

Development of Self Directed Learning Skills Scale for Pre-Service Science Teachers

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Abstract

The aim of this study is to develop a valid and reliable instrument which is enable to assess pre-service teachers' self-directed learning skills. 140 students included in this study for validity and reliability. Exploratory and confirmatory factor analyses were adopted, and item analysis was used. Cronbach's alpha reliability coefficient was calculated. At the end of study, a scale with 25 items ($\alpha=0.85$), explains 56.997% of the total variance, was developed. Confirmatory Factor analysis indicated that four items do not related to the overall items and they removed from the scale and scale was finalized with 21 items. According to the result of factor analysis of scale, two factors were determined. These factors was named as "self-efficacy" (10 items, $\alpha=0.74$), and "awareness" (11 items; $\alpha=0.84$).

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1. Introduction

Consisting of continuous learning, learning required knowledge, skills, attitudes and behaviours which are increase day by day, makes individuals aware of required to know how to learn. When we consider the proliferation and regeneration of information, science education takes an important place. In this respect, science education must be able to adapt to gain continuous improvement and innovation of personal and professional aspects. Satisfying the learning needs of the students and they need to gain self-directed learning necessity for vocational life, which is preparation of lifelong learning, has become mandatory. Self-directed learning allows the students what they learned to their own learning trajectory and freedom to choose how they will learn to be provided (Polat&Odabaş, 2008).

Instead of traditional teacher-centred learning, self-directed learning students belong to the learning responsibility, student-centred learning, they decide what, how, where, and when will be learned determined by this method. Students should be responsible from planning learning, manage and the control in the period up to evaluation of results. Students, who have their own self-directed learning skills, are aware of their responsibilities in learning; they act independently without the help of others, curious, eager, self-confident, organize the time effectively and plan to complete their work (Hall, 2011).

Development in information technology has provided the redefinition; learning, curriculum, pedagogy and tasks of schools. In the past, the road goes to knowledge was passing from teacher. Now teachers have a role of facilitator in the learning, and learners planning, research, reasoning, and related materials in learning. Learning while limited by the physical location of learners, teaching and learning at home, in schools, libraries can happen in any place

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where there is internet connection anymore. Basic skills need to be redefined in the light of these developments (Mok and Lung, 2005).

To support the development of self-directed learning skills of students' and to make the curriculum more attractive in schools technology should be used. So teachers, who will train our students with have self-directed, learning skills, have great tasks.

Self-Directed Learning: Today, because of constant change and development of professional qualifications, it is impossible to find enough the gains provided by educational institutions to finish education in our work lives. Knowles (1975) defines the self-directed learning as a process; to determine learning needs by taking or not for help by others, to express their learning goals, to identify human and material resources for learning, select and apply appropriate strategies for learning, and they take initiative in assessing the learning outcomes defined.

Brookfield (1986) has considered Self Directed Learning in terms of both cognitive and behavioural. According to him; SDL is a cognitive process that allows us to look from another window to the World and how to change our perspectives is based on the action thinking. He mentioned to look a concept from one direction, planning ability and although the students in different environments with different learning style that learning styles are limited.

Candy (1991); SDL is seen as an aim and besides as a process, and defines SDL interaction between person and his environment, acquisition of knowledge without being aware of the social environment, learning by reading and definition of individuals based on the relationship with the environment was made. Also, he considered as self-management as a result of education, and self-management as a training method.

The Role of Teacher and Student for Self Directed Learning: Patterson et al., (2002), stated for SDL, a person need to have knowledge and skills of to be able to identify the learning needs of the individuals, to evaluate him and others, ability to reflect and to manage information in an accurate, ability of critical thinking and critical evaluation.

SDL can be seen as, learners to take responsibility for their own learning and also as a goal in personal autonomy and striving for individual choices in order to become stronger. Accordingly, achievements will lead to win the next success. There are some characteristics associated with students' self-directed learning skills. These are expressed as; to be controlled scientific method, logical and critical thinking, working collaboratively, curious, sociable, to be creative and motivated, to be insistent and responsible for learning, to be confident and talented, reflective and self-awareness. (Ekinci, 2005)

Duties required for teachers to improve students' SDL are: Helping in determining the starting point of the topics which will be learned, and how to do proper work. They support the view of students' description of knowledge, stimulates thinking through discussing and question-answering dialogues. They help students to regulate learning objectives, strategies, and environmental factors. They provide support to students acquisition of the necessary techniques to be learned subject, giving examples of previous learning helps to configure their prior learning. They help to ensure awareness about the source, learning strategies and subject. And so, research methods, decision making, personal development and SDL are taught (W. J. Rothwell, K. J. Sensenig, 1999).

According to the result of studies, Mok and Lunk (2005) examined, in his study of 'Development of Teacher Candidates Self Directed Learning Skills', effects of design project and application working on teachers' SDL skills. It is found that, students have different SDL qualifications and they are able to develop the capacity SDLS'.

Purpose of Study: The purpose of this study is to develop a valid and reliable measurement scale for teacher candidates to determine whether they have the self-directed learning skills or not. Scientific age requires that our teachers need to be aware of self-directed learning skills. Because of the meaning of teaching, fundamentals of lifelong learning is discarded to students and guided them in this regard. Therefore it is known the fact that teachers must have SDLS' and its importance, but it isn't known that teachers have these skills or not in our country.

Despite recent attends for worldwide education reform; progress has been slow in practice. The task of teachers on successful implementation of education reform plays an important role. Researches Show that unless teachers change the way of teaching the realization of effective learning for students does not occur (Black & Wiliam, 1998; Hopkins et al., 2007). All these results in the teacher education process it is need to be gained to teacher SDLS.

They have to be sufficient in learning's that will need throughout their lives. After the end of undergraduate education, learning won't be terminated, by contrast, every moment they should be need for a new knowledge. Therefore, individuals are expected to be qualified to take responsibility for their own learning to perform. However, these individuals are expected to be able to take responsibility for their learning is ignored how they are ready to their own learning skills.

2. Method

In this study, several steps are followed by the details of the actions. Hinkin indicates that, in the study of development scale tool consist of five basic stages (Hinkin, 1995). These are; creating an item pool, expert conclusion, pilot study, validity and reliability analysis. Researchers have followed all the steps required to develop a scale in this study. Below all things, made at this stage, are summarized under the relevant headings.

2.1. Item Pool Steps (Development of draft Form)

In scale development studies, experimental and theoretical processes are usually followed. In the experimental process, though literature or expert opinion candidate scale form is obtained. A sample group with similar properties of target audience pilot application is made and then, to determine psychometric properties with similar the scale items are determined and final version of the scale is provided (Yurdagül, 2005).

In the experimental process, the literature on self-directed learning skills was examined and 32 items draft scale form has been prepared for science teachers. Firstly scale items constructed by the researchers in order to be simple, understandable and appropriate expressions for teachers. Structured expressions regulated by two language professionals working at Pamukkale University and 5 Turkish Language experts who works at the Ministry of Education as teacher in affiliated institutions. Draft form which arranged in terms of language presented for the opinion of 4 faculty members and 2 science teachers, and according to the feedbacks 7 items were removed from the scale. The validity of the scale was carried out by 140 students who were studying in primary school science teacher.

The proportionalization developed by Likert (1932) is based on for the sample approach. In this approach, a plural of positive and negative expression is applied to purity of respondents. Respondents choose one of the propositions of 'Totally agree', 'agree', 'undecided', 'disagree', and 'strongly disagree'. In this study rating process, developed by Likert, has been used scoring between 5 and 1.

2.2. Stage of Expert Opinion

Language Validity: Created draft scale, in terms of sentence structure and meaning analysed by Turkish Language experts (n=5). Then 7 items were removed from draft scale.

Construct Validity: For the study of construct validity, exploratory factor analysis and confirmatory factor analysis methods were used. According to the result of exploratory factor analysis, there are two factors, has Eigen-value greater than one. Another reason required to collect the scale in two factors is, the difference of eigenvalues between the first and second sub-dimensions is less than the twice of difference between the first and second factors. Eigenvalue of the first dimension is 18,486 and for the second dimension is 38,901. In addition, while variance of the scale, explained for all dimensions is 79,226%, the percentage of variance explained by the first dimension is 18,486%, and for the second dimension is % 38.901. So; the scale can be considered in two dimensions. During the confirmatory factor analysis, 4 items with no relation with the factor structure were removed from the scale and scale was finalized with 21 items.

Pilot Implementation Phase (Application and Data Analysis): The final form of draft scale was administered to 140 pre-service science teachers. After application, internal consistency, stability, and item analysis was conducted in terms of separation power of unanticipated responses from expected responses. To evaluate the reliability of the scale, item-total correlations, the upper and lower method with 27% selectivity group's item distinctiveness was evaluated (Tezbaşaran, 2008). Cronbach's alpha internal consistency coefficient is recommended to be over 0, 70 (Büyüköztürk, 2010).

Exploratory and confirmatory factor analysis was conducted to provide construct validity of the scale. By the exploratory factor analysis while trying to reach strong factor structure between the variables, in confirmatory factor analysis, hypothesis and theories previously determined is attempted to be tested (Büyüköztürk, 2010). SPSS software was used for data analysis during the validity and reliability studies that outlined in the tables.

Sample Properties: The draft scale consisting of 25 items was administered to 140 pre-service science teachers who are studying in Pamukkale University. The majority of participant consists of female teachers (%71, 4). The average of age is greatly 18-21 range (72, 9%). For about a range of grade levels are available for all grade levels. The major general of academic average (42.9 %) is seen to exhibit an average value (2, 5-3) (Table 1).

Table 1. Demographics of the Participants

	Demographic Participants	N	%
Gender	Female	100	71,4
	Male	40	28,6
Age range	18-21	102	72,9
	21 and over	38	27,1
Grade Level	1. Class	34	24,3
	2. Class	27	19,3
	3. Class	35	25,0
	4. Class	44	31,4
Akademic Average	Between 1-2	3	2,1
	Between 2-2,5	42	30,0
	Between 2,5-3	60	42,9
	Between 3-3,5	19	13,6
	Between 3,5-4	16	11,4

3. Findings

Findings related to item analysis: Items of the scale prepared based on a specific technical is analysed whether the behaviour associated with the desired size and varying degrees on attitudinal dimensions are examined in terms of features to distinguish from one another and items, strong relationship with the attitude or discriminator ones can be selected for the scale (Tezbaşaran, 2008). To measure attitudes required to determine the scale, to determine the measure strength of each item 2 different “item analysis” has been proposed by Likert (1932).

Table 2. Item-Total Correlation Coefficients

item	r*	item	r*	item	r*
1	0,55	9	0,34	17	0,53
2	0,53	10	0,45	18	0,35
3	0,44	11	0,46	19	0,43
4	0,40	12	0,27	20	0,35
5	0,56	13	0,36	21	0,49
6	0,56	14	0,51	22	0,32
7	0,52	15	0,40	23**	0,25
8	0,55	16	0,27	24	0,41
				25**	0,25

*Item-Total Correlation Coefficients, **items are removed

In this study, firstly we looked at the item-total correlation coefficient for item analysis. Overall, the substances indicated that item-total correlation coefficients of 0, 30 and higher, distinguish the individuals good degree, in case of necessity the items between the range of 0, 20-0, 30 can be taken to test, and items less than 0, 20 should be removed from the test. In the analysis, the total-item correlation of 4 items are low value of 0, 30. However, two values are close to 0, 30 only other two value is removed from scale. As a result, for remaining 23 items item-total correlations were calculated again and two items removed from scale (Table 2).

To determine what extent measures the items of the scale the teacher candidates SDLS, relating to scale total score as listed 27% top and 27% bottom in the score range, for the t-test analysis the significance of difference between the average scores was conducted. For remaining items, item-total correlations ranges from 0, 33 to 0, 57 were found. According to the t values distinctiveness of difference between item-total correlations of Bottom 27 % and top 27% groups were found significantly at the level $p < 0, 05$. Results of the t-test of each item-total correlation and item distinctiveness are presented in the Table 3. Item-total correlation for each item and the t-test results of the item distinctiveness are presented in Table 3.

Table 3. t-test results for the Item-total Correlation and item distinctiveness of items

Item No	r**	t*	Item No	r**	t*	Item No	r**	t*
1	,552	5,483*	9	,342	5,598*	17	,503	5,228*
2	,533	6,581*	10	,463	5,390*	18	,316	6,256*
3	,468	5,645*	11	,478	4,703*	19	,434	4,942*
4	,411	4,597*	12	,287	2,383*	20	,363	4,602*
5	,584	5,818*	13	,310	4,852*	21	,361	4,938*
6	,573	6,522*	14	,520	5,272*	22	,281	4,751*
7	,532	7,870*	15	,408	4,246*	24	,420	4,824*
8	,555	6,454*	16	,269	3,753*			

*item distinctiveness Coefficients, **Item-Total Correlation Coefficients

3.1. Factor Analysis

Exploratory factor analysis, in order to determine construct validity of scale with 23 items, was conducted on the data obtained. Exploratory Factor Analysis is grouping the items determined by researchers which identify items to measure the same structure or nature, and an analysis technique aimed to describe the measure with the small number of significant factors (Büyüköztürk, 2010).

Table 4. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,798
<i>Bartlett Test</i>	Chi-Square	1018,214
	df	253
	Sig.	,000

As can be seen at Table 4, the coefficient of KMO is 0,798 indicates that the sample size is excellent. Barlett's test results ($X^2=1018.21$; $df = 253$; $p<.000$), shows that the resulting data set is suitable for exploratory factor analysis, in terms of revealing the existence of the correlation between the scale items.

According to the result of KMO and Barlett tests of the scale after determining compliance with the factor analysis, an exploratory factor analysis was applied using varimax rotation method. The number of factors is determined by the percentage of the total variance explained by each factor.

The number of factors will be included in the model is equal to the number of factors which have eigenvalue is over 1. The first results of the principal component analysis 5 factors were determined identified with eigenvalues above 1 or over. These factors describe the %58,429 of the total variance (Table 5).

Table 5. Analysis Results of First Principal Components

Factors	Initial Eigenvalues			Sum of Squares Extract of Loadings			Sum of Squares Rotating Loadings		
	Total	% V.	Total %	Total	% V.	Total %	Total	% V.	Total %
1	6,061	26,352	26,352	6,061	26,352	26,352	2,868	12,470	12,470
2	1,839	7,997	34,350	1,839	7,997	34,350	2,765	12,023	24,493
3	1,668	7,251	41,600	1,668	7,251	41,600	2,454	10,669	35,162
4	1,574	6,845	48,445	1,574	6,845	48,445	2,194	9,541	44,703
5	1,233	5,361	53,807	1,233	5,361	53,807	1,852	8,053	52,756
6	1,063	4,622	58,429	1,063	4,622	58,429	1,305	5,673	58,429

When the result on Table 5 was examined, after the second component contribution to the total variance is also small. According to the graph of slope (Figure 1), it was decided on 2 factors and principal component analysis was repeated.

According to the results in the Table 6, two factors explain %34, 35 of the total variance. However, all of these stages was repeated several, principle components analysis and varimax rotation requirements will be satisfied. In these steps, some items, which installed under several factors, are removed from the scale (Büyüköztürk, 2002).

Eventually the final analysis, there is no item remaining outside 21 items grouped under the defined two factors has remained. In other words, 2 items were removed from the 23 item

scale in factor analysis stage. Defined 2 factors explain the %34, 35 of the total variance. First factor of eigenvalue is 6, 06 and explains %26,352 of the total variance, the eigenvalue of the second one is 1,839 and explains %7,997 of the total variance.

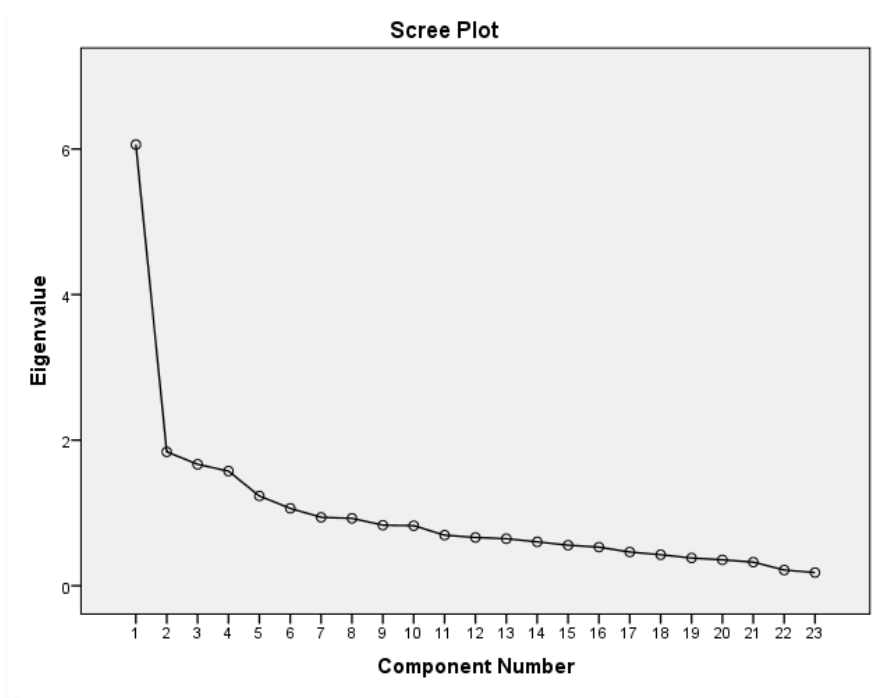


Figure 1. The graph of the slope of the First Principle Component Analysis

Table 6. Results of Principle Component Analysis

Factor	Intial Eigenvalues			Sum of Squares Extract of Loadings			Sum of Squares Rotating Loadings		
	Total	% V.	Total %	Total	% V.	Total%	Total	% V.	Total %
1	6,061	26,352	26,352	6,061	26,352	26,352	4,473	19,449	19,449
2	1,839	7,997	34,350	1,839	7,997	34,350	3,427	14,901	34,350

3.2. Reliability Calculation

To calculate the reliability of the scale, the Cronbach alpha coefficient was used. Alpha values for two factors were calculated in the range of 0, 74 to 0, 84. This value for whole scale is $\alpha = 0.85$. Hair et al., (1995) suggest that this coefficient should be 0, 70 or above. Reliability values for each factor and scale are given in Table 7.

Table 7. Average of Items, Standard Deviation, Item-Total Correlation, Factor Loadings after Rotation

No	Factor 1: “Awareness” “ $\alpha=0,84$ ”, “Eigenvalue=5,295”, “% Variance=27,986”	X	SS	r	VFY
1	I can say what I have learned at which level.	2,06	,727	,552	,670
2	I try to learn something that I think it is necessary to learn.	1,76	,801	,533	,616
3	If I’m interested in a subject, it doesn’t create a problem for me to study on this.	1,58	,832	,468	,708
4	I feel responsible for what I learned about a topic.	2,00	,929	,411	,436
5	To learn a subject ideally I search from different sources.	1,96	,826	,584	,710
6	To learn a new topic I think various ways.	2,09	,809	,573	,745
11	I usually use internet for educational purposes in the course.	2,16	,845	,478	,521
14	It is fun to experiment in the laboratory.	1,58	,832	,520	,553
17	When I faced a subject that I don’t understand I try to learn that by myself.	1,96	,639	,503	,673
19	Schools are not boring places.	2,20	,983	,434	,450
20	I would be happy If my mentor shows my errors while learning a subject.	2,28	1,018	,363	,624
	Factor 2: “Self-efficacy” “ $\alpha=0,74$ ”, “Eigenvalue=1,766”, “% Variance=13,299”	X	SS	r	VFY
7	Until now, I think I’ve very good learning experiences.	2,41	,805	,532	,561
8	I can learn a new thing not just in the class anywhere where I am.	2,18	,825	,555	,495
9	I can’t learn without the help of another person in the course.	2,40	1,030	,342	,577
10	I know how to learn a subject related to the course.	2,06	,707	,463	,474
12	I can learn each subject of the course myself.	2,89	,997	,287	,434
13	I don’t know what I learned and why I learned in the course.	2,09	,818	,310	,584
16	I can’t study alone very well.	2,19	,872	,269	,576
18	I forced to do plan in order to realize my ideas in the course.	2,62	,909	,316	,362
22	I’m tired of being had to learn something continuously about the course.	2,53	,940	,281	,336
24	I’ve the ability to learn what I want to learn about the subject in a short time.	2,25	,721	,420	,401

For whole scale $\alpha=0,85$ The percentage of Variance explained=56,997

r: item-total correlation, VFL: Varimax Factor Loadings†

4. Result

The aim of this study is to develop a valid and reliable scale for students at different grades, who will be science teacher in the future, to grouping and evaluate the self-directed learning skills of them. Findings show that developed scale has appropriate qualifications to determine the self-directed learning skills of science teacher candidates. Scale will help teacher candidates to determine their own learning's under the factors of "self-efficacy" and "awareness".

In the restructuring process of the education, teachers assumed leading role, so that responsibility is given to students in learning process. Learning is a process; learners take responsibility for the planning, implementation and evaluation processes. In other words, is a process that tries to gain self-directed learning skills to student? Therefore, to gain the students SDLS and complete the weakness in this area is becoming inevitable, so teachers have great responsibilities. Researches show that, unless the teachers change the way of the teaching, effective learning doesn't occur in students (Black & Wiliam, 1998; Hopkins ve diğ. 2007). All these results, teacher candidates are need to gain the self-directed learning in the process of teacher education.

Although it is frequently mentioned that lifelong learning skills of teachers, self-directed learning, that will form the basis of lifelong learning, is not given too much area in literature. It is clear that, this development scale will contribute to the Works they'll be done in this area. In today's society where learning is no longer limited with educational institutions, individuals was determined to be questioned the requirements again, they can access to information, and this can be fit into their structure, can add new ones, and circulate these information. Today, individuals, with their own self-directed learning skills, can keep abreast this rapid change and shall have the qualifications to meet the needs of society.

The developed scale in this study determines teacher candidates, who will actively involve in shaping our society, must be aware of their own learning's, for determining each individual may have different learning styles. This developed scale is considered to be guided for teachers, teacher candidates, literature, and in the realization of learning more effective.

5. Discussion

Most of researchers state that to occur learning permanent and effective, and development of learning depends on their own self-directed learning skills (Hall, 2011; Mok & Lung, 2005; Owen, 2002; Baker & Piburn, 1997; Brooks & Brooks, 1999). Instead of traditional teacher-centred learning, SDL is student-centred learning and responsibility of the learning belongs to the student. Student What, When, How, and Where will learn is determined by this method. Students should be responsible and controlled in the period from planning learning, manage up to evaluation of results. Students who have their own self-directed learning skills are aware of their responsibilities in learning, act independently without the help of others, curious, eager, self-confident, they have ability to organize the time and to make plan to complete their work is indicated.

The first aim of this study is to develop valid and reliable scale to be understandable of self-directed learning skills of students who will be science teacher in the future. According to the factor analysis, scale is grouped under two headings namely "Self-efficacy" and "Awareness".

Students gained Self-directed learning increase their learning abilities and make a huge contribution of their universities educational quality (Soran, 2006). Today universities not only

improve the learning ability of students, but also must prepare students for lifelong learning by gained those self-directed learning skills (Wilcox, 1996). Accordingly, it is necessary have the knowledge of how to develop and completed self-directed learning skills in individuals. This case is possible only with valid and reliable scale which was developed as specific for this area. So, this study has emerged a unique scale for the area.

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