

Exploring and Developing Items Measuring Self-Directed Learning

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Abstract

Purpose of the Study : With exploratory factor analysis (EFA), this study aimed to create a valid and trustworthy survey instrument to gauge self-directed learning. With the ultimate goal of promoting lifelong learning skills, this research endeavors to create a foundation upon which doctoral students can build not only their dissertations but also a mindset that transcends academia, preparing them for a future of continuous intellectual and professional development. **Methodology:** The researcher used IBM-SPSS-AMOS 24.0 to run the EFA procedure on construct elements for a survey with an interval scale between 1 and 10 and the extraction method of Principal Component with Varimax Rotation. Additionally, the Bartlett's Test of Sphericity and the KMO sampling adequacy were carried out. The reliability of the kept items was examined using Cronbach's Alpha. **Primary Results:** The Bartlett's Test of Sphericity has a significant level of significance (sig. 000). Additionally, there is great sample adequacy as indicated by (KMO=0.860). Cronbach's alpha values for the two components are more than 0.7. Additionally, all 13 items' Cronbach's Alpha values were higher than the cutoff value of 0.7. The instrument's consistency and stability across samples was verified by the development scale and validation. **Applications of the Study:** This research was conducted primarily for postgraduate students studying at Malaysian public universities, particularly those in Sabah and Sarawak. The PhD candidates who are enrolling in doctorate programmes at local public universities were the focus of the study. **Originality of this Study:** The study's unique contribution is in its ability to quantify self-directed learning within the setting of doctorate students. The EFA outcomes revealed that the elements are usable in this study, as they constitute a configuration that isolates two components of self-directed learning that can be measured by 13 items established in this research.

Keywords: Self-Directed Learning, Exploratory Factor Analysis, Efa, Survey

Introduction / Background

"A process in which individuals take initiative, with or without the assistance of others, to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes" is what self-directed learning is defined as (Knowles, 1975). Even after doctoral students finish their official education, they can continue to grow more independent and autonomous in their thinking, learning, and behaviour through self-directed learning. Research on self-directed learning has revealed significant gaps when it comes to taking tertiary education aspects into account when it comes to autonomous learning. High school students in particular have frequently been linked to passive learning, and a lack of independence in the classroom (Liu & Fang, 2023; Assem et al., 2023). Researchers (e.g., Murniati et al., 2023; Kemp et al., 2022) has cast doubt on earlier findings and asserted that students could exhibit traits of self-directed learning when they were not given instructions but instead had to manage their time and resources, make decisions, solve problems, and interact with people in different fields. Concerning postgraduates' self-directedness, there is no consensus. This study looked at PhD students' self-directed learning in Malaysian public universities.

Year	Doctorates		
	Students	Graduates	Quits
2022	-	-	2,797
2021	42,834	3,681	2,364
2020	37,501	3,407	2,017
2019	36,329	3,827	2,683
2018	35,362	4,121	1,866
2017	33,838	4,040	1,595
Total	185,864	19,076	13,322

Figure 1: The total number of doctorate students enrolled, graduated, and dropped out between 2017 and 2022

Universities are becoming more and more attractive destinations for PhD students seeking the best education due to the rise in the number of doctorate holders. System MyMoheS KPT (2023) states that there are 42,834 doctoral students enrolled overall in Malaysia's public universities as of 2021. The report from the Malaysian Department of Statistics eStatistics in 2023 shows that the number of PhD students who graduated from 2017 to 2021 is 19,076. However, this number is far from the actual target of 60,000 PhD holders in 2023. The displayed table in Figure 1 shows that the number of doctorate students who drop out of studies every year is increasing. In 2020, during the COVID-19 pandemic, the number of doctorate students who graduated was the lowest.

There have been concerns raised by Selvanathan et al. (2023) regarding how to give these students effective educational experiences at several Malaysian universities. Within this study, "doctorate student" refers to doctoral students who are supposed to be self-directed learners who take initiative, set goals, and pursue their research and academic progress independently throughout their academic journey. A key component of their capacity to succeed in PhD programmes and contribute significantly to their fields of study is self-directed learning (Boyer et al., 2022).

Doctorate students have the capacity to be independent and self-governing. It is anticipated that they will assume a significant level of autonomy and accountability for their own education (Rini et al., 2022). Self-directed learning is crucial for research and problem-solving since it helps with finding research gaps, creating research questions, and creating plans for autonomous data collection and analysis (Ibrahim et al., 2022). Students pursuing a doctorate programme must learn and adapt to new ideas, approaches, and advancements in their profession during the course of several years of study (Alfaro-Tanco et al., 2023). Planning, writing, and revising the dissertation are all heavily influenced by self-directed learning, which is also essential for remaining current and developing as a researcher (Astuti et al., 2023). A broad range of research, analytical, and communication skills are required of doctorate students (Phillips & Johnson, 2022). They typically pick up these abilities through self-directed learning, which might include online courses, workshops, or independent study (Arnandho & Sutheejariyawattana, 2022). Doctorate students are also encouraged to hone their critical thinking abilities through self-directed learning (Chukwunemerem, 2023). To effectively contribute to the academic debates, they must also critically analyse both their own and other people's work.

Finding out how doctorate students in Malaysian public universities use self-directed learning is the aim of this research. The study on the self-directed learning of these PhD candidates helps to measure their self-directed learning as well as increase the likelihood that they will continue learning after fulfilling the criteria of their doctorate programme. Assisting doctorate students with self-directed study and enhancing their sense of autonomy is critical. Learners should use proactive tactics in a self-directive manner to organise, monitor, and regulate their learning during academic activities, according to Balasubramanian & Manivannan (2022) and Al Najjar et al. (2021).

The literature on doctorate students' self-directed learning has less studies on it. Therefore, our work aims to close the gap. With exploratory factor analysis (EFA), this study aimed to create a valid tool for measuring self-directed learning. This study was conducted by the researcher on PhD students in Malaysia who are enrolled only in public universities.

Methodology

Pre-Test

Pre-testing is necessary for studies that use survey questionnaires as a data collection strategy (Hung & Swanto, 2023; Dehisat & Awang, 2020). This allows researchers to identify any concerns about the questionnaire ahead of time, such as bothersome concepts or poorly worded questions. During a pre-test, the researcher incorporated the opinions of experts and practitioners into the questions (Al-Khamaiseh et al., 2020). While calculating the factors, expert opinions are required to examine and determine strange items (Baistaman et al., 2020). In contrast, EFA validated findings based on respondents perceptions. Some items must be dropped in order to validate with EFA. The sensitivity of the elements depends critically on the views of respondents. Experts are assumed to be professionals in the academic subject in this study. In order to make sure that the questions are responsive to the language and cultures of the respondents, particularly with regard to the attitudinal and behaviour measures, this study collected data in three stages: a pre-test, instrument validation, and finally using the pilot study (Ehido et al., 2020).

A team of external experts reviewed and examined the questionnaire during the pre-test phase to make sure it measured the intended outcomes and to assure its validity. The researcher conducts a pre-test to assess the degree of self-directed learning among doctorate

students in Malaysian public universities. Doctorate students were chosen by the researcher using a straightforward random sample technique. The doctorate students received an email from the researcher inviting them to take part in the study and survey. The email also asked the students to flag any questions that were unclear or difficult to answer. The expert was given access to the survey in English by the researcher to make sure the wording chosen for it were suitable. Based on the feedback and comments from the experts, the researcher made modifications to the instrument and enhanced it as a result. presented a revised version of the survey after that. The expert was asked by the researcher to evaluate the questionnaire's word choice, item clarity, number of items needed to measure the components, and layout. Within two weeks, the experts provide their input again. On the instrument, the experts offered their opinions and suggestions. The instrument's validity and reliability for gathering primary data were both acceptable.

Validity

Validity is the degree to which an idea of excitement is accurately shown on a scale or collection of evaluations (Hair & Alamer, 2022). According to the researcher's conviction to judge precisely, it demonstrated how we can quantify indicated required to measure precisely, or how the exploration results are substantial and reasonable to have the research prevail concerning accomplishing what it is planned to evaluate (Bougie & Sekaran, 2019).

The face, content, and construct validity classifications are used in this study (Muda et al., 2020). The degree to which the instrument items address and evaluate important aspects of the study topic is shown by the face validity for this research, the content, and construct validity classifications that are employed. According to Al-Khamaiseh et al. (2020) and Alias et al. (2019), content validity is the degree to which data collected with a certain tool corresponds to the ideal substance to be measured. The extent to which the practical variable identification accurately reflects a true theoretical meaning is the measure of a construct's validity. In order to verify the poll's face validity and content validity, the researcher closely examined a few experts in self-directed learning. The concept of self-directed learning among doctorate students at Malaysian public universities informed the substance of all instrument components, which identified the challenges under investigation. This enhanced the underlying poll's validity both in appearance and content. These methods contributed to improving the poll's suitability in terms of its goals, content, and structure.

Factor Analysis

The pilot study was intentionally conducted to improve the materials, systems, and parameters related to the actual research, according to Hair Jr et al. (2019). Similarly, it eliminates methodological flaws in common sense research. Moreover, the pilot study guarantees the member's level of understanding of the guidelines enclosed in the exploration tool, allows analysts to work on leading the investigation, and survive and reduce mistakes in the real examination (Tan, 2022). The purpose of a pilot research is to assess the questions' content and relevance to the test participant, as well as to measure the clarity and ease of understanding, as stated by Wen et al. (2022) and Al-Khamaiseh et al. (2020). According to Lakssoumi et al. (2022), the poll design is improved and areas of the survey that need improvement are identified in the pilot test for the objective example.

According to Hair Jr. et al. (2019), a pilot test may also enhance the instrument's quality and validity. The pilot research, according to Lawson et al. (2022), is similar to a feasibility study and is carried out in the early phases to develop a precise core study. The pilot research

provides assurances that: (a) the review instructions are justified; (b) the study is comprehensive and easy to complete (Wen et al., 2022); and (c) the instruments collect the necessary data (Juhana & Ruminda, 2023). To improve the validity and quality of the instrument, the researcher conducted a pilot test on the objective contributors (Hair Jr et al., 2019).

Following the completion of pre-testing, the researcher revised the item statement in light of reviewers' feedback. Using a structured Google Form survey, the researcher randomly gathered data from 105 (out of 701) doctorate students who participate in an online social support network for doctorate students and are exclusively contacted. The group of 701 PhD students were all assigned with numbers between 1 and 701. A numbers generator from the internet was used to generate 105 random numbers between 1 and 701. After that, researcher selected and emailed to randomly generated 105 numbered respondents. After signing an NDA form, all emails were obtained by asking them from the same entity that offers the doctorate students an online social support. The target population can be estimated from the 100 participants in the pilot project (Awang et al., 2023).

The items and their dimensionality (if any) in measuring the specific construct were examined and evaluated by the researcher using the Exploratory Factor Analysis (EFA) method (Alkhwaja et al., 2020). Construct validity was created via factor analysis. The notion of components classified as practical is validated by this method. It suggests the ideal elements for each component (Bougie & Sekaran, 2019). The potential of factor analysis stability was estimated using Bartlett's test, and the suitability of the sample size for analysis was assessed using the KMO test (a KMO value near unity is favoured). Next, it was decided whether the instrument was appropriate for use with PhD candidates in Malaysian public universities and whether the construct validity was sound.

Discussion / Analysis

When there are variations in the study field, the socioeconomic position, and the population culture between this study and previous studies, the dimensionality of the items may alter. Time between the current study and earlier research is the other aspect. Depending on the previously noted changes, the findings from other studies could not hold true (Mohamad et al., 2019; Ehido et al., 2020).

EFA Process

This work used an interval scale with 13 elements in the instrument, ranging from 1 (strongly disagree) to 10 (strongly agree), to measure this construct (Al-Khamaiseh et al., 2020; Awang et al., 2023; Musa et al., 2023; Awang et al., 2018; Awang et al., 2016). Every component of Self-Directed Learning has been measured, and the descriptive statistics Table 1 displays the mean and standard deviation score for each component.

Table 1

Descriptive Analysis for Self-Directed Learning (PTK) Items

	Item Statement	Mean	Standard Deviation
PTK1	<i>I am very good at finding out answers on my own for things that my lecturer does not explain it to me</i>	7.2700	.89553
PTK2	<i>I am better at learning things on my own</i>	6.8600	.79798
PTK3	<i>I regularly learn things on my own outside of class</i>	7.4100	.71821
PTK4	<i>If there is something I don't understand, I always find a way to learn it on my own</i>	7.5500	.76589
PTK5	<i>I am good at finding the right resources to help me do well in my studies</i>	7.2800	.83721
PTK6	<i>I view self-directed learning based on my own initiative as very important for success in studies and in my future career.</i>	7.8700	.75611
PTK7	<i>I am very motivated to learn on my own without having to rely on other people</i>	6.9800	.70498
PTK8	<i>I like to be in charge of what I learn and when I learn it.</i>	7.5700	.87625
PTK9	<i>I carry out my own study plan.</i>	7.4300	.85459
PTK10	<i>I seek assistance when facing learning problems.</i>	8.0000	.92908
PTK11	<i>I manage time well.</i>	6.3980	.74531
PTK12	<i>I set up my learning goals.</i>	7.4700	.85568
PTK13	<i>I have higher expectations for my learning performance.</i>	7.7600	.79292

Source: (Tang et al., 2021; Rafique et al., 2021)

KMO Value and Bartlett's Test

For construct elements, the researcher conducted the EFA approach using the Principal Component with Varimax (Variation Maximisation) Rotation extraction method. The results of Table 2 show that the Bartlett's Test of Sphericity has a high degree of significance (sig. 000). Additionally, Kaiser-Meyer-Olkin's sampling adequacy (KMO=0.860) is outstanding, surpassing the necessary value of 0.6 (Awang, 2012, 2018; Muda et al., 2020; Awang et al., 2023, Bahkia et al., 2019). Both of these findings suggest that there is sufficient data to move forward with the EFA data reduction process (Ehido et al., 2020; Baistaman et al., 2020).

Table 2

Bartlett's Test and KMO value

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	966.231
	df	78
	Sig.	<.001

As a result of the EFA procedure, 13 items were divided into two components, each with its own two components elements; the components that emerged from this process are shown in Figure 2. The rotated component matrix will show each element's precise affiliation with each component (Dehisat & Awang, 2020; Hung & Swanto, 2023; Bahkia et al., 2019).

Table 3 illustrates the two components and how the derived Eigenvalue is the basis for the two EFA processes. The eigenvalues fell within the range of 3.756 and 5.317. For component 1, the total variance explained is 40.897%, while for component 2, it is 28.896%. The total variance explained for this construct is 69.792%, which is above the minimum of 60% and thus considered acceptable (Musa et al., 2023; Bahkia et al., 2019; Hoque et al., 2018).

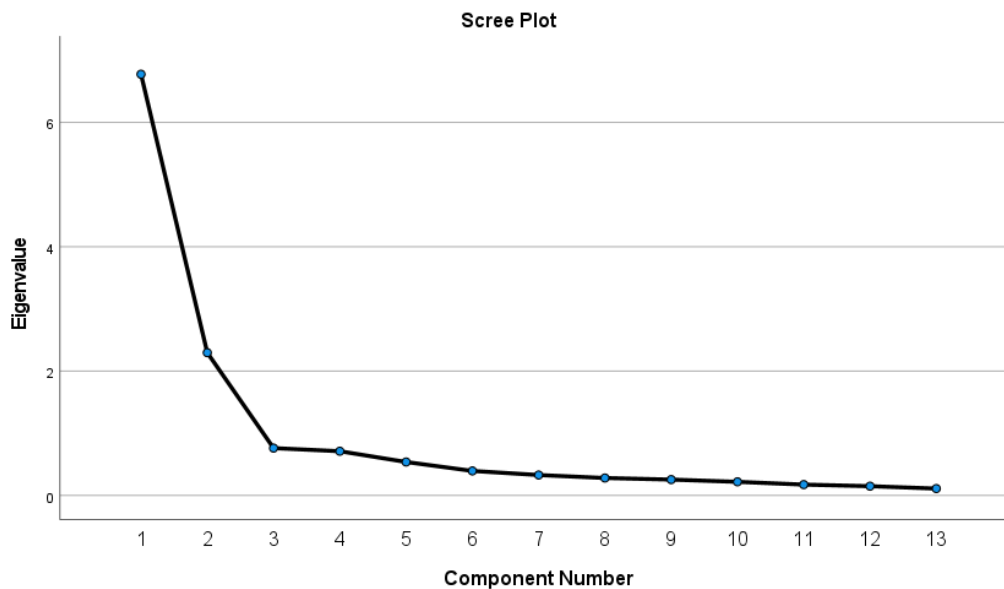


Figure 2: Extracting Two Components

Table 3

The Total Variance Explained

The Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	5.317	40.897	40.897
2	3.756	28.896	69.792

Extraction Method: Principal Component Analysis.

Both of the components and their related elements are shown in Table 4 as resulting from corresponding elements together. According to Alias et al. (2019), Bahkia et al. (2019), and Musa et al. (2023), each element's factor loading needs to be greater than 0.6 in order for any item to be retained.

Table 4

*The Number of Components***Rotated Component Matrix^a**

	Component	
	1	2
PTK1	.742	
PTK2	.812	
PTK3	.772	
PTK4	.855	
PTK5	.805	
PTK6	.824	
PTK7	.811	
PTK8	.712	
PTK9		.724
PTK10		.810
PTK11		.843
PTK12		.900
PTK13		.778

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Internal Reliability

Lastly, Cronbach's Alpha, which measures the reliability of the retained items in measuring this construct, must be calculated for the study. The degree to which items hold together when measuring particular constructs is indicated by their internal consistency or reliability. Cronbach Alpha must be more than 0.7 for elements to have Internal Reliability (Alkhawaja et al., 2020). Two components measuring the self-directed learning construct are shown in Table 5, along with the corresponding Cronbach Alpha value.

Table 5

The Internal Reliability of Cronbach's Alpha

Component	No. of Elements	Cronbach's Alpha
1	8	.929
2	5	.894
	13	.921

Both components have Cronbach's alpha values greater than 0.7. Additionally, the 13 items' combined Cronbach's Alpha score of 0.921 surpasses the 0.7 requirement. As a result, the research came to the conclusion that the self-directed learning construct's measurement tools had sufficient internal reliability (Muda et al., 2020; Shrestha, 2021; Bahkia et al., 2019; Baistaman et al., 2020).

As a result, these findings demonstrated that the two parts of the self-directed learning construct had reliability measures higher than the required value. The derived components and their corresponding items can thus be used to measure the self-directed learning

construct with accuracy and appropriateness. Therefore, this study recommended that self-directed learning components be used in subsequent research.

Conclusion

The present study makes a noteworthy addition to the self-directed learning construct measurement, namely within the setting of doctorate students. The EFA outcomes created a configuration that isolates two aspects of self-directed learning, which are measured by 13 items developed specifically for this study. These items have high Cronbach's Alpha values, meet significant Bartlett Test results, have KMO values greater than 0.6, and have factor loading above the minimum threshold of 0.6. The findings of this study indicate that the elements are relevant (Jusoh et al., 2022; Mohamad et al., 2019; Shrestha, 2021; Awang et al., 2023). This research contributes to the evolution of pedagogical practices in doctoral education by providing a nuanced understanding of self-directed learning, allowing for the development of targeted strategies that can be implemented to empower and support students in their academic journeys. By unraveling the dimensions of self-directed learning specific to doctoral students, this study not only enriches academic scholarship but also offers practical implications for institutions aiming to create environments that encourage autonomy, resilience, and continuous intellectual growth among their graduate student population.

Future research can use the validated instrument to assess components of self-directed learning, as it is consistent and stable across samples, as confirmed by the construction of the demanding scale and the validation conducted in this study.

Limitations and Future Study

A few restrictions on the current investigation could have an impact on the generalizability and results. The study's focus was on the tertiary education sector, hence its findings were limited to that industry in Malaysia. Doctorate students from public institutions in that sector were chosen for the study, and the results were not extended to other education sectors.

Given the limitations of the quantitative and cross-sectional approaches, it is advised that future research employ the mixing method or longitudinal approach in order to produce more insightful findings. This survey can also be administered in private universities and at any level of the educational system. Due to their ability to delve deeply into people's brains, focus groups and interviews would also be helpful in analysing the information gleaned from the sample.

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