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Pre-service biology, chemistry, and physics teachers' expectations in science courses

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Abstract

This study explains the adaptation of Maryland Physics Expectations Questionnaire (MPEX) developed by Redish et al. (1998) into the Science Expectations Questionnaire (SEQ) investigating pre-service biology, chemistry, and physics teachers' science expectations. Furthermore, this study probes whether pre-service teachers' expectations in science courses are different from each other. The questionnaire was applied to 382 pre-service teachers. The results showed that being in variety departments like biology, chemistry, or physics really did not make difference on students' science expectations. Specifically, our results suggested that the SEQ was applicable to pre-service biology, chemistry, and physics teachers to measure their science expectations.

Keywords: Science expectations; belief, pre-service teachers, MPEX, scale adaptation.

1. Introduction

Students' understanding of what science is and students' expectations of a science course is crucial in the learning-teaching process (Mistades, 2007). Redish and Steinberg (1999) emphasized the importance of determining how students view the nature of physics after s/he is taught physics as a course objective. Students go to the schools with expectations different from experts. Students whose expectations are similar to experts' have greater success in learning (Schommer, 1993; Redish et al., 1998). What the students expect to do and what the instructor expects them to do play important role in the planning of teaching-learning process. Therefore, in the literature, there are lots of studies investigating students' expectations in science courses. A variety of questionnaires were developed by researchers in order to explore students' views regarding knowing and learning physics (Views about Science Survey (VASS), Halloun, 1996; The Maryland Physics Expectations (MPEX) Survey, Redish et al., 1998;

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Epistemological Beliefs Assessment for Physical Sciences (EBAPS), Elby, 2001; White, Elby, Fredriksen, & Schwarz, 1999). For example, in order to explore student attitudes, beliefs, and assumptions about physics, Redish et al. (1998) developed the Maryland Physics Expectations (MPEX) Survey. They evaluated how university students' expectations changed after they took physics course. The results of their study showed that the expectations of students were very different from the expectations of experts; even the gap between the expectations of students and experts became large after the students took physics course. Im and Pak (2004) explored secondary and university students' expectations on learning physics by using MPEX Survey. They found that students' expectations on learning physics gradually changed towards "unfavorable" as the level of school became higher while university students' expectations are relatively "favorable". Similarly with Redish et al. (1998), they also indicated that the expectations of students were still far from the expectations of experts. Henry (2001) compared students' expectations on learning physics who were taught physics by using traditional instruction and who were taught physics by using constructivist pedagogy. He found that the physics expectations of students who were taught physics by using constructivist pedagogy were more like the expectations of experts while the physics expectations of students who were taught physics by using traditional instruction were not. Taganahan (2003) explored college physics students' views of what physics knowledge is and what learning physics involves by testing students on the MPEX survey and Schommer's Epistemological Questionnaire. The results from the questionnaires showed that students developed mature beliefs of learning and physics knowledge after they took introductory college physics instruction.

In the literature, many studies have been focused on the students' expectations on physics. However, there is a need for exploring the students' expectations, especially pre-service teachers' expectations, on other science courses such as chemistry and biology. Therefore, this study explains the adaptation of MPEX (Maryland Physics Expectations Questionnaire) developed by Redish et al (1998) into the Science Expectations Questionnaire (SEQ) investigating pre-service biology, chemistry, and physics teachers' science expectations. Furthermore, the study probes whether pre-service biology, chemistry, and physics teachers' expectations in science courses are different from each other. The research questions of this study are presented below:

1. Are pre-service biology, chemistry, and physics teachers' expectations on science courses different from each other?
2. Could the SEQ be used to evaluate pre-service biology and chemistry teachers' expectations in science?

2. Method

The Maryland Physics Expectations (MPEX) survey consists of 34-item 5-point Likert-type (from strongly agree to strongly disagree) questionnaire. In MPEX survey, students' beliefs toward the way of doing physics categorized in six dimensions which are independence, coherence, concepts, reality link, math link, and effort link. The first three dimensions were taken from Hammer's (1994) research on student's epistemological beliefs, and the last three dimensions - reality link, math link, and effort link- were added by The University of Maryland Physics Education Research Group. The MPEX survey developed by Redish et al. (1998) was adapted by researchers via one of the qualitative methods called one-way translation and Science Expectations Questionnaire (SEQ) was constructed. First, The SEQ was translated from English to Turkish by 7 researchers. While adapting the MPEX, the items were modified based on the science context. The Turkish version of the SEQ and original of the MPEX survey were checked over by 14 science education experts. Based on the feedbacks, the researchers formed the final form of the SEQ. The questionnaire was applied to 382 pre-service teachers (126 biology teachers, 114 physics teachers, and 142 chemistry teachers) in a university in Turkey.

3. Results

The six dimensions of the questionnaire were constructed based on Redish, Saul, & Steinberg (1998) study. Although the translated survey which explores students' expectations on science had a 5-point Likert type, the responses of students were recoded according to 3-point Likert type scale- strongly disagree (1) and disagree (2) responses were tallied as unfavourable, undecided (3) was tallied as neutral, and agree (4) and strongly agree (5) responses were tallied as favourable based on Redish et al., (1998).

In order to analyze the SEQ data, Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA) statistical analyses were conducted via SPSS 15.0 program for Windows. A one-way between groups analysis of variance was conducted to explore the differences among the pre-service biology, chemistry, and physics teachers' expectations' on science courses (for the descriptive statistics see Table 1 below). The homogeneity of variance was tested via Levene's test and because the significance value was greater than .05 (p=.331), the assumption of homogeneity of variance was not violated. The ANOVA results showed that the effect of pre-service biology, chemistry and physics teachers' expectations on science courses was not significant at the p<.05 level ($F(2,379) = 2.14, p = .119$). In other words, being in variety departments like biology, chemistry, or physics really do not make difference on university students' science expectations.

Table 1. The descriptive statistics for departments

Depar ment	Me n	Std. Dev ation	N
Biolog /	116 9479	9.66782	126
Physic	115 9441	11.80500	114
Chemi try	114 3832	9.37267	142
Total	115 5950	10.28038	382

Because the six dimensions which are independence, coherence, concepts, reality link, math link, and effort are related to each other, MANOVA was conducted to compare the pre-service biology, chemistry and physics teachers' expectations on science courses in terms of six dimensions (for the descriptive statistics see Table 2 below). The Box's test of equality of covariance matrices tests the assumption of homogeneity of covariance matrices and because the significance value was .049 (p>.001 level is recommended), this assumption was not violated. Another assumption of equality of variance for dependent variables was tested via Levene's test. No significant value was found less than .05, which indicated that the assumption of equality of variance was not violated. The Wilks' Lambda multivariate test of overall differences considering six dimensions among the pre-service biology, chemistry and physics teachers' expectations on science courses was not statistically significant ($F(12,662) = 1.23, p = .259, partial\eta^2 = .022$). The results imply that among six dimensions the pre-service biology, chemistry and physics teachers' expectations on science courses do not differ.

Table 2. The descriptive statistics for dimensions by departments

Dimensi ns	Depar ment	Me n	Std. Dev tion	N
Independ nce	Biolog /	18.2 821	1.95133	117
	Physic	18. 531	2.24459	98
	Chemi try	17.8 871	2.45350	124
	Total	18. 003	2.22983	339
Coherenc :	Biolog /	15.2 541	1.89548	117
	Physic	14.8 776	2.27159	98
	Chemi try	15.0 403	2.08517	124
	Total	15. 740	2.09305	339
Concepts	Biolog /	17.9 060	2.31182	117
	Physic	17.8 265	1.91050	98
	Chemi try	17.4 513	2.02780	124
	Total	17.7 935	2.09504	339
Reality li k	Biolog /	13. 453	1.28831	117
	Physic	13.0 918	1.26072	98
	Chemi try	13. 371	1.23851	124
	Total	13. 268	1.25875	339
Math linl	Biolog /	14.7 592	1.75865	117
	Physic	14.7 959	2.04061	98
	Chemi try	14.4 516	2.01762	124
	Total	14.6 508	1.93992	339
Effort	Biolog /	17.4 701	1.71491	117
	Physic	17.6 531	1.54053	98
	Chemi try	17. 855	1.66439	124
	Total	17.4 189	1.65386	339

4. Conclusion and Implications

Students whose expectations match with experts' have greater success in learning. Therefore, instructors should know students' expectations in the context of educational environment. Also, in order to construct good quality lessons, it is crucial to determine students' science expectations and based on these expectations lessons can be designed. The results of this study suggest that being in variety departments like biology, chemistry, or physics really do not make difference on students' science expectations. Specifically, our results indicate that the SEQ is not only applicable to physics pre-service teachers, it is also applicable to biology and chemistry pre-service teachers to evaluate their science expectations. Thus, the instructors could use the SEQ to evaluate biology, chemistry, and physics pre-service teachers' expectations.

References

Elby, A. (2001). Helping physics students learn about learning. *Physics Education Research, American Journal of Physics Supplement, 69*(7), 52–57.

Halloun, I. (1996). *Views about science and physics achievement.* The VASS story. In Proceedings of the International Conference on Undergraduate Physics Education, American Institute of Physics Press, College Park, MD, 1997.

Hammer, D. (1994). Epistemological beliefs in introductory physics. *Cognition and Instruction, 12*, 151-183.

Henry, D. (2001). *High school student expectations after a year of constructing physics understanding*. Unpublished manuscript. Retrieved November 4, 2009 from http://physiced.buffalostate.edu/pubs/Results_of_CPU.pdf

Im S., & Pak, S.J. (2004). Secondary and University Students' Expectations on Learning Physics. *Journal of the Korean Physical Society, 44*(2), 217-222.

Mistades, V.M. (2007). Exploring Business Students' and Liberal Arts Students' Beliefs about Physics and Physics Learning. *Asia Pacific Education Review, 8*(1), 100-106.

Redish, E.F., Saul, J.M., & Steinberg, R.N. (1998). Student expectations in introductory physics. *American Journal of Physics, 66*, 212–224.

Redish, E. F., & Steinberg, R.N. (1999). Teaching physics: Figuring out what works. *Physics Today, 34*, 24-30.

Schommer, M. (1993). Epistemological Development and Academic Performance Among Secondary Students. *Journal of Educational Psychology, 85*(3), 406-411.

Taganahan, T. D. (2003). *Epistemological beliefs and conceptual understanding of physics concepts: challenge of physics teaching and re*search. Paper presented the 8th SPVM National Physics Conference and Workshop. Tagbilaran-Philippines.

White, B.Y., Elby, A., Fredriksen, J.R. & Schwarz, C. (1999). *The epistemological beliefs assessment for physical science*. Paper presented at the American Education Research Association, Montreal.