Jour. Myan. Acad. Arts & Sc. 2009 **Vol. VII. No. 8**

A Diagnostic Assessment Model for Mathematics in Upper Secondary Level

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Abstract

It is the purpose of this study to develop a Model describing and explaining the nature of the Diagnostic Assessment Process for Mathematics in First Year Upper Secondary level. Multiple sources of data were collected through questionnaires; classroom observations; clinical, structured, and informal interviews; and case studies. After investigating the nature and purpose of the assessment activities and the use of assessment information in current mathematics classrooms, a model of diagnostic assessment for mathematics in first year upper secondary level was developed from a consideration of the data collected during the above investigation. The proposed model includes four phases: identification, diagnosis procedure, remediation and evaluation. For each phase of the diagnostic assessment process, the model explains strategies and instruments needed to use in practice. The feedback loops provide the needed information which feeds back to each phase. The proposed model was applied in practical situation (remedial class, remedial group, and individualized remediation) and validated as diagnostic test, observation checklists, interview schedule, and opinionnaire. The data analysis involved four main stages:(a) statistical analysis using SPSS version 13.0 for quantitative data;(b) development of summary case studies;(c) formal analyses based on coding systems using ratings or frequency counts; and (d) informal analyses based on the researcher's intuitive reasoning from a thorough reading of data. Five factors of variables had been identified as influencing mathematics learning of students: parents, teacher, student, peer and feedback. The cognitive, motivational, and affective factors also affected to influence students' learning of mathematics. This model is useful not only for Mathematics assessment but also for other subjects such as English, Physics and so on. It would enable the teachers to improve their pedagogical skills, especially assessment skills. And it is very sure that this study provides positive contribution to the field of educational assessment.

Introduction

There are many specific tasks that teachers must deal with and imply decisions to be made and actions to be taken. These tasks tend to fall into four major categories: assessment procedures and evaluation, instructional objectives, instructional procedures and managerial procedures. Teachers need to find out what their students already know, what they can do, and how they feel. Teachers want to help their students by planning their teaching so they will be able to relate what they are learning to what they already know. If students are learning with understanding what teachers have set as the objectives, teachers can plan different types of activities in which the learned concept is related to other ideas, reinforced, and applied in varied settings.

In order to get the necessary information about each student, the teachers need to select or create procedures for assessing. The relationship between learning and assessment is strong and robust. In addition to gathering information and making decisions about learning progress, assessment increases learning and motivation. It is evident that assessment is a critical component of education. Hence, it is incumbent upon educators to utilize assessment in an effective manner, keeping in mind the purpose of and principles behind it. Effective instructional assessment is classroom-based, educational and self-administered, and empowers learners and teachers (Gong, Brain, Venezky & Mioduser, 1992). In particular, it is especially crucial that they investigate and utilize diagnostic assessment, which is underused- yet effectual - component of the educational process. The purpose of diagnostic assessment is to ascertain each student's strengths, weaknesses, knowledge and skills (Child, 1993). Establishing these permits the instructor to remedy students.

Diagnosis and remediation of learning difficulties involves determining the nature of the difficulties, the factors causing it, and applying remedial procedures (McNell & Wiles, 1990). To get the necessary information about the students, the teachers need to select or create procedures for assessing and a thorough assessment will even suggest what kind of instruction is most likely to be effective (Ashlock, Johnson, Wilson & Jones,

1983). Among the procedures, teacher-made diagnostic instruments may be more effective in identifying deficiencies (Gay, 1985). Because in constructing their own tests, teachers can match what is tested with what is taught, design the test format, determine how to administer and score the test. Many of the criticisms of teacher-made tests can be overcome by properly designing.

Purpose of the Study

It is the purpose of this study to develop a **Model** describing and explaining the nature of the **Diagnostic Assessment** Process for Mathematics in First Year Upper Secondary Level.

Scope of the Study

Subjects of the study are grade ten Mathematics teachers and grade ten students from twelve selected Basic Education High Schools of Yangon City Development Area.

Definition of the Terms

Diagnostic assessment. Diagnostic assessment is an evaluation of a learner's skills, strengths and weaknesses (ERIC, 2002).

First year upper secondary level. First year upper secondary level is grade 10 in Myanmar.

Methodology

This part is framed around the research instrumentation, procedure, sample, and analysis of data. The study involved a small number of students and teachers. Descriptive, quantitative and qualitative research methods were used. Multiple sources of data were collected through questionnaires and case studies.

Questionnaire for teachers includes personal information, perception on the assessment activities and the use of assessment information in current

Mathematics classrooms, and attitudes and ratings on the bright and slov students. It includes 35 items (78 points).

In student questionnaires, a comprehensive history include background information on health, about his/her school, attitudes toward Mathematics, present living arrangements, family, number of school transfers attendance patterns, achievement data for understanding the context of th students' present difficulties, including factors that may be contributing to th problem. Student questionnaires designed as a self-report assessed students goals and learning strategies. In it there were 35 items and asking 63 points

Before making the case studies, the researcher wrote down the outlin for making a case study. It includes ten parts; identification of pupil (name address, age, sex, school, grade), statement of the problem (an account of wh the pupil is being studied, what appears to be his or her trouble, is he or she deficient in Mathematics, or what?), diagnostic test data, interview with th pupil, the pupil's physical condition, social and emotional adjustment educational record, home condition, diagnosis of the case an recommendation. In this research the form of case study was clinical study.

A survey study was conducted in 2004-2005 academic year with grad ten Mathematics teachers and grade ten students from selected basic educatio high schools in Yangon. The pilot testing was in January, 2005. For pilo study, two basic education high schools were selected. Ten grade te Mathematics teachers and forty grade ten students were samples. From th interpretation the first trial run the researcher improved the weaknesses o wording, length and kinds of questions because they could result in inaccurat or incomplete responses. After improving the questionnaires the packages o questionnaires were sent to selected schools in February, 2005.

Case studies were done to explore the other factors causing the difficulties for selected students who need remedial instruction. Five sample students (3 males and 2 females) were studied during the 2005-2006 academic year. The researcher met each sample two or three days per week along the case studies. The researcher emphasized to record information of each sample, according to the outline for making a case study. It is both practically and

theoretically important that the teachers develop a comprehensive understanding of how various cognitive, motivational, and affective factors interact when students decide why, how and how hard to work on their learning. The researcher attempted to address these questions empirically and in ecologically valid context.

In the case studies the researcher gathered data derived from the four methods; long-term participant observation, diagnostic testing, home visit and focused interview. In open ended focused interview, the researcher was interested in learning about predetermined outlines for case study. No uniform set of questions was prepared, but the interviewer (the researcher) did try to limit the interview to certain predetermined outlines. The questions in the focused interview and the way the questions were phrased ordered and varied among the interviewees.

For first step of study, survey with questionnaires, teachers who teach Mathematics in first year upper secondary level (grade ten) and grade ten students who need Mathematics remediation were identified as population. The researcher used cluster sampling. From Yangon City Development Area twelve Basic Education High Schools were selected randomly. From these selected schools, all grade ten Mathematics teachers and all grade ten students who needed Mathematics remedial instruction (identified by the class teachers) were selected as participants. The number of respondents was 221 students and 53 teachers. Among them 115 students were males and 106 were females. Out of teacher samples 8 teachers were males, 45 were females.

For case studies five students (3 males and 2 females) were chosen by using purposive sampling method.

Finding

To examine various aspects of classroom Mathematics learning and assessment and various factors causing difficulties of Mathematics learning, data were collected using questionnaires for teachers, questionnaires for students and case studies.

The data analysis involved four main stages:

(a) statistical analysis using SPSS version 13.0 for quantitative data;
(b) development of summary case studies;
(c) formal analyses based on coding systems using ratings or frequency counts; and
(d) informal analyses based on the researcher's intuitive reasoning from a thorough reading of data.

Table (1) The teachers' suggestions for the students who always get low score

NO	Responses	Respondents
1	Remedial teaching should be given.	15
2	Sound basic skills should be mastery.	8
3	Teachers should be cooperated with parents.	14
4	Students should be interested in teachers' presentation.	4
5	Students have to practice themselves.	3

Above suggestions indicate about differences in teachers' attitudes and experiences that produce remarkable differences in students' learning. All of suggestions are necessary for effective learning, and show that teachers, students and parents are responsible and important to consider for getting low score.

Table (2)shows the ratings of the respondent teachers on the outstanding or bright students. The rating scales were classified in 5 stages such as inferior, poor, average, excellent and superior and calculated with 1,2,3,4,5 marks. This table is ranking the means of each variable.

Table (2) Teachers' ratings for bright learners ranked by mean value of rating scales

No	Variables concern with bright learners	Mean	Ranking
1	Attendance pattern	4.11	1
2	High ambition	4.09	2
3	Health condition	4.00	3
4	Interest in Mathematics	3.91	4

No	Variables concern with bright learners	Mean	Ranking
5	Parental support	3.90	5
6	Obedience	3.89	6
7	Drill him or herself	3.81	7
8	Teacher presentation	3.79	8
9	Test scores in other subjects	3.79	9
10	High intelligence	3.77	10
11	Self-confidence	3.75	11
12	Mastery of basic Mathematics skills	3.72	12
13	Teachers encouragement	3.70	13
14	The teacher gives more attention than other students	3.57	14
15	Reaction to teachers' instruction	3.55	15
16	Instructional time	3.45	16
17	High level of parents' education	3.44	17
18	Mastery of basic English skills	3.20	18
19	Parent-teacher discussion	3.17	19
20	Complexity of teaching material	2.13	20

The ratings of the teachers on the slow learners are shown clearly by ranking in table (3).

Table (3) Teachers' ratings for slow learners ranked by mean value of rating scales

No	Variables concerning with slow learners	Means	Ranking
1	The teacher gives more attention than other students	3.47	1
2	Complexity of teaching material	3.35	2
3	Parent-teacher discussion	3.08	3
4	Teachers encouragement	3.00	4
5	Health condition	2.92	5
6	Instructional time	2.90	6
7	Attendance pattern	2.57	7
8	Teacher presentation	2.48	8
9	Obedience	2.13	9
10	High ambition	2.12	10
11	High level of parents' education	2.09	11
12	Test scores in other subjects	2.02	12
13	High intelligence	2.00	13
14	Self-confidence	1.91	14
15	Drill him or herself	1.85	15
16	Reaction to teachers' instruction	1.81	16
17	Interest in Mathematics	1.79	17
18	Mastery of basic English skills	1.75	18
19	Parental support	1.70	19
20	Mastery of basic Mathematics skills	1.60	20

As comparison of table 4.2 and 4.3, bright learners had better school attendance pattern than slow learners. The bright learners showed high ambition, good health condition and obedience to teachers. They were interested in Mathematics, and made drill themselves. They got more than enough parental support, teachers' encouragement and teachers' attention. They exhibited having high intelligence, self-confidence, mastery of basic Mathematics and English language skills, low complexity of teaching

materials, and getting high test score in other subjects. Their parents' education levels were also high and there were parent-teacher discussions. In instructional time, the bright learners reacted to teachers' instruction. The teachers remarked their presentations were effective in teaching the bright learners.

In the other hand, the slow learners were below the average mastery of basic Mathematics and English language skills. They got low test scores in other school subjects, and less than enough parental support. They made a few drill themselves and reaction to teachers' presentation.

Table (4) shows the effect of present living arrangement (guardianship) in the learning of Mathematics. As a result, it was found that the students in this study, who lived with their fathers, only got low score in Mathematics.

Table (4) The effect of guardianship on the average marks in Mathematics

Guardianship	N	Mean	Std. Deviation
parents	128	39.4258	9.96758
Father	3	21.8333	7.91036
mother	15	38.4833	8.50655
guardian	29	41.5862	6.95530
Total	175	39.4014	9.64532

Table (5) The analysis of variance of language difficulties on the average marks in Mathematics

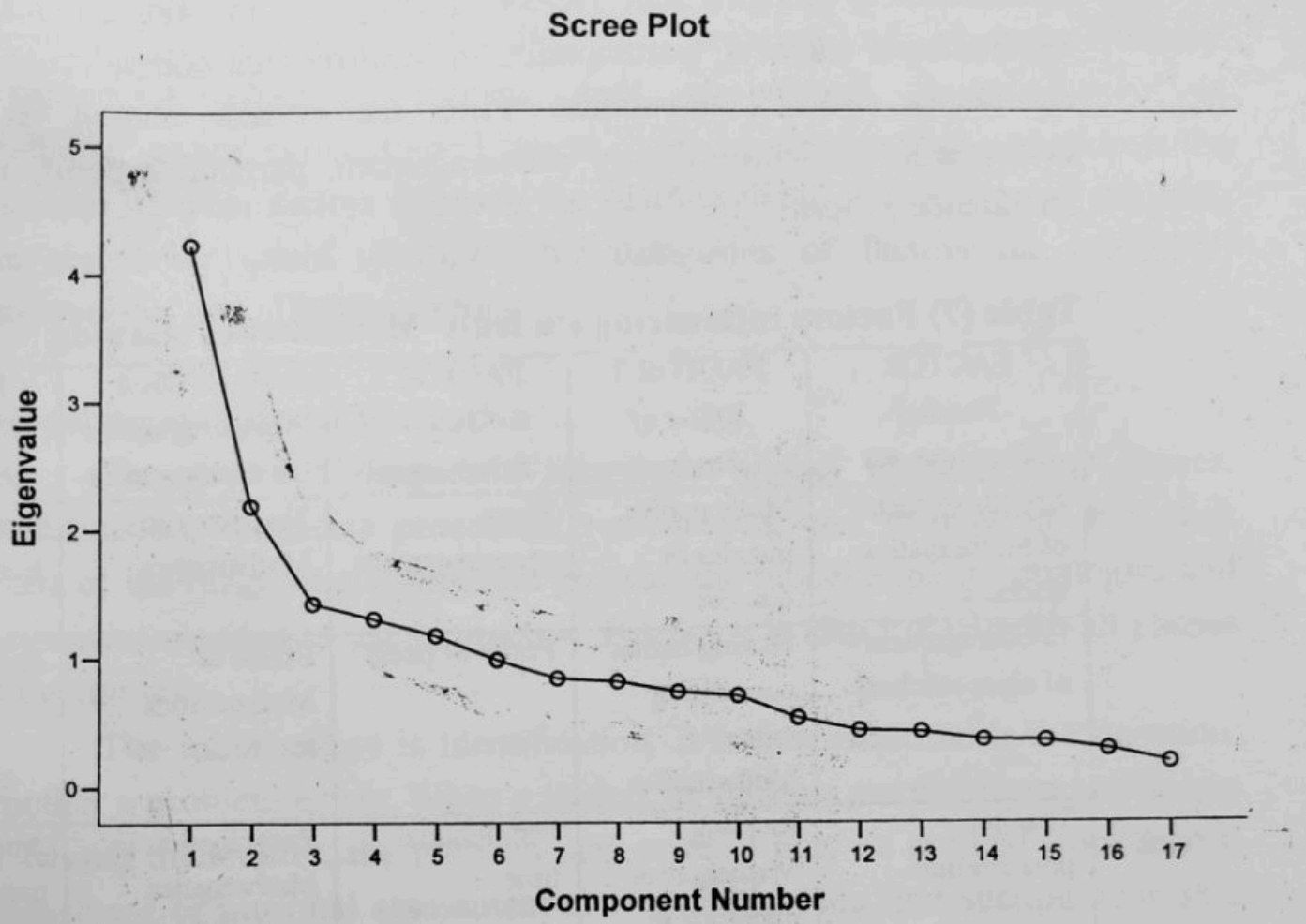
Source of variance	Sum of squares	Mean Square	df	F	Sig
Between groups	7.210	.089	81	1.716	.006
Within Groups	4.824	.052	93		
Total	12.034		174		

As shown in table (5), the research data revealed that there were significant differences among selected students who had language difficulties in Mathematics learning and who did not have.

It could be stated from the tabulated data in table (6) that students wanted teachers' interesting explanation and presentation in their Mathematics learning. They knew that they should make drill themselves but they wanted the encouragement of parents, teachers and the significant persons to do so. They realized the importance of help and support from parents and teachers and the importance of mastery of basic Mathematics skills.

Table (6) Students' suggestions how to help them to improve their Mathematics learning

NO	Responses	respondents
1	Teachers should make interesting explanation and presentation.	97
2	Students should be encouraged to make drill.	70
3	Students need help and support from parents and teachers.	30
4	Basic Mathematics skills should be revised.	24



According to the specifying the Factor Rotation Matrix with Kaiser Normalization from student questionnaires five factors were obtained as table 4.11. Factor-loadings are those values which explain how closely the variables are related to each one of the factors discovered. It is the absolute size (rather than the signs, plus or minus) of the loading that is important in the interpretation.

First factor contains three variables of encouragement of Mathematics teachers, encouragement of class teachers, and teacher presentation and was named as ***teacher involvement***. Second factor was labeled as ***effect of student*** because it contains four variables such as Mathematics puzzles or quizzes, having habits concerning with Mathematics, reading Mathematics materials in magazines and journals, and interest in Mathematics. Third factor, ***peer involvement,*** combines with three variables as peers encouragement, praise of peers, and instructional time (with peers). Fourth factor, ***encouragement in***

Mathematics, includes four factors as test score in Mathematics, praise of Mathematics teachers, participation in Mathematics competitions, and self-confidence with Mathematics. Fifth factor was named as ***parental involvement*** including family encouragement, parental support, and school attendance pattern.

Table (7) Factors influencing students' Mathematics learning

FACTOR *Teacher Involvement*	FACTOR 2 *Effect of Student*	FACTOR 3 *Peer Involvement*	FACTOR 4 *Encouragement in Mathematics*	FACTOR 5 *Parental Involvement*
Encouragement of Mathematics teachers	Mathematics puzzles or quizzes	Peers encouragement	Test score in Mathematics	Family Encouragement
Encouragement of class teachers	Having habits concerning with Mathematics	Praise of peers	Praise of Mathematics teachers	Parental support
Teacher presentation	Reading Mathematics materials in magazines and journals	Instructional time	Participation in Mathematics competitions	Attendance pattern
	Interest in Mathematics		self-confidence with Mathematics	

Conclusion, Discussion, and Recommendation

This research aimed to achieve the said purpose, to develop a diagnostic assessment model for Mathematics in First Year Upper Secondary Level. With this end in view the research was conducted using descriptive, quantitative and qualitative methods. To find out factors influencing Mathematics learning, to get necessary information for developing the model, and to validate the proposed model, multiple sources of data were collected through survey questionnaires, case studies, classroom observation, clinical informal interview and testing.

From survey questionnaires five factors of variables have been identified as influencing Mathematics learning of students: teacher involvement, effect of student, peer involvement, encouragement in Mathematics and parental involvement. From qualitative study, to address the question of what factors improve the Mathematical competence of students, the researcher could identify three categories of factors the cognitive, motivational and affective factors.

Modeling and Model Validation

The proposed diagnostic assessment model includes four phases: identification, diagnosis procedure, remediation, and evaluation. For each phase of the diagnostic assessment process, the model explains strategies and instruments needed to use in practice. Feedback is also linked with all phases of the model.

The initial phase is identification. It is concerned with the question: whether a problem exists. When a student or students are displaying problems or having difficulties, the problem may arise. It may be noticed from formal assessment or informal assessment or from both. This first section addresses identifying or selecting students who need remediation.

Second phase indicates an investigation and identification of the cause or nature of the problem. The teachers can select or create and apply assessing instruments such as diagnostic tests, observation, interview, and case study. When the teachers can target the specific academic weaknesses of their students they can make personal plans for effective remediation.

After diagnosis procedure third phase, remediation comes. Based on the diagnostic assessment results, each student who has a deficit is given required remediation. Effective remediation depends on how well the teacher plans. Remediation may be made or can be made as a remedial class, or group remediation or individualized remediation. At least, even individual attention increases the student's achievement of Mathematics learning.

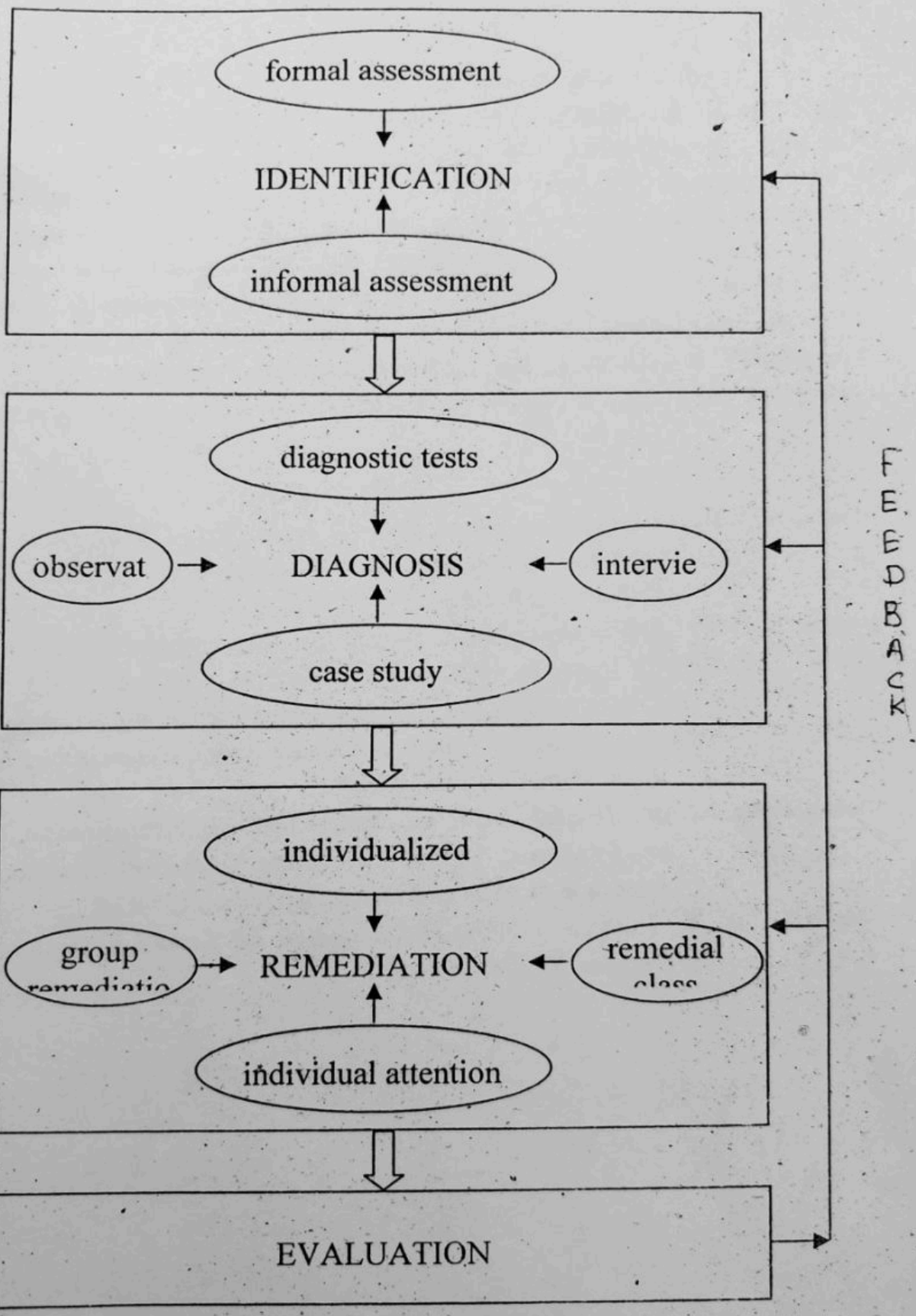
Fourth phase, evaluation is essential for determining effectiveness of any remedial instruction. Through evaluation it can determine the extent to

which objectives are attained, and the effectiveness of learning experiences providing in the remediation. Last feature, feedback is also linked with all phases of the model. The learners, teachers, parents and all participants will be provided with their progress. It is tended to that classroom teachers can apply this model. Teacher-made instruments are emphasized.

In model validation, the researcher identified students who need remediation, using inference of their parents, teachers, and family members. For diagnosis procedure, diagnostic tests, observation, interview, documentary analysis, case studies were used. To make remediation, remedial class, remedial group, and individualized remediation were applied. In this study, it was found that individualized remediation was the most effective approach.

The opinions on the proposed diagnostic assessment model were acquired from the fifty experienced teacher educators (professors, associate professors, lecturers, assistant lecturers and tutors) of Sagaing Institute of Education and Yangon Institute of Education.

The diagnostic assessment model developed in this study, could address the so many questions for learning difficulties. Using it the classroom teachers would become to know what topics are causing the most difficulty for the student, which materials seem to help and which inhibit, whether or not the teachers modify assessment procedures, what conditions effect the learning process, how the classroom environment influences the achievement of students' learning, how the school climate and structure affect the students' desire to participate in the learning activities, and so on. Therefore, the Diagnostic Assessment Model for Mathematics in First Year Upper Secondary Level developed in this dissertation would enable the classroom teachers to improve their pedagogical skills, especially assessment skill.



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Acknowledgements

I would like to express my heartfelt gratitude to Dr. Myo Tint, the academic supervisor for his expert guidance, valuable and timely advice to complete this study, great support, encouragement and invaluable kindness through out the study. Special acknowledgement also goes to Dr. Aye Aye Myint for her expert guidance to establish framework for the study and encouragement during this study. I owe a great debt to Dr. Soe Win for his great help and valuable suggestions in the quantitative data analysis of this study. I would like to express my appreciation to the teacher educators of Yangon Institute of Education and Sagaing Institute of Education for their kind help and invaluable comments and suggestions in validating the proposed diagnostic assessment model by answering opinionnaire. I am also profoundly grateful to all of my friends for their love and patience.

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