Teachers' influene to the mathematics achievement of grade four students

A comparative study between Chinese Taipei and Yemen in TIMSS 2011

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Abstract. TIMSS measurement shows that students in the world get quite different mathematics achievement in different countries. Students' mathematics achievement is influenced by many factors such as teachers, schools, parents and so on. It's complicated to explain what leads to these different performance between students. This paper aims to find how teacher's factors influence students' mathematics performance by comparing mathematics teachers of grade four in Chinese Taipei and Yemen who have participated in TIMSS 2011.The differences between them are shown by analyzing the datas of teachers questionnaires in TIMSS 2011. The result indicates that teachers' education degree, majors, teaching experience, professional development, preparation degree, confidence degree and career satisfaction are important factors to influence students' achievement. The students get better achievement when their teachers are better in these aspects.

Introduction

TIMSS(Trends in International Mathematics and Science Study) is a famous international mathematics and science measurement which is held by IEA(International association for the evaluation of educational achievement)every four years. TIMSS 2011 was held in 63 countries and areas, there were about 600,000 students who took part in this measurement[1].Half of these students were in grade four while the others were in grade eight. There are some questionnaires in TIMSS measurement which are tested in students, teachers, parents and school leaders. These questionnaires' results have shown the differences in these countries and areas. There are scores and ranks of these countries and areas in every TIMSS measurement. The TIMSS 2011 has shown that Chinese Taipei grade four students got scores of 591 and ranked 4th in mathematics measurement while the students in Yemen got scores of 248 and ranked last. This result is affected by many factors and this article is aimed to find the relationship between grade four students' mathematics achievement and teacher's factors.

Data and Method

This paper uses the data of TIMSS 2011 to compare the differences between Chinese Taipei grade 4 mathematics teachers and Yemen grade 4 mathematics teachers. Teachers' influence to students' mathematics achievement can be found by analyzing the results of questionnaires that they have taken part in.

Data

There were 155 Chinese Taipei grade 4 mathematics teachers and 223 Yemen grade 4 mathematics teachers who have participated in these questionnaires. There are some aspects of questions in these questionnaires such as the basic information about these teachers, the information about the school, the attitude towards being a teacher, the situation about the TIMSS class, the method of how to teach the TIMSS class, the resources of teaching mathematics, attitude towards

these mathematics topics, mathematics content coverage, mathematics homework, mathematics assessment and preparation to teach mathematics. Every part of this questionnaire contains detailed questions and options.

Method

This article compares the questionnaire results of Chinese Taipei and Yemen grade four mathematics teachers. These differences are shown in the tables below by counting the data of each option. Percentages are used to show each aspect of results clearly. The students' mathematics achievement influenced by teachers will be analyzed by these tables and datas. The ways to narrow the gaps among teachers are also discussed as follows. The literature method is also used in this study in order to research teachers' influence on studens' achievement.

Results and analysis

Teachers' education degree is important to support their teaching work because teacher is a quite professional job. It's necessary for teachers to own professional skills and knowledge. TIMSS 2011 was used to investigate education degree of teachers in these two areas. The formal education degree of teachers in Chinese Taipei and Yemen is shown in Table I, which indicates that the educational level of teachers in Chinese Taipei is much better than Yemen. Almost all teachers in Chinese Taipei completed Bachelor's Degree or Postgraduate's Degree while only one thirds of Yemen's teachers completed Bachelor's degree. There are no teachers in Yemen who completed Postgraduate's Degree. It means that Teachers in Yemen are lack of high quality education. Chinese Taipei students have gotten better achievement in TIMSS 2011, which indicates that teachers' educational level influence students' performance. The teachers' education level would influence their understanding about education and knowledge, which is also important to students' education. Their students are influenced by their teachers' ideas and habits , and this influence will grow more with time. In order to give teachers better education, the government can organize more teachers to have further education. It's a useful way to help underdeveloped areas to improve whole literacy of teachers.

TABLE I. THE PERCENTAGE OF FOUTH GRADE MATHEMATICS TEACHERS' FORMAL EDUCATION

Teacher 's educational level	**Country(area)**	
	Chinese Taipei	***Yemen***
completed postgraduate university degree	26	0
completed bachelor's degree or equivalent but not a postgraduate degree	72	34
completed post-secondary education but not a bachelor's degree	2	31
no further than upper-secondary education	0	35

Teaching mathematics in grade four needs both mathematics knowledge and primary education knowledge. Teachers should know how to teach mathematics and know the requirement of grade four students. The data in table II shows that about one thirds of teachers in Chinese Taipei majored in primary education and mathematics, and about fourty percents of teachers majored in primary education. These percentages are much higher than Yemen. These teachers have better knowledge structure than Yemen. The other big differences are that about one fourth of Yemen teachers who never majored in primary education and about one thirds Yemen teachers didn't receive formal Education beyond upper-secondary. These teachers in Yemen are scarce of professional knowledge, so their students are poor in math literacy and get much lower scores than Chinese Taipei students. It's obvious that teachers in Chinese Taipei are more professional than Yemen from the majors comparison. This means teachers' knowledge structure influences their teaching effiency. A teacher who has both mathematics and education knowledge is better at teaching mathematics. This shows subject literacy is quite important in a teacher's career. Professional subject and education knowledge is necessary to mathematics teachers, it's not easy for a teacher to do well without these knowledge background. Professional teachers know the characteristics of a subject and they master

comprehensive knowledge of a subject. So schools need to hire more professional teachers and teachers need to participate in major learning further.

TABLE II. THE PERCENTAGE OF FOUTH GRADE TEACHERS MAJORED IN EDUCATION AND MATHEMATICS

	Country(area)	
	Chinese Taipei	***Yemen***
major in primary education and major (or specialization)in mathematics	32	15
major in primary education but not major (or specialization)in mathematics	39	11
major in mathematics but not major in primary education	4	23
all other majors	25	15
no formal education beyond upper-secondary	0	36

From table III, the working experience of teachers are thought to be obviously related to students' performance. Teachers with more experience can handle teaching situation better than those with less experience. Teachers' styles and methods will grow with their more experience, and teachers with rich experience can find and solve problems more quickly. Mathematics is a subject which needs much more exercises. Old teachers own rich experience which young teachers are scarce of. Then old teachers know how to start a topic more suitably and how to introduce the topic to students step by step according to the studens' situation. From the Table III, we found that teachers' years of experience are similar in these two areas, which means the teachers' age structure are similar in these two areas, but this factor can't influence student's performance in these two areas. The communication among all teachers is quite necessary, which can help teachers learn from each other, and it's meaningful for teachers' career[2].

TABLE III. TEACHERS' YEARS OF EXPERIENCE

	Country(area)	
	Chinese Taipei	***Yemen***
20 years or more	26	15
at least 10 but less than 20 years	50	60
at least 5 but less than 10 years	17	15
less than 5 years	7	11
average years of experience	15	14

It's a trend for teachers to attend professional development after work in the world[3].There are a variety of professional development courses both online and offline nowadays. Teachers have more choices than before to develop themselves if necessary. Professional development can give teachers the chance to learn new knowledge and popular ideas[4].Teachers' ideas and views will influence their students how to think and behave, so it's important for teachers to participate in professional development. Table IV indicates that nearly half of grade four mathematics teachers in Chinese Taipei participated in professional development about mathematics content, mathematics curriculum and integrating information technology into Mathematics. These percentages are much higher than Yemen's teachers. This shows that teachers in Chinese Taipei learn more new professional development knowledge than Yemen. The difference between these two areas indicates that students in Chinese Taipei get more professional and newer knowledge than Yeman. More professional teachers help students understandmore about the math,which would result that students in Chinese Taipei got better scores in TIMSS 2011. It's a fact that when teachers have graduated from university, they would develop slowly in their knowledge. Then teachers' knowledge will fall behind with time when they don't participate in professional development, and they will not know the newest trend of their subjet. Teachers in Chinese Taipei know much more about how to integrate information technology into mathematics and they are more professional in mathematics curriculum. The professional development is more and more useful in toady's globalization and informatization trend. But it's scarce in areas which doesn't have advanced economy like Yemen. The way to solve

this problem is encouraging teachers in developing areas to participate in more professional development.

TABLE IV. TEACHER PARTICIPATION IN PROFESSIONAL DEVELOPMENT IN MATHEMATICS IN THE PAST TWO YEARS

	Country(area)	
	Chinese Taipei	***Yemen***
mathematics content	45	22
mathematics pedagogy / instruction	42	40
mathematics curriculum	50	19
integrating information technology into mathematics	41	6
mathematics assessment	34	25

TIMSS has some mathematics topics for teachers to teach, the degree how teachers are prepared will affect their teaching effect. Table V shows that teachers prepared with similar degree in topics like overall mathematics, number, geometric shapes and measures. But teachers in Chinese Taipei prepared better in data display. The result shows that teachers in these two areas prepared in similar degree, this will not make big difference on students in these two areas. It's necessary for teachers to prepare well before classes, because there are sudden situations in classes, only when teachers prepare well for all these situations can the teaching quality be guaranteed. Mathematics is a subject which needs comprehensive knowledge system. A mathematics teacher should have the literacy of both theory and practice. It's a challenge for teachers to know these fields deeply and teach their students properly. The points of class teaching are to help students understand the concept of mathematics instead of just teaching students how to do exercises right.

TABLE V. TEACHERS FEEL VERY WELL PREPARED TO TEACH TIMSS MATHEMATICS TOPICS

	Country(area)	
	Chinese Taipei	***Yemen***
overall mathematics(18 topics)	86	73
number (8 topics)	89	86
geometric shapes and measures (7 topics)	85	71
data display (3 topics)	81	42

Confidence is a support to do work well, which affects the attitude how people do job. Teachers need be confident about the content they teach, only when they feel confident enough can they do best performance in classes[5].A confident teacher is brave enough to reform his teaching method, which will make his teaching full of energy and fresh enough to attract students. Teachers' confidence comes from their preparation for the content they teach and the literacy they have of this subject. Teachers' confident degree also affect students' confidence to this teacher and his class, so teachers have to improve their confidence[6].Table VI indicates that the confident degree of teachers in these two areas are almost in same level, so this will not make a big difference on their status in classes. So students in these two areas will see almost same confident teachers in class, teachers' status will make almost same influence on students' emotion in these two areas. This aspect will make no difference on students' performance in TIMSS. Teachers in Chinese Taipei are more confident in most teaching process. This is a symbol they are confident to handle the class and teaching well. Confidence is built on professional knowledge and rich experience. It's possible for teachers who are not very confident to attend professional training to learn how to behave more confidently.

TABLE VI. CONFIDENCE IN TEACHING MATH

	Country(area)	
	Chinese Taipei	***Yemen***
very confdent	71	64
somewhat confdent	29	36

In order to make it clear that how teachers' components of confidence are different when they teach mathematics, the test of this aspect is included in the TIMSS 2011 and the result is shown in Table VII. The result shows that Chinese Taipei teachers are more confident when they answer students' questions about mathematics, and teach students a variety of problem solving strategies and provide challenging tasks for capable students. But when help students appreciate the value of learning mathematics, teachers in Yemen are more confident. Mathematics is a precise and interesting subject, teachers need to help students solve problems in a mathematics thought and guide students to get interested in mathematics. Students' curiosity is a key to learn a subject well, and this is what teachers should think carefully[7]. International trend is that students should develop polybasic ability such as exploring mathematics phenomenon after classes, and it's also necessary for teachers to guide students. So the requirement for teachers is more and more multiple, teachers' confidence about these fields are necessary to be strengthened.

TABLE VII. COMPONENTS OF CONFDENCE IN TEACHING MATHEMATICS

	Country(area)	
	Chinese Taipei	***Yemen***
answer student questions about mathematics	87	76
show students a variety of problem solving strategies	79	64
provide challenging tasks for capable students	57	44
adapt teaching to engage student interests	57	56
help students appreciate the value of learning mathematics	46	71

Career satisfaction is related with working enthusiasm. Teacher is a profession which needs patience and enthusiasm. If a teacher is not satisfied with his career, he will feel stressful and upset. Teachers' mood often affect students' mood, students hope their teachers to be active and optimistic[8].Table VIII shows that teachers in Yemen are more satisfied with their career, this figures out that teachers in Yemen are more active in work. It indicates that teachers in Yemen have more enthusiasm, but these teachers don't get better teaching achievement in TIMSS measurement. When a teacher often keeps bad mood in class, the atmosphere of his class must be depressive and boring. Teachers' career satisfaction is made up of his satisfaction with students' performance, salary, working environment, workload and retirement life[9].

TABLE VIII. TEACHER'S CAREER SATISFACTION

	Country(area)	
	Chinese Taipei	***Yemen***
Satisfed	31	49
Somewhat Satisfed	64	47
Less Than Satisfed	5	4

Conclusion

This article compares some factors of grade four mathematics teachers in Chinese Taipei and Yemen. According to the comparison, teachers in Chinese Taipei perform better in educaton degree, major situation, professional development. As students in Chinese Taipei made much better achievement in TIMSS 2011 than Yemen, it indicates that these factors of teachers affect students' performance.

It's a global trend that teachers need to be more and more comprehensive and professional. This study has shown how teachers' factors influence grade four students' mathematics achievement. Teachers need to learn lifelong to improve themselves so that they can always be competitive.

The study will continue to explore how teachers influence students' achievement and how to solve these problems.

Education is a career which is developing dynamically, this career will never be perfect, but we will continue to make it better.

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References

[1] Askin and F. Gokalp,“Comparing the Predictive and Classification Performances of Logistic Regression and Neural Networks:A Case Study on Timss 2011,”Procedia-Social and Behavioral Sciences,2013, 106:667-676.

[2] L.P. Yieng and R.M. Saat,“Use of Information Communications Technology (ICT) in Malaysian science teaching: A microanalysis of TIMSS 2011,” Procedia-Social and Behavioral Sciences, 2013, 103: 1271-1278.

[3] J.A. Belasco and J.A. Alutto,“Decisional participation and teacher satisfaction,” Educational Administration Quarterly,1972, 8(1): 44-58.

[4] Timss 2011 International Results in Mathematics. http : // timssandpirls .bc.edu / timss 2011 / international - results-mathematics.html.

[5] R.M. Klassen and M.M. Chiu,“Effects on teachers' self-efficacy and job satisfaction:Teacher gender, years of experience, and job stress,”Journal of educational Psychology,2010,102(3):741.

[6] Y. Tao,M. Oliver and G.Venville,“A comparison of approaches to the teaching and learning of science in Chinese and Australian elementary classrooms:Cultural and socioeconomic complexities,” Journal of Research in Science Teaching,2013,50(1):33-61.

[7] L.Woessmann,“Schooling resources, educational institutions and student performance:the international evidence,”Oxford bulletin of economics and statistics,2003, 65(2): 117-170.

[8] A.J. Wayne and P. Youngs,“Teacher characteristics and student achievement gains:A review,”Review of Educational research,2003, 73(1):89-12

[9] C.S. Chai,J.H.L. Koh and C.C. Tsai,“Facilitating preservice teachers' development of technological, pedagogical, and content knowledge (TPACK),” Journal of Educational Technology&Society,2010,13(4):63-73.