

Results of the Self-efficacy Stimulative Scale used for e-learning by Physical Therapy Vocational School Students —Examination by Exploratory Factor Analysis—

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Abstract. [Purpose] The purpose of this study was to prepare a scale for promoting sense of self-efficacy in physical therapy students in e-learning and to examine the scale items with factor analysis. [Subjects and Methods] Thirty-seven physical therapy students were asked to participate in e-learning and we measured the effect of e-learning using a Self-efficacy Stimulative Scale which we developed for this research. [Results] Factor analysis identified 3 factors, which were named “sense of accomplishment”, “accumulation of experience” and “inquisitive mind”. Coefficients of reliability were 0.89, 0.81 and 0.86, respectively, for each of the three factors. Furthermore, among the subscales, a significant correlation was found between “sense of accomplishment” and “accumulation of experience”. [Conclusion] The results indicate that the Self-efficacy Stimulative Scale is structurally stable and has high factorial validity.

Key words: E-learning, Self-efficacy Stimulative Scale, Factor analysis

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INTRODUCTION

The number of physical therapists in Japan has grown rapidly since the beginning of the 21st century, and the quota for one grade of physical therapist schools exceeds 12,000. This corresponds to the 4th largest number following nurses, practical nurses and health nurses among the types of health workers¹⁾.

Utilizing e-learning to provide effective education to large numbers has become a standard procedure, and many such classes have already been provided in nursing education.

However, there may be conflicts between organic medical education with its focus on individuality and humanity and apparently inorganic e-learning, and it is considered that there are still many problems in replacing traditional medical education entirely with e-learning like other general university education.

In addition, in the recent years there are more students with low self-esteem due to lower self-respect and self-affirmation. It is not easy to motivate them or make them try harder, not only in medical and nursing education, but also in physical therapy education.

To address such problems, many studies have been

conducted on self-efficacy, which is one of the central concepts of social learning theory introduced in studies by Bandura et al.²⁾, Scales of self-efficacy arranged for the Japanese by Sakano³⁾, Narita⁴⁾ and others are beginning to be applied widely in Japan. Furthermore, scores on these scales of self-efficacy are known to increase after clinical training or exercise in classes in medical and nursing education, and thus they are often used to verify the effects of such training methods^{5,6)}. In addition, many studies have examined factors that affect the implementation of such practical training or exercise^{7–9)}.

The implementation of these scales has varied widely, including practical training and exercise, and the results of their reliability or the promoting factors that affect them have been mixed, whereas the scales for self-efficacy are said to have high internal consistency and reliability⁴⁾.

According to the study by Endo, et al.¹⁰⁾, the sense of self-efficacy in nursing students is thought to have increased after nursing skill exercises such as blood pressure measurement and urethral catheterization.

Moreover, Bandura lists “mastery experiences”, “social persuasion”, “physiological and emotional states” and “vicarious experiences” as factors that promote self-efficacy. Endo, et al. prepared a self-efficacy stimulative

Table 1. Self-efficacy stimulative scale for e-learning

1.	I was able to read the article and write by accessing the e-learning site.
2.	I understood the articles used on the e-learning site.
3.	I could trace the links and so forth on the article and refer to other articles.
4.	I studied textbooks and literature in the library in addition to the internet and made some comparison.
5.	The instructor praised me in this e-learning.
6.	The instructor encouraged me to do properly in this e-learning.
7.	The instructor evaluated my work well in this e-learning.
8.	My classmates evaluated my work well in this e-learning.
9.	e-learning was fun.
10.	Experiencing e-learning helped.
11.	e-learning gave me sense of accomplishment.
12.	I feel that it may help when I encounter similar cases in practical training or clinical scenes after graduation.
13.	I learned how to search literature on the internet.
14.	I began to think the differences between the internet and printed literature and their authenticity.
15.	I learned to try to get the overall picture by piecing up the individual segments of knowledge together via the internet.
16.	I came to think more about communication.

scale for nursing skill exercises based on three of these factors.

The purpose of this study was to prepare a scale for promoting self-efficacy, examine it with factor analysis, and calculate the internal consistency and subscale correlation to elucidate the factors that affect the self-efficacy of physical therapy students in order to study how education utilizing e-learning can affect the self-efficacy of physical therapy students.

SUBJECTS AND METHODS

We invited 37 sophomore students in Fiscal 2009 in the department of physical therapy in a 4-year vocational school where the authors worked to be test subjects, and the criterion for exception was refusal to cooperate in e-learning or self-efficacy measurement.

E-learning materials were prepared for a class called "General Exercise Therapy" in the latter half of 2009 through lecture designing and development based on Instructional Design (hereafter abbreviated as ID)^{11,12}, Lectures utilizing e-learning were provided as a supplement to face-to-face lectures over 6 weeks from October through December of the same year¹³.

After the implementation of the e-learning, we measured the e-learning with our modified version of the Self-efficacy Stimulative Scale of Endo, et al. (Table 1).

The e-learning sense of self-efficacy promotion scale we prepared is comprised of 16 items, with each of the 4 promotion factors of Bandura represented by 4 items. Since we expected that the answers would concentrate on the neutral point for many of these items, we used the Likert scale with 4 bipolar answers to develop the raw scores and calculated the score for each item as well as the total score.

Next, we conducted factor analysis on the results of this promotion scale and examined its characteristics, reliability coefficient and the subscale scores. We first analyzed the items to check for ceiling and floor effects, and then conducted exploratory factor analysis. We used SPSS for Windows Ver14.0 for all our statistical analyses with a significance level of less than 5%.

We explained to the students that they were free to participate in this study and that the study had nothing to do with their grades, before asking for their cooperation. This study was approved by Ethical Review Board of the Graduate School of the International University of Health and Welfare (Approval No. 09–70).

RESULTS

Of the 37 physical therapy students, 33 (89.2%) were included in the final analysis after application of the exclusion criteria.

The subjects were 18 men and 15 women with an average age of 20.3 (± 1.7).

In the results of item analysis, a ceiling effect was observed only for Q10, among the 16 questions, and therefore it was removed from the factor analysis.

We conducted factor analysis using the principal factor method on the remaining 15 items of the self-efficacy stimulative scale. We considered it was adequate to have a 3-factor structure based on the results of characteristic value, scree plot and cumulative contribution ratio. We factor analysis using the principal factor method and Promax rotation supposing the number of factors were 3, and extracted 3 factors with characteristic values of 1 for reference. Q3 and Q4, which showed in sufficient factor loading, were removed from the analysis and a third factor analysis was conducted on the remaining 13 items. We obtained 3 clear factors with 71.42% rate of accumulative explanation.

Since the first of the 3 factors was related to the sense of accomplishment from e-learning or the results of evaluation by others, it was named the "sense of accomplishment" factor. The second factor was named the "accumulation of experience" factor because it was related to accumulation of experience through e-learning, and the third factor was named the "inquisitive mind" factor as it was related to having questions and reflecting on oneself instead of simply accepting knowledge (Table 2).

Furthermore, reliability measured by the internal consistency of the 3 factors was 0.89 for "sense of

Table 2. Factor patterns of the self-efficacy stimulative scale in e-learning after Promax rotation

		1st factor	2nd factor	3rd factor
Q8.	My classmates evaluated my work well in this e-learning.	0.90	-0.28	0.20
Q5.	The instructor evaluated my work well in this e-learning.	0.85	0.07	-0.01
Q11.	e-learning gave me sense of accomplishment.	0.79	0.20	-0.06
Q7.	The instructor evaluated my work well in this e-learning.	0.77	0.07	-0.12
Q1.	I was able to read the article and write by accessing the e-learning site.	0.60	0.29	-0.22
Q6.	The instructor encouraged me to do properly in this e-learning.	0.58	-0.25	0.28
Q9.	e-learning was fun.	0.58	0.20	0.09
Q13.	I learned how to search literature on the internet.	-0.23	0.91	0.11
Q12.	I feel that it may help when I encounter similar cases in practical training or clinical scenes after graduation.	0.07	0.78	0.09
Q16.	I came to think more about communication.	0.10	0.67	0.14
Q2.	I understood the articles used on the e-learning site.	0.34	0.40	-0.15
Q15.	I learned to try to get the overall picture by piecing up the individual segments of knowledge together via the internet.	0.07	0.14	0.88
Q14.	I began to think the differences between the internet and printed literature and their authenticity.	0.00	0.12	0.76
Correlation between factors		1st factor	2nd factor	3rd factor
1st factor		—	0.59	0.07
2nd factor			—	0.06
3rd factor				—

Table 3. Correlation, average, SD and α coefficient for self-efficacy stimulation

	Sense of accomplishment	Accumulation of experience	Inquisitive mind	Average	SD	α
Sense of accomplishment	—	0.74*	0.19	2.53	0.72	0.89
Accumulation of experience		—	0.30	2.94	0.50	0.81
Inquisitive mind			—	2.72	0.74	0.86

* $p < 0.05$.

accomplishment”, 0.81 for “accumulation of experience” and 0.86 for “inquisitive mind”. A significantly high correlation was seen between “sense of accomplishment” and “accumulation of experience” ($p < 0.05$ Table 3).

DISCUSSION

The self-efficacy stimulative scale in nursing skills developed by Endo et al. incorporates 3 of the 4 factors for promotion of self-efficacy reported by Bandura, excepting “vicarious experiences”. This was because exercises for nursing skills cannot be given to all nursing students in class. Since this study of ours concerned exercises through e-learning and all students could access the problems on the internet, which are vicarious experiences, we considered that all 4 factors should be included and we prepared a scale including the 4 factors of promotion reported by Bandura.

The results of factor analysis indicated that this scale was structurally stable and that its factorial validity was high, because all items had factor loading of a certain level or higher.

Regarding the factor structure, we extracted 3 factors, which were “sense of accomplishment”, “accumulation of experience” and “inquisitive mind”. All of these are considered important keywords for not just e-learning, but also education in general, and especially self-learning. It is important in e-learning that students should be supported so

that they can have a “sense of accomplishment”, “accumulate experiences” and develop an “inquisitive mind”. Moreover, satisfactory reliability was found for the internal consistency of the final 13 items, excepting Q3, Q4 and Q10 (Table 3).

Dale’s cone says experience has a higher learning effect than looking or hearing and direct experience has an even higher effect¹⁴⁾. The problems on the internet in our e-learning corresponded to “Dramalized Experiences” in it. We consider that creating “simulated experiences”, utilizing the internet, to improve the learning effect has advantages over unidirectional face-to-face lectures mostly comprising of reception.

It is assumed that significant correlation could not be observed between “inquisitive mind” and either of the other factors while subscale correlation was observed between “sense of accomplishment” and “accumulation of experience” because the number of items for “inquisitive mind” was as small as 2. Thus, we consider it necessary to revise the questions by increasing the number of those related to “inquisitive mind” in the future.

One of the limitations of this study was that it only examined data from one vocational school. Also, the number of subjects was small and too insufficient for the results to be generalized to all physical therapy students. Future studies will need larger numbers of subjects and expanded scope with the inclusion of universities and other

vocational schools. Furthermore, the validity of this study is limited to examination only due to factorial validity. Our future challenge is to develop a scale capable of extracting the promotion factors in actual e-learning scenes by providing the basis for its validity, including examination of content validity and verifying the goodness of the model using covariance structure analysis of the same construct.

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