated lack of interest and sometimes resistance in training at the maternity floor.

Male students in this maternity course were distinguished in their acceptance of the maternity course and role play: they did play the role of pregnant women, and women in labor. They also discussed issues that are considered to be taboos, such as sexuality, violence, and sexual behaviors affecting pregnant woman.

In passing comment one of the students said “this course has changed my entire life, the role play made me realize that women are different from men, still they are important and equal to them”. Another student commented “our experience in the simulated lab by living experiences of

our clients have helped us to understand many of our client’s behaviors that we were not able to analyze earlier, I felt that I became better in providing care to my clients”. In all their assessments, students achieved the highest grades in the simulated labs and role play, and most of the questions that related to the material presented in the labs were answered correctly.

The significant difference in the learning preferences of the students in the pre-post test might be explained as a change in the students’ approach of thinking. In the pre-test the average of the total VARK score = 13.9 (SD = 2) where as in the post test the mean of the total VARK score = 16.5 (SD = 3.5). In the pre-test 54% of students ($n = 58$) had a multimodal preference whereas 68% ($n = 62$) of students have a multimodal preference post-test. This change in students’ preferences might be attributed to the use of PBL; this could have helped nursing students appreciate and value different ways of learning, the PBL experience perhaps confirming and strengthening the students’ perceptions of their preferences and their appreciation of multi-modal learning.

Enhancing students’ abilities to adopt new learning modalities has been shown to improve the process of learning as well as their understanding of the real life environment ([Cassidy and Eachis, 2000](#)). Findings of this study might indicate that managing and presenting course material in multiple sensory presentations and using active learning modalities may help different students to become confident in making decisions, and to mature as evolving professionals.

The Results should be taken with consideration to the study limitations. One of the limitations is related to the design in which one cohort was used without a control group. The Hawthorn effects and novelty value can be expected to be large, as the educational intervention is so markedly different to standard university teaching in Jordan. Moreover, using a convenience sample limited the generalizability of the results. Sample bias by having unequal number of males and females is another limitation.

Conclusion

Most students were able to learn effectively when the teacher provides different learning activities in the areas assessed in VARK, that is, Visual, Auditory, Read/Write, and Kinesthetic. Active learning might be enhanced in large classrooms by presenting models and demonstrations, discussions, collaborative testing, debates games, and answering

questions, manipulating models and role playing. However, some students prefer one particular learning modality. Such students need special attention from the instructor since they could struggle to understand the subject material if their particular learning preference is not predominant in the course.

This needs further study, and if substantiated, could be a further driver for educators to transition from a traditional to a liberal approach such as PBL.

Nurses in their work seldom work alone: they need to be able to work cooperatively in groups and be able to assess problems and develop solutions. Problem-based learning enhances cooperation and team-work. It generates high levels of motivation and prepares students to work in real healthcare environments. As nursing curricula progress from basic sciences and lectures in first year to clinical/practice oriented education in second, third and fourth years, it would be valuable to assess any changes in learning preferences of nursing students across these years and its impact on their skills and achievement.

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