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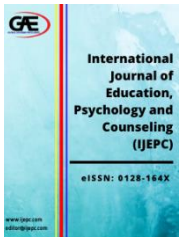

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LEARNING MOTIVATION TOWARDS LINEAR PROGRAMMING QUESTIONNAIRE FOR POLYTECHNIC DIPLOMA STUDENTS

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Abstract:

The objective of this research was to assess the reliability and validity of learning motivation toward the Linear Programming (LMLP) Questionnaire by using the Rasch Measurement Model. The LMLP Questionnaire was adapted from Keller's ARCS Model of motivation to evaluate the motivation level in learning Linear Programming among students of Diploma of Mechanical Engineering at Polytechnic Kota Kinabalu. The LMLP Questionnaire consisted of 34 items with the use of a 5-point Likert scale. The level of student motivation was measured based on four main constructs which are Attention (A), Relevance (R), Confidence (C) and Satisfaction (S). The sample comprised 56 third-semester students of Diploma of Mechanical Engineering. The results of the study found that overall, this questionnaire had high reliability with a Cronbach's alpha (KR-20) value of 0.97. The questionnaire was found to have good item reliability and item separation values of 0.84 and 2.26, respectively. The questionnaire also had excellent person reliability and good person separation values of 0.93 and 3.74, respectively. Meanwhile, the validity of the LMLP instrument was appropriately established through the item fit, person fit, and unidimensionality. In conclusion, this study shows that the LMLP Questionnaire is a reliable and valid instrument to measure the level of learning motivation towards Linear Programming among third-semester Diploma students in Mechanical Engineering.

Keywords:

Learning Motivation, Linear Programming, Polytechnic Diploma Students, Rasch Measurement Model.

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Introduction

Linear Programming is one of the compulsory subjects to be taken among Polytechnic Diploma students, especially for Mechanical Engineering students. This subject needs students to apply most of their mathematical skills to solve the problems such as how to develop mathematical representations from sentences (Rabe et al., 2022). Dantzig (2002) mentioned that Linear Programming is used to formulate real-world problems in detailed mathematical terms (models), techniques for solving the models (algorithms), and engines for executing the steps of algorithms (computers and software). The skills in Linear Programming empower the students to solve problems from several kinds of situations such as game schedules for sports (Aggarwal et al. 2012), dietetic problems (Das & Edalatpanah, 2021) and even loss and profit problems (Chanda et al., 2022). Therefore, it is a 'must' for Polytechnic Diploma students to comprehend this subject as a value-added to face the real-world problem. Students have an inadequacy of learning motivation towards this subject because it needs students to master the word problem and an abundance of steps to solve the problem (Karuniakhalida et al., 2019).

The good performance or getting high achievement in studies is one of the main targets in any learning and teaching process. This is because getting good grades means that students manage to understand well about their studies. Motivation to learn has been said as one of the most crucial factors in improving students' achievement in their studies (Zahay et al.,2017; Ariani, 2016; Woytek, 2005). Motivation is a theoretical concept utilized to elucidate human behaviour. Motivation acts as a stimulus for human beings to react and fulfil their needs. In education, motivation has its definition which can be concluded as the strength behind behaviour that has to be maintained associated with physical, emotional and logical to determine the directions, force and insistence in one's action (Gopalan et al., 2017). Motivation and learning have a huge relationship thus leading to the study of learning motivation. Students learning motivation toward Linear Programming needs to be accumulated to make sure the students can grasp the skills.

However, there is a lack of studies that involve learning motivation for higher education students in Malaysia particularly. To enumerate the level of student learning motivation in Linear Programming, an adequate instrument such as a learning motivation questionnaire needs to be developed. By evolving this questionnaire will help educators to detect their students' level of learning motivation so that they can adjust their teaching and learning process (Nakata et al., 2022). Fives et al. (2022) stated that motivation with a good teaching and learning strategies will eventually give rise to a students with virtuous achievement.

Motivation is an important component in learning successfully. Durlak et al. (2011) stated that motivation is what causes a person eager to know, act, understand, believe, or gain particular knowledge, skills, attitude, or values. Many studies discussed the importance of motivation and motivation's role especially in learning Mathematics (Huang et al., 2017; Hannula, 2006; Kloosterman, 2002). All these studies have been conducted as Mathematics seems to be one of the most difficult subjects in school as reported by Ali and Reid (2012). According to Acharya (2017), one of the factors affecting the learning of mathematics among mathematics learners is due to lack of motivation and counselling which brings anxiety and negative thoughts about this subject. A high level of learning motivation is important especially to tertiary level students as it is one way to promote lifelong learning and helps in promoting student autonomy (Afip, 2014).

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One of the tertiary level students that may have to concern is the Technical and Vocational Education and Training (TVET) students. This is because previous research shows that TVET students have a low level of learning motivation (Hassan & Baroroh, 2020; Azahari, 2019). Syaparuddin and Elihami (2020) stated that a higher level of learning motivation in students will help in achieving learning goals better. Motivation will help students learn harder, rigorously and fully concentrated during the learning process. Motivation in learning is one of the things that need to be highlighted in the education system as stated by Harackiewicz et al. (2014). There is the importance of learning motivation as listed by Filgona et al. (2020) as motivation can stimulate learners to think, concentrate, and learn effectively; motivation helps to increase the speed of work that a learner is putting to achieve a goal; motivation helps the learner to concentrate on what a learner is doing, and thereby gain satisfaction, and motivation increases the initiation and persistence of learning activities and cognitive processing. Thus, educators need to have an instrument to measure students learning motivation simultaneously to intensify student's attention, confidence and satisfaction in their studies

Problem Statement

In Malaysia education system, the level of student's achievement whether good or not in their studies are measured by examination. The higher marks obtained by students show that students master the subject well. Mathematics is one of the popular subjects that will affect student's performance as it is compulsory subject not only in schools but also in higher education level. Since that, students become more anxious when they want to further their studies result to mathematics anxiety (Kok et al., 2022; Mamolo, 2022). This anxiety surely will affect the level of student's learning motivation (Zhou et al., 2022). Better level of motivation contributes in high level of student's achievement. As reported by Foong et al. (2022), one of the factors causes the failure of engineering students closely related to low level of motivation. Unfortunately, Mayer (2014) also disclose that students' motivation for learning is possibly weak will therefore weaken the activity and the quality of learning achievement. The problem of low levels of motivation among TVET students has been discussed in several studies (Hassan & Baroroh, 2020; Azahari, 2019). On the contrary with findings reported by Zainuddin & Kutty (2022) which mentioned that the high level of students' motivation leads to social harmony. Same goes to research conducted by Nurja (2022) who explained that students from the community college have a high level of learning motivation. This contradiction results led to the need in the development of a questionnaire to assess the level of students' learning motivation especially for Linear Programming.

This explains that the problem of low motivation needs to be measured so that the causes of this problem can be known and resolved. Without good learning motivation, students will find it difficult to stay motivated to solve the problems they face. This is in line with the study by Wulandari et al. (2018) who stated that learning motivation contributes significantly to problem-solving ability. Rigusti & Pujiastuti,(2020) stated that motivation will help in intellectual development which can be indicated by the desire of the students to learn. In order to improve students' learning motivation, Ismail (2018) suggested the teachers to modify their learning and teaching strategies. Before choosing the suitable method, educators must know how motivate their students. Several existing instruments can be used to measure students' motivation such as the Motivated Strategies for Learning Questionnaire (Pintrich & de Groot, 1990), Student Motivation Scale (Martin, 2003) and Motivation Questionnaire based on Expectancy-Value and Flow Theory (Burak, 2014). However, these instruments don't fit to be used in the Linear Programming subject. Furthermore, those instruments were not suitable for

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the tertiary level student. As a consequence, the purpose of this research was to develop and evaluate the reliability and validity of a questionnaire on students' learning motivation toward Linear Programming.

Research Objective and Research Question
The objective of this research was to assess:

i. the reliability of the LMLP Questionnaire; and
ii. the validity of the LMLP Questionnaire by using Rasch analysis.

Based on the research objectives above, there were two main research questions to be answered in this research which were:

i. What is the value of person reliability, item reliability, person separation value, item separation value and Cronbach's alpha (KR-20) of the LMLP Questionnaire?
ii. What is the value of item fit, person fit and unidimensionality of the LMLP Questionnaire?

Research Methodology

Instrument
LMLP Questionnaire which stands for learning motivation for Linear Programming is a questionnaire that consists of 34 items. This instrument has been adapted from Keller (2010) based on the ARCS model that represents Attention, Relevance, Confidence and Satisfaction. These four main constructs were used to determine the level of learning motivation. The instrument was modified to match the topic chosen which is Linear Programming. ARCS model abbreviated from Attention, Relevance, Confidence and Satisfaction were used to measure the level of learning motivation of Diploma students in Linear Programming. The first construct which is attention meant the student's attention to learn something more effectively after using new learning strategies. As Gopalan et al. (2017) stated that gaining students' attention during the learning process is very crucial and will help in sustaining the student's engagement in learning. Meanwhile, the relevance construct represents the importance and value of learning (Chang & Chen, 2015). This construct is related to students' experience and the needs related to the relevance of their studies (Gopalan et al., 2017). The third construct which is confidence refers to students' confidence level in their ability to complete a learning-related task that they studied (Chang & Chen, 2015). Based on Gopalan et al. (2017), confidence is related to the student's emotions and anticipation during their learning process. Satisfaction refers to the potential for satisfaction in the learning process and the gained knowledge to complete the whole process (Chang & Chen, 2015; Gopalan et al., 2017). In other words, students should feel a sense of satisfaction regarding their achievement in the opportunity of learning (Cook et al., 2009).

The LMLP Questionnaire was modified to match the context of this research which is to measure the level of learning motivation for Linear Programming with tertiary level students as the respondent. 34 items with a 5-Likert scale were categorized into four main constructs in this instrument. Reverse questions in each construct were also used to make sure the students read the question properly before answering. The division for each construct is shown in Table 1.

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Table 1: Division of Each Item based on ARCS Model

Construct	Attention	Relevance	Confidence	Satisfaction
Item Number	1	2	3	7 (*reverse*)
	4 (*reverse*)	5	6 (*reverse*)	12
	10	8 (*reverse*)	9	14
	15	13	11 (*reverse*)	16
	21	20	17 (*reverse*)	18
	24	22	27	19
	26 (*reverse*)	23	30	31 (*reverse*)
	29	25 (*reverse*)	34	32
		28		33
Total	8	9	8	9

Research Sample

Rasch analysis which was conducted is based on the data obtained from the pilot test with 56 semesters of three Mechanical Engineering students from Polytechnic Kota Kinabalu, Sabah. The pilot test was conducted by their Engineering Mathematics lecturer after the Linear Programming lesson. Based on the polytechnic syllabus, this topic is included in Engineering Mathematics for Mechanical Engineering students only, hence the sample is taken from a related course only. There are three main courses involved in this study which are the Diploma of Mechanical Engineering, Diploma of Mechatronic Engineering and Diploma of Mechanical Engineering (Manufacturing).

Procedure to Analyse Data

Data obtained was analysed using the WINSTEP software version 5.0.2.0. Rasch Polytomous model was used since the data for the LMLP questionnaire acquired is polytomous data which embraces five possible scales using the Likert scale. The scale consists of "1 for extremely disagree", "2 for disagree", "3 for not sure", "4 for agree" and "5 for strongly agree". Sumintono and Widhiarso (2015) stated that there are three suitable index criteria to prove the reliability of the instrument for the Rasch Model, which is Cronbach's Alpha value, person and item reliability value and separation value for both person and item. The criteria are shown in Table 2 below.

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Table 2: Reliability in Rasch Analysis.

Statistics	Fit Indices	Interpretation
Cronbach's alpha (KR-20)	< 0.5	Low
	0.5-0.6	Moderate
	0.6-0.7	Good
	0.7-0.8	High
	>0.8	Very High
Item and Person Reliability	<0.67	Low
	0.67-0.80	Sufficient
	0.81-0.90	Good
	0.91-0.94	Very Good
	>0.94	Excellent
Item and Person Separation	> 3	A high separation value indicates that the instruments have a good quality since they can identify the group of items and respondents.

Source: Sumintono and Widhiarso (2015)

In the meantime, the validity of the instrument using the Rasch measurement model can be evaluated based on the item and person fit. Item fit will help the researcher to find out whether the item used in the instrument can measure the construct (Sumintono & Widhiarso, 2015). Olsen (2003) stated that Logit obtained from the Rasch analysis gives a hint about students' ability in answering the question based on the level of difficulty. To assess, whether the item functions well or not, there are three criteria suggested by previous researchers (Boone et al., 2014; Bond & Fox, 2015). The evaluation will be based on the value of Outfit MNSQ, Outfit ZSTD and PTMEA-CORR that can be obtained from Rasch analysis.

Each criterion gives a different meaning to each item and person involved. Based on Bond and Fox (2007), the Outfit MNSQ value will notify the researcher about the suitability of items in measuring validity. It means that this value can tell us whether the item computes well all of the constructs of the instrument. Meanwhile, Outfit ZSTD is a t-test that will inform the researcher whether the data collected suits with model prepared. For the moment, the value from PTMEA-CORR gives information about the extent to which the development of the construct has achieved its goal. The positive value of PTMEA-CORR shows that the constructed item measures what it has to measure, otherwise the negative value shows the item did not achieve its objective (Table 3).

Table 3: Suitability of Item Index

Statistics	Fit Indices
Outfit Mean Square Values (MNSQ)	0.5 – 1.5
Outfit Z-Standardized Values (ZSTD)	-2.0 - +2.0
Point Measure Correlation (PTMEA-CORR)	0.4 – 0.85

Source: Boone et al. (2014)

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Rasch analysis also gives the researcher information about the suitability of the person or respondent. Rasch model can identify the suitability of the respondent whenever the data shows an unusual pattern (Boone, 2016). For example, the pattern exhibits either sloppy responses by students or there is a counterfeit occurring between students. The removal of a misfit person will help to increase the reliability of the instrument (Khamis & Yahya, 2015). Person fit evaluation can be detected by looking at the value of 'MEASURE', Outfit MNSQ and Outfit ZSTD (Edwards & Alcock, 2010; Nevin et al., 2015). The value of Outfit ZSTD that is greater than 2.0 with a high value of MEASURE will give hint to the researcher that there is the possibility that students have a high ability to answer 'easy' questions wrongly (Nevin et al., 2015). Meanwhile, if the value of Outfit ZSTD that is greater than 2.0 added with a low value of MEASURE shows that students have a low ability to answer 'difficult' questions correctly yet cannot answer well another item in the instrument.

Besides the suitability of the item and person, the researcher needs to evaluate the unidimensionality of the instrument to make sure the instrument measures what should be measured (Sumintono & Widhiarso, 2015). In this case, the item should be suitable, reliable and valid to measure the level of learning motivation for Linear Programming. For Rasch analysis, to know the unidimensionality of the instrument can be obtained from Principal Component Analysis (PCA). The unidimensionality criteria suggested by Sumintono and Widhiarso (2015) are based on 'raw variance explained by measure' in PCA. If the value of 'raw variance explained by measure' is 20 per cent and above, it still can be accepted based on Reckase (1979). It is better if the value is higher than 40 per cent (Linacre, 2012). Meanwhile, the ideal value for 'unexplained variance' for 1st to 5th contrast should be less than 15 per cent.

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Result

Reliability of the LMLP Questionnaire

Person and Item Reliability

SUMMARY OF 56 MEASURED (EXTREME AND NON-EXTREME) Person

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	121.3	34.0	1.43	.41				
SEM	3.1	.0	.32	.06				
P.SD	22.8	.0	2.41	.45				
S.SD	23.0	.0	2.43	.45				
MAX.	170.0	34.0	8.09	1.83				
MIN.	76.0	34.0	-1.81	.22				
REAL RMSE	.62	TRUE SD	2.33	SEPARATION	3.74	Person RELIABILITY	.93	
MODEL RMSE	.60	TRUE SD	2.33	SEPARATION	3.86	Person RELIABILITY	.94	
S.E. OF Person MEAN = .32								

Person RAW SCORE-TO-MEASURE CORRELATION = .95 (approximate due to missing data)
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .97 SEM = 3.67 (ap
STANDARDIZED (50 ITEM) RELIABILITY = .96

SUMMARY OF 34 MEASURED (NON-EXTREME) Item

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	199.7	56.0	.00	.22	.98	-.42	1.00	-.44
SEM	2.2	.0	.10	.00	.11	.44	.12	.45
P.SD	12.8	.0	.58	.01	.64	2.52	.71	2.56
S.SD	13.0	.0	.59	.01	.65	2.55	.72	2.60
MAX.	220.0	56.0	1.64	.22	3.86	9.13	4.29	9.21
MIN.	162.0	56.0	-.98	.20	.44	-3.37	.43	-3.46
REAL RMSE	.24	TRUE SD	.53	SEPARATION	2.26	Item RELIABILITY	.84	
MODEL RMSE	.22	TRUE SD	.54	SEPARATION	2.48	Item RELIABILITY	.86	
S.E. OF Item MEAN = .10								

Item RAW SCORE-TO-MEASURE CORRELATION = -1.00 (approximate due to missing data)

Figure 1: Person and Item Reliability for LMLP Questionnaire

Table 4: Value of Person and Item Reliability from Rasch Measurement Model

Statistics	Value	Interpretation
Person Reliability	0.93	Very good
Item Reliability	0.84	Good

Figure 1 and Table 4 show the value of the person and item reliability for the LMLP Questionnaire based on Rasch analysis in WINSTEPS. The value for person reliability is 0.93 meanwhile the value for item reliability is 0.84. Based on Bond and Fox (2007), the person reliability value that exceeds 0.80 shows that the responses from the respondents are very good and have an effective level of consistency. This explanation is per Sumintono and Widhiarso (2015) who stated that a value higher than 0.80 for person reliability is categorized as a good respondent. Meanwhile, for item reliability value, the value of 0.84 is categorized as an accepted value. Based on Bond and Fox (2007), a value higher than 0.80 for item reliability is in the 'good' category meanwhile a value that is less than 0.80 is less acceptable. This score interpretation is also agreed by Sumintono and Widhiarso (2015) who stated that the value in the range of 0.81 to 0.90 is still in the good category and can be accepted.

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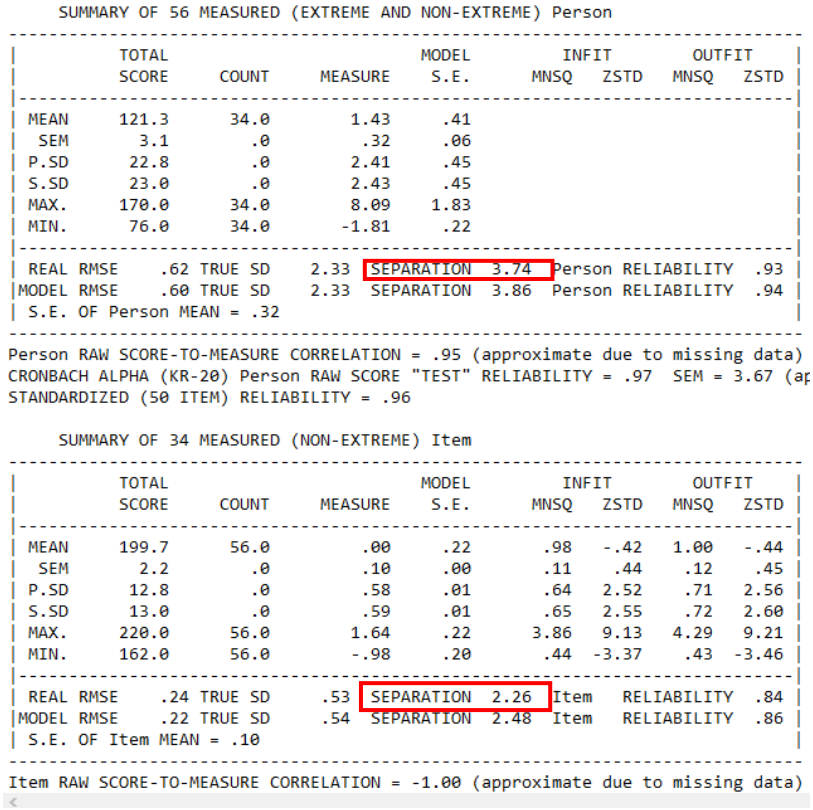
Person and Item Separation Value

Table 5: Person and Item Separation Value from Rasch Measurement Model

Statistics	Value	Interpretation
Person Separation Value	3.74	Good and acceptable
Item Separation Value	2.26	Good and acceptable



SUMMARY OF 56 MEASURED (EXTREME AND NON-EXTREME) Person

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Figure 2: Person and Item Separation Value for LMLP Questionnaire

Sumintono and Widhiarso (2015) mentioned that the higher the separation value will indicate the better quality of both item and person since it can identify the group for item and respondent. The separation values for both person and item which are 3.74 and 2.26 respectively can be interpreted as good and acceptable **(**Table 5 and Figure 2). This interpretation is based on Linacre (2003) who stated that the good separation value for item difficulty is suitable if and only if the value is higher than 2.00. Moreover, Krishan and Idris (2014) also stated that the separation value higher than 1.00 shows that the item and respondent have sufficient scattering.

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Cronbach's Alpha (KR-20)

Table 6: Cronbach's Alpha Value from Rasch Measurement Model

Statistics	Value	Interpretation
Cronbach's Alpha (KR-20)	0.97	Very High

Based on the Rasch Measurement Model, Cronbach's Alpha value for this research is 0.97 (Table 6 and Figure 3). Bond & Fox (2015) stated that if the value is in the range of 0.9 to 1.0, it specifies that the instrument is very good and has an effective level of consistency. This statement is also supported by Sumintono and Widhiarso (2015) that a value greater than 0.8 indicates that the instrument is very highly reliable. Therefore, Rasch's analysis shows that the instrument is appropriate to be used in the actual study.

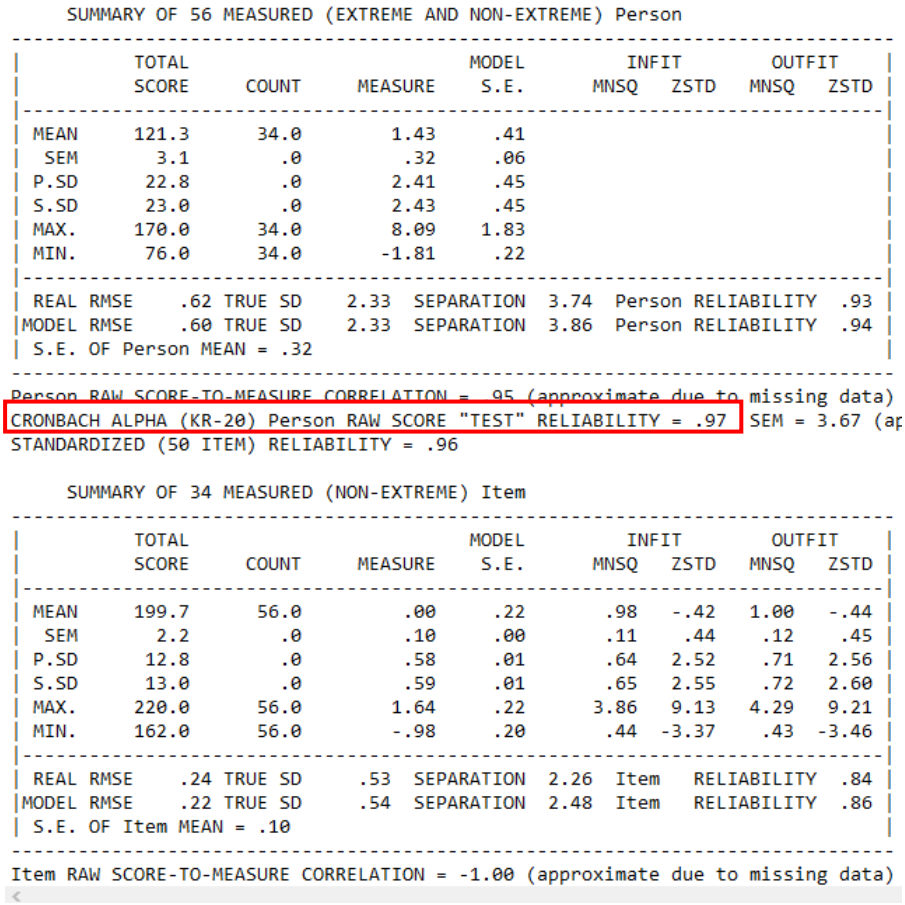

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Figure 3: Cronbach's Alpha Value for LMLP Questionnaire

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Validity of the LMLP Questionnaire

Person Fit

OUTFIT		PTMEASUR-AL		EXACT MATCH		
MNSQ	ZSTD	CORR.	EXP.	OBS%	EXP%	Person
3.25	5.25	B-.37	.41	32.4	60.5	05
2.40	3.66	F-.12	.36	47.1	61.3	07
.25	-3.65	m-.22	.38	88.2	63.0	11
.23	-3.87	k-.25	.37	91.2	63.1	36

Figure 4: Person Fit

Figure 4 shows the most unsuitable respondent for this test. Rasch analysis for the LMLP instrument shows that four students did not meet the main criteria which are the value for OUTFIT-MNSQ, OUTFIT-ZSTD and PTMEA-CORR. It can be said that their response differs from the devoted value from the Rasch Measurement Model. Students from the samples were enumerated as 05, 07, 11 and 36. Students 05 and 07 give the value of 5.25 and 3.66 respectively for OUTFIT-ZSTD, which are greater than 2.0, and give the negative value for MEASURE shows that there is the possibility that the students have a low ability to answer the difficult level of the item (Nevin et al., 2015). The values that are out of the range exhibit that the respondent might imitate or be careless while answering the questionnaire.

Item Fit

Table 7 shows the item that has not met the criteria either for OUTFIT-MNSQ, OUTFIT-ZSTD or PTMEA-CORR. However, all of the items meet at least one of the criteria means that all of the items can be accepted (Boone et al., 2014). The bold value shows the value that is out of range for the criteria suggested by Boone et al. (2014). Rasch analysis shows that the value in the highest rank is the most unsuitable item (Item 32). Therefore, this item has to be considered for change or removal from the instrument. Nevertheless, based on three criteria to identify the misfit item suggested by Boone et al. (2014), all of the items listed meet at least one of the criteria. Other items that are not listed in Table 7 meet all the three misfit identification criteria that are accepted and can be used in the actual research. Sumintono and Widhiarso (2015) stated that the item that meets one of these three criteria should be maintained. The item can be abolished if and only if the item did not meet all three criteria. Hence, all the items are retained and can be used for actual research.

Table 7: Item Fit for LMLP Questionnaire

ITEM	Outfit MNSQ (0.50-1.50)	Outfit ZSTD (-2.0-2.0)	PTMEA-CORR (0.40-0.85)
32	**4.29**	**9.21**	0.41
16	**2.18**	**4.40**	0.61
11	**1.97**	**3.76**	0.57
2	**1.63**	**2.60**	0.56
7	**1.66**	**2.73**	0.62
13	**1.62**	**2.58**	0.66

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1	**0.48**	**-3.02**	0.79
18	**0.43**	**-3.46**	0.80
28	0.61	**-2.11**	0.78
26	0.56	**-2.53**	0.75
30	0.59	**-2.29**	0.76
34	0.59	**-2.27**	0.77
5	0.58	**-2.29**	0.78
25	0.53	**-2.68**	0.77
27	0.54	**-2.55**	0.81
29	0.52	**-2.81**	0.78

Unidimensionality

Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = Item information units

	Eigenvalue	Observed		Expected
Total raw variance in observations =	60.3404	100.0%		100.0%
Raw variance explained by measures =	26.3404	43.7%		44.6%
Raw variance explained by persons =	14.0586	23.3%		23.8%
Raw Variance explained by items =	12.2818	20.4%		20.8%
Raw unexplained variance (total) =	34.0000	56.3%	100.0%	55.4%
Unexplned variance in 1st contrast =	7.4574	12.4%	21.9%	
Unexplned variance in 2nd contrast =	3.7871	6.3%	11.1%	
Unexplned variance in 3rd contrast =	3.1154	5.2%	9.2%	
Unexplned variance in 4th contrast =	2.5530	4.2%	7.5%	
Unexplned variance in 5th contrast =	2.2579	3.7%	6.6%	

Figure 5: Unidimensionality for LMLP Questionnaire

Based on figure 5 above, the 'raw variance explained by measures' value is 43.7 per cent. This value is accepted as the condition for the instrument to be accepted with the adequacy of the nature of unidimensionality is the value of 'raw variance explained by measures must exceed 20 per cent (Reckase, 1979). Although the value observed is less than the value expected by the model which is 43.7 per cent compared to 44.6 per cent, the value is still acceptable as it is greater than the minimum value suggested by Linacre (2012) which is 40 per cent. The second condition stated by Reckase (1979) in the determination of unidimensionality is that the first to 5th contrast values must be less than 15 per cent which gives the meaning that the items for the LMLP instrument are less interfere and valid in the measurement of the four constructs to measure learning motivation.

Discussion

For this research, two main points can be discussed which are the reliability and validity of the instrument. For instrument reliability, the discussion is based on Cronbach's Alpha value, person and item reliability and separation values for person and item. Overall, it can be said the LMLP Questionnaire has a high value of Cronbach's alpha (KR-20) which means that the instrument has a good and effective level of consistency. The similar findings were found in Tsai et al. (2022)'s study who applied the ARCS model in developing their questionnaire. Other than that, this instrument has a high level of person reliability and good value for item reliability based on the Rasch Measurement Model. This shows that the instrument is very reliable to measure the learning motivation for Linear Programming topics, especially for Polytechnic Kota Kinabalu students. According to Ardiyanti (2016), the number of separate

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item strata (H) can be obtained from the separation index by calculating the equation: H = [(4 x separation index) + 1] / 3. The separation value for a person was H = 5.32 which means that students can be divided into five different groups of learning motivation levels which are high, medium-high, medium, low and very low. Meanwhile, the item separation value of H = 3.34 shows that the item can be divided into three levels which are low, medium and high based on the student's responses.

The validity of the instrument is based on the fitness of the item and person. The researcher decided to sustain all the LMLP items as all the items meet at least one of the valuation criteria which are the value of Outfit MNSQ, Outfit ZSTD and PTMEA-CORR. On the other hand, the PTMEA-CORR value for all items is positive values which means that all the items are moving in one direction (Bond & Fox, 2015). Although several items give a value that is out of range for Outfit MNSQ and Outfit ZSTD, these items are still acceptable because the value of PTMEA-CORR is still in the range. For person fit, there are only four students that did not meet all the criteria. Besides that, the LMLP questionnaire also has proved that it has a strong unidimensionality value from PCA analysis. This means that the instrument measure what it has to measure, which in this case, it is the level of learning motivation towards Linear Programming.

Conclusion

In conclusion, Rasch Measurement Model shows that the LMLP questionnaire is valid and reliable to measure the level of learning motivation of tertiary students, especially polytechnic students. For further research, it is suggested to use a different sample from other tertiary institutions or other TVET institutions. Other than that, this instrument can be tested using another type of measurement model to confirm its reliability and validity.

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References

Acharya, B. R. (2017). Factors affecting difficulties in learning mathematics by mathematics learners. *International Journal of Elementary Education*, *6*(2), 8-15.

Afip, L. B. A. (2014). Motivating adult learners using blended learning in higher education institution. *Researchers World*, *5*(3),35.

Aggarwal, A., Mehra, A., & Chandra, S. (2012). Application of linear programming with I-fuzzy sets to matrix games with I-fuzzy goals. *Fuzzy Optimization and Decision Making*, *11*(4), 465-480.

Ali, A. A., & Reid, N. (2012). Understanding Mathematics: Some Key Factors. *European Journal of Educational Research*, *1*(3), 283-299.

Ardiyanti, D. (2016). Aplikasi model Rasch pada pengembangan skala efikasi diri dalam pengambilan keputusan karir siswa. *Jurnal Psikologi*, *43*(3), 248-263.

Ariani, D. (2016). Why do I study? The mediating effect of motivation and self-regulation on student performance. *Business, Management and Education*, *14*(2), 153-178.

Azahari, M. A. B. (2019). Pembangunan video bagi peningkatan penguasaan kandungan autocad isometrik bagi pelajar TVET. Penerbit Universiti Tun Hussein Onn Malaysia.

Bond, T. G., & Fox, C. M. (2007). *Applying the Rasch model: Fundamental measurement in the human sciences*. Psychology Press.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 7 Issue 47 (September 2022) PP. 364-379
DOI 10.35631/IJEPC.747031

Bond, T. G., & Fox, C. M. (2015). Applying the Rasch model: Fundamental measurement in the human sciences. https://doi. org/10.1017. *CBO9781107415324*, *4*.

Bond, T. G., & Fox, C. M. (2015). *Applying the Rasch model: Fundamental Measurement in the Human Sciences*, New Jersey: Lawrence Erlbaum 3rd Edition

Boone, W. J. (2016). Rasch analysis for instrument development: why, when, and how? *CBE—Life Sciences Education*, *15*(4). 1-7.

Boone, W. J., Staver, J. R., & Yale, M. S. (2014). *Rasch analysis in the human sciences*. Springer Science & Business Media.

Burak, S. (2014). Motivation for instrument education: A Study with the perspective of expectancy-value and flow theories. *Eurasian Journal of Educational Research, 55*, 123-136. http://dx.doi.org/10.14689/ejer.2014.55.8

Chanda, R., Pabalkar, V., & Gupta, S. (2022). A Study on application of Linear Programming on product mix for profit maximization and cost optimization. *Indian Journal of Science and Technology*, *15*(22), 1067-1074.

Chang, N. C., & Chen, H. H. (2015). A Motivational Analysis of The ARCS Model for Information Literacy Courses in A Blended Learning Environment. *Libri*, *65*(2), 129-142.

Cook, D. A., Beckman, T. J., Thomas, K. G., & Thompson, W. G. (2009). Measuring Motivational Characteristics of Courses: Applying Keller's Instructional Materials Motivation Survey To A Web-Based Course. *Academic Medicine*, *84*(11), 1505-1509.

Dantzig, G. B. (2002). Linear programming. *Operations research*, *50*(1), 42-47.

Das, S. K., & Edalatpanah, S. A. (2021). Application of Linear Programming in diet problem under Pythagorean Fuzzy Environment. In *Pythagorean Fuzzy Sets* (pp. 315-327). Springer, Singapore.

Durlak, J.A., Weissberg, R.P., Dymnicki, A.B., Taylor, R.D. and Schellinger, K.B., 2011. The impact of enhancing students' social and emotional learning: A meta-analysis of school- based universal interventions. *Child development*, *82*(1), pp.405-432.

Edwards, A., & Alcock, L. (2010). Using Rasch analysis to identify uncharacteristic responses to undergraduate assessments. *Teaching Mathematics and its Applications: An International Journal of the IMA*, *29*(4), 165-175.

Filgona, J., Sakiyo, J., Gwany, D. M., & Okoronka, A. U. (2020). Motivation in learning. *Asian Journal of Education and Social Studies*, *10*(4), 16-37.

Fisher, W. P. (2007). Rating scale instrument quality criteria. *Rasch Measurement Transactions*, *21*(1), 1095.

Fives, C., Lone, M., & Nolan, Y. M. (2022). Motivation and learning methods of anatomy: Associations with mental well-being. *Clinical Anatomy*, *35*(1), 26-39.

Foong, C. C., Liew, P. Y., & Lye, A. J. (2022). Changes in motivation and its relationship with academic performance among first-year chemical engineering students. *Education for Chemical Engineers*, *38*, 70-77.

Gopalan, V., Bakar, J. A. A., Zulkifli, A. N., Alwi, A., & Mat, R. C. (2017, October). A review of the motivation theories in learning. In *AIP Conference Proceedings* (Vol. 1891, No. 1, p. 020043). AIP Publishing LLC.

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics*, *63*(2), 165-178.

Harackiewicz, J. M., Tibbetts, Y., Canning, E., & Hyde, J. S. (2014). Harnessing values to promote motivation in education. In *Motivational interventions*. Emerald Group Publishing Limited.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 7 Issue 47 (September 2022) PP. 364-379
DOI 10.35631/IJEPC.747031

Hasan, A. A., & Baroroh, U. (2020). Pengembangan Media Pembelajaran Bahasa Arab Melalui Aplikasi Videoscribe Dalam Meningkatkan Motivasi Belajar Siswa *(LISANUNA): Jurnal Ilmu Bahasa Arab dan Pembelajarannya*, *9*(2), 140-155.

Huang, C. S., Su, A. Y., Yang, S. J., & Liou, H. H. (2017). A collaborative digital pen learning approach to improving students' learning achievement and motivation in mathematics courses. *Computers & Education*, *107*, 31-44.

Ismail, H. (2018). Peningkatan motivasi belajar matematika melalui pembelajaran berbasis masalah pada siswa kelas V SD Inpres Palupi. *Jurnal Kreatif Online*, *4*(4), 343-350.

Kok, H. H., Vejaratnam, N,. Md. Ithnan, I. H.., Mohd Zaid, S., Ismail, N., Abbas, M.S., Mohd Amin, F.A. (2022). Correlates of mathematics anxiety among business studies students: A Case of an institution of higher learning in Malaysia. *Central Asia and the Caucasus*, *23*(1), 1717-1727.

Karuniakhalida, P., Maimunah, M., & Murni, A. (2019). Development of ICT-Based Mathematical Media on Linear Program Materials to improve motivation learning students. *Journal of Educational Sciences*, *3*(2), 195-204.

Keller, J. M. (2010). Tools to support motivational design. In *Motivational design for learning and performance* (pp. 267-295). Springer, Boston.

Khamis, M. R., & Yahya, N. C. (2015). Does law enforcement influence compliance behaviour of business zakat among SMEs: An evidence via Rasch measurement model. *Global Journal Al Thaqafah*, *5*(1), 19-32.

Kloosterman, P. (2002). Beliefs about mathematics and mathematics learning in the secondary school: Measurement and implications for motivation. In *Beliefs: A hidden variable in mathematics education?* (pp. 247-269). Springer, Dordrecht.

Krishnan, S., & Idris, N. (2014). Investigating reliability and validity for the construct of inferential statistics. *International Journal of Learning, Teaching and Educational Research*, *4*(1), 51-60.

Linacre, J. M. (2003). Dimensionality: contrasts and variances help for Winsteps Rasch Measurement software. *http://www. winsteps.*

Linacre, J. M. (2012). Winsteps Rasch Tutorial 2. *Retrieved from Winsteps & Facets Rasch Software website: https://www. winsteps. com/a/winsteps-tutorial-2. pdf.*

Martin, A. J. (2003). The Student Motivation Scale: Further testing of an instrument that measures school students' motivation. *Australian journal of Education*, *47*(1), 88-106.

Mayer, R. E., (2014). Incorporating motivation into multimedia learning. *Learning and Instruction, 29*, 171-173.

Nakata, Y., Nitta, R., & Tsuda, A. (2022). Understanding motivation and classroom modes of regulation in collaborative learning: An exploratory study. *Innovation in Language Learning and Teaching*, *16*(1), 14-28.

Nevin, E., Behan, A., Duffy, G., Farrell, S., Harding, R., Howard, R., .& Bowe, B. (2015). Assessing the validity and reliability of dichotomous test results using Item Response Theory on a group of first year engineering students.

Nurja, N. A. (2022). Impak pembelajaran dalam talian terhadap kesihatan pelajar kolej komuniti. *Journal of STEM and Education, 2*(1), 49-60.

Olsen, L. W. (2003). *Essays on George Rasch and his Contributions to Statistics.* (Doctoral dissertation, Phd (Dissertation Department of Economics)-University of Copenhagen).

Pintrich, P. R., & de Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40.

International Journal of Education, Psychology and Counseling
IJEPC
EISSN : 0128-164X
Volume 7 Issue 47 (September 2022) PP. 364-379
DOI 10.35631/IJEPC.747031

Rabe, M., Bilan, Y., Widera, K., & Vasa, L. (2022). Application of the Linear Programming method in the construction of a mathematical model of Optimization Distributed Energy. *Energies*, *15*(5), 1872.

Reckase, M. D. (1979). Unifactor latent trait models applied to multifactor tests: Results and implications. *Journal of educational statistics*, *4*(3), 207-230.

Rigusti, W., & Pujiastuti, H. (2020). Analisis kemampuan pemecahan masalah ditinjau dari motivasi belajar matematika siswa. *Prima: Jurnal Pendidikan Matematika*, *4*(1), 1-10.

Sumintono, B., & Widhiarso, W. (2015). *Aplikasi pemodelan rasch pada assessment pendidikan*. Trim komunikata

Syaparuddin, S., & Elihami, E. (2020). Improving student learning motivation through the utilization of video media in education students. *Jurnal Edukasi Nonformal*, *1*(2), 228-235.

Tsai, C. Y., Shih, W. L., Hsieh, F. P., Chen, Y. A., Lin, C. L., & Wu, H. J. (2022). Using the ARCS model to improve undergraduates' perceived information security protection motivation and behavior. *Computers & Education*, *181*, 104449.

Woytek, A. (2005). Utilizing assessment to improve student motivation and success. *Essays in education*, *14*(1), 22.

Wulandari, A. E., Azhar, E., & Jusra, H. (2018). Hubungan antara motivasi belajar terhadap kemampuan pemecahan masalah matematis siswa pada kelas VII. *Prosiding SENAMKU*, *1*, 397-405.

Zahay, D., Kumar, A., & Trimble, C. (2017). Motivation and active learning to improve student performance. In *Creating Marketing Magic and Innovative Future Marketing Trends* (pp. 1259-1263). Springer, Cham.

Zainuddin, N. F. B., & Kutty, F. M. (2022). Hubungan motivasi diri dan sokongan sosial terhadap kesejahteraan psikologi pelajar universiti. *Malaysian Journal of Social Sciences and Humanities*, *7*(2), e001308-e001308.

Zhou, D., Liu, J., Wang, T., Liu, J., & Li, G. (2022). Relationships among problematic smartphone use, mathematics anxiety, learning interest, and achievement: A multiple mediation model. *Computers in Human Behavior*, *129*, 107171.