Measuring Problem Solving Ability of Myanmar Student Teachers: A Study Based on Optimal Test Development

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Abstract

The main aim of this study was to measure the problem solving abilities of Myanmar student teachers through the optimal test development. The samples were 1626 student teachers from three universities of education. Descriptive research design and survey method were chiefly used. To achieve the main goal, a problem solving ability test was firstly developed by using Classical Test Theory (CTT). It included three subtests and total 15 items. Based on the test, findings revealed that the student teachers had higher problem solving ability and they are highest in logical problem solving ability. The result showed that male student teachers have higher problem solving ability than females ($p<0.001$). It was found that among the three universities, University 3 was lowest in problem solving ability. This study hopes to be a support for upgrading teacher education in Myanmar.

Keywords: Problem solving, classical test theory, optimal test.

Introduction

In this modern technological era, communications are sophisticated, and people have a variety of information to stimulate and inform their thinking. However, it is not just right information that is distributed in society. False and misleading information is also spread out to people too. People have to be able to analyze, discriminate and make good decisions on the basis of sound reasons. Education therefore has a crucial role to play in developing that ability.

Therefore, the teachers' tasks are getting more and more complex because of the technically, economically, socially, and politically changing world. Teachers have to face with increasing challenges. Nearly every class has students facing integration problems, students who are under-motivated, aggressive or have other behavioural problem or students who have learning problems. For this reason, it is important that student teachers who will take responsibility for national education should have the problem solving ability about the issues.

Cognitive ability is a principal characteristic which can distinguish human beings from other species including the higher animals is. It includes thinking, reasoning, problem solving and other aspects based on human brain functions. The challenges and problems faced by the individual, or by society, in general, are solved through serious efforts involving thinking. The powers of thinking and problem solving skills may thus be considered to be the essential tools for the welfare and meaningful existence of the individual as well as society (Khin Zaw, 1994) [1].

As indicated above it can be argued that problem solving ability has become more important for teachers and student teachers in this present age. Accordingly, these facts come to be the reasons for the researcher to investigate the problem solving abilities of Myanmar student teachers by developing an optimal test.

Aim of the Study

The main aim of this study is to measure the problem solving ability of student teachers from Universities of Education in Myanmar by developing an optimal test. The specific objectives are to develop a problem solving ability test by using Classical Test Theory (CTT), to examine the problem solving ability of student teachers, to compare the student teachers' problem solving abilities by gender and to compare the student teachers' problem solving abilities by university.

Review of Related Literature

To reveal the student teachers' problem solving abilities in this research, MacLellan, Langley and Walker's (2012) generative theory of problem solving is based [2]. This theory is due originally to Newell, Shaw, and Simon's (1958) standard theory [3].

This new generative theory of problem solving adopts all of these norms, however it also exchanges to integrate new hypothesizes. These include as follows.

The primary mental structure in problem solving is the problem, which includes a state description and a goal description. A problem solution consists of a problem P; an applied intention or operator instance I; a right sub-problem, which is a sub-problem that has the same goals as P, but has a state that results from the application of I to P; a down sub-problem, which is a sub-problem that shares P's state but has

preconditions corresponding to I's preconditions; and the solution to P's sub-problems. In the terminal case, a problem solution can also be a problem P that is marked as done. Problems and their (attempted) solutions reside in a working memory that changes over the course of problem solving, whereas operators and strategic knowledge reside in a long-term memory that changes gradually if at all.

The problem-solving process operates in cycles that involve five stages: problem selection, termination checking, intention generation, failure checking, and intention application. Each stage involves changes to the problem structures in working memory. Alternative problem-solving strategies result from variations on these five processing stages, with their settings being entirely independent of each other.

As a result, problem solvers should consider each stage and its possible settings in more detail.

Methodology

Sampling

The samples of this study were 1626 student teachers from first year to fifth year: male (n=746) and female (n=880). The participants for the study were chosen from Universities of Education in Myanmar. A stratified random sampling technique was used.

Research Method

Descriptive research design and survey method were mainly used in this study. Classical test development procedure was followed for optimal test development.

Pilot Testing on Problem Solving Ability Test

There were three subtests in problem solving ability test. They are logical puzzles, mathematical puzzles and classroom problems. Each subtest has 5 items. All items were open-ended types and the response for each item will be scored from 0 to 4. The test was administered to a sample of 220 student teachers (from first year to fifth year) in Sagaing University of Education. According to data analysis of non-speediness of the test, it could be confirmed that all tasks of the tests in current study were non-speeded. After carrying out the item analysis procedure based on Classical Test Theory (CTT) for essay tests, all items were selected to be reused in the field testing.

Data Analysis and Findings

Developing the Problem Solving Ability Test

Confirmatory Factor Analysis for Problem Solving Ability Test

Confirmatory factor analysis was used to establish the three factors structure of the problem solving ability test: logical puzzles, mathematical puzzles and classroom problems. In this study, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.725 and so it was above the recommended value of 0.7 that is indicating sufficient items for each factor. Then,

Table 1. Factor loading for the rotated factors of problem solving ability test

Factors	Items	Factor Loading 1	2	3	Communality
Logical Puzzles	Item 1	.724			.561
	Item 2	.511			.266
	Item 3	.334			.221
	Item 6	.307			.226
	Item 7	.257			.243
Mathematical Puzzles	Item 9		.511		.275
	Item 14		.319		.231
	Item 11		.279		.225
	Item 8		.212		.296
	Item 12		.209		.283
Classroom Problems	Item 13			.454	.210
	Item 5			.416	.287
	Item 4			.388	.253
	Item 10			.311	.227
	Item 15			.224	.261
Eigenvalues		2.23	1.81	1.53	
% of variance		8.18	5.39	3.54	

According to Table 1, it was verified that the items related to logical puzzles were grouped into factor 1 and so the first 5 item-group was named as logical puzzles. In the second factor, the items related to mathematical puzzle were grouped and so this 5 item-group was named as mathematical puzzles. In the third factor, the items related to classroom problem items were clustered and so this 5 item-group was named as classroom problems.

Checking for Non-speediness of the Test

After the preliminary testing, the non-speediness of the test was investigated by the non-speeded (power) test method (Gulliksen, 1950) [4]. According to results, the variance ratio

Table 2. Item analysis result for the problem solving ability test

	Items	Difficulty Index (P)	Discrimination Index (D)
Logical Puzzles	Item 1	0.592	0.372
	Item 2	0.475	0.371
	Item 3	0.594	0.322
	Item 6	0.428	0.342
	Item 7	0.4088	0.332
Mathematical Puzzles	Item 9	0.594	0.354
	Item 14	0.433	0.361
	Item 11	0.577	0.354
	Item 8	0.415	0.308
	Item 12	0.405	0.302
Classroom Problems	Item 13	0.517	0.365
	Item 5	0.495	0.337
	Item 4	0.504	0.328
	Item 10	0.431	0.347
	Item 15	0.421	0.312

According to Table 2, the difficulty indices of all items were between 40% and 60% and their discrimination indices were also above the typical value (0.3). Therefore, these all items were selected as good items. According to the result, the reliability of the test was 0.78. Therefore, the current problem solving ability test has high reliability. The format and content specification of the optimal problem solving ability test are as follows:

Table 3. Content specifications of problem solving ability test

No.	Names of Tasks	Amount of Items	Time Limit (minute)	Marks
1.	Logical Puzzles	5	15	20
2.	Mathematical Puzzles	5	15	20
3.	Classroom Problems	5	10	20
	Total	15	40	60

Data Analysis and Findings for Problem Solving Ability

To explore the problem solving ability of student teachers, descriptive statistics, mean comparisons by gender and mean comparisons by university were executed.

Descriptive Statistics for Student Teachers' Problem Solving Ability

Table 4 showed that student teachers' logical problem solving ability was the highest ability among three abilities ($\bar{X}$=11.16). Besides, the sample mean score of the total problem solving ability (30.4) is above the theoretical mean score (30). Therefore, it can be concluded that they have better ability to solve several problems they faced.

Table 4. Descriptive statistics for student teachers' problem solving ability

Problem Solving Ability	Mean	Std. Deviation
Logical Problems	11.16	5.07
Mathematical Problems	9.27	4.49
Classroom Problems	9.97	3.92
Total	30.4	9.68

Comparisons of Student Teachers' Problem Solving Ability by Gender

According to Table 5, it was found that there were statistically significant differences in problem solving abilities by gender. Specifically, all the scores on logical mathematical and total problem solving abilities were significantly higher in favour of male student teachers. However, females' classroom problem solving ability was higher than males (p< .001).

Table 5. Independent samples *t* test results of problem solving ability by gender

	Gender	Mean	Mean Difference	*t*	*df*	*p*
Logical	Male	9.95	2.06**	8.32	1624	.000
	Female	7.89				
Mathe-matical	Male	7.65	0.60*	2.68	1624	.007
	Female	7.05				
Class-room Problem	Male	7.39	-0.93**	-4.80	1624	.000
	Female	8.32				
Total Problem Solving Ability	Male	24.98	1.72**	3.59	1624	.000
	Female	23.26				

Note. ** p< 0.001, * p< .01.

Comparison of Student Teachers' Problem Solving Ability by University

According to Table 6, ANOVA result showed that there were significant differences in reasoning skills among universities (p< .001). To obtain more detailed information, Post-Hoc test was executed by Tukey HSD method.

Table 6. ANOVA result of problem solving ability by university

	Sum of Squares	*df*	Mean Square	*F*	*p*
Between Groups	33259.147	2	16629.574	226.635	.000
Within Groups	119089.300	1623	73.376		
Total	152348.448	1625			

According to Table 7, it became obvious that the problem solving ability of the student teachers in University 1 and University 2 were significantly higher than that of University 3 (p< .001).

Table 7. Post-hoc test result of student teachers' problem solving ability across university by Tukey HSD method

(I) University	(J) University	Mean Difference (I-J)	Std. Error	*p*
University 1	University 2	-.397	.530	.734
	University 3	9.228*	.517	.000
University 2	University 1	.397	.530	.734
	University 3	9.626*	.516	.000

Note. * p< 0.001.

As indicated by the results, student teachers from university 3 were lowest in problem solving ability among three universities. This may be due to the entrance system of respective university. The entrance system of university 3 is different from others. Selection of the candidates of university 3 is based on the ethnic groups in border areas while that of university 1 and 2 focus on the matriculation examination marks. Moreover, student teachers from university 3 may be difficult in communication because of their different languages. Therefore, it can be assumed that these factors become barriers to solve problems well and successfully in their current situations.

Conclusion and Discussion

The tasks of teachers in the 21st century are not as straight forward as in the 20th century. They need to solve many problems and challenges reasonably inside and outside the classroom.

The foremost responsibility would be the universities. After the students have selected to attend the respective university, they will study about specific knowledge which is expected to use for working in the future. Normally the Universities of Education teaches them academic and teacher education knowledge because this is their main duty. In the meantime, the challenges of the modern era would like the graduated students to have some other skills to work such as problem solving ability.

Future professionals are no longer to satisfy with their own expertise only, however they need to constantly study, learn, review, analyze, and classify the thinking ability to fit the needs of society in the future world. For that reason, the Universities of Education should consider their teaching techniques on how to improve the students' working skills. They should also consider whether the assessment methods reflect sufficiently an emphasis on problem solving ability. Then only, the student teachers would have confidence to face many inside and outside the classroom problems when they become teachers.

In order to fulfill the goal of teacher education programs and improve students' problem solving ability, this study finally offers the following recommendations based on research findings and literature reviews.

Firstly, the instructional goals may need to be reviewed to improve the necessary skills for functioning after graduation. Moreover, teaching methods need to be revised to increase the problem solving ability. The teaching-learning environment should also provide more chances for student teachers to argue and provide thoughts for instructors.

Consequently, teacher educators should discuss and guide occasionally their trainees about how to solve classroom problems and how to reason methodically a problem. Furthermore, to assess sufficiently the students' problem solving abilities, the teachers should change the traditional classroom assessments to usable alternative methods.

To sum up, since education is to prepare citizens with virtuous problem solving ability, it is hoped that the contributions of this study can not only provide insight to know about problem solving ability but also be a support for upgrading teacher education in Myanmar.

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