Identifying the Factors Affecting Students’ Performances in Primary School Mathematics

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Abstract. Educational system reform is generally observed to bring change to the school and students’ performance. After 5 years of its implementation, this study attempts to have an overview of schools from three different groups based on their students’ mathematics achievements. This is done by identifying the factors that may have contributed to the students’ low, medium and high achieving performances in mathematics in three case studies primary schools in Brunei Darussalam. The data were collected through lesson observations, interviews with the principals and the teachers, and field notes. The roles of the principals, teachers and parents were found to have significant factors, both enabling and constraining towards the students’ performances.

1. Introduction
In Brunei Darussalam, a major educational reform was implemented to the nation starting 2009. The new educational system includes new educational curriculum documents that aim to develop the human capital of the nation towards a highly skilled, problem solving and innovative persons. The educational system was called Sistem Pendidikan Negara Abad 21, also known as SPN21, or in the English Language the National Educational System for the 21st Century[1]. This is in alignment with the nation’s framework towards Brunei Vision 2035 as a recognizable nation of its highly accomplished and capable people in par with international measures. One of the educational strategies readied by the Ministry of Education is to instill international best approaches in teaching and learning.

One of the educational goals is to guarantee quality primary education for all children with no exceptions. Government primary schools provide 7 years of free education from pre-schools up until Year 6, where it is compulsory for children in Brunei to be in Year 1 by the age of 6, irrespective of their backgrounds and needs. The ministry also ensured the quality of teachers where it can be seen that there is an increase of percentages of teachers in primary schools who are certified to teach with required academic qualification [2]. In addition to this, the student-teacher ratio in primary classrooms showed a decrease in percentages at an average of 20 students per teacher from 2008 to 2012 to ensure quality education for all.

To ensure teachers’ quality, the ministry has launched a series of professional developments for primary mathematics teachers nation wide since 2007. This includes lesson study, active mathematics in classroom, SPN21 Primary Mathematics briefings and workshops, Primary Numeracy Initiatives and Numeracy Project on Pedagogy for Primary and Secondary Mathematics Teachers[3-9]. One of the major changes in the mathematics curriculum is the teaching and learning of mathematics in English medium for lower primary classes. Furthermore, the mathematics curriculum framework
consisted of multiple mathematical skills and knowledge that is expected of a 21st century learner. The higher institutions and educational related authorities expected a change in the teaching and learning of mathematics as implied in the new curriculum documents.

A nationwide study on upper primary school mathematics was conducted five years since the beginning of the reform. The aim of the study was to have an overview of the mathematics teachers in upper primary schools and the teaching and learning involve in those grades, which include Years 4, 5 and 6 classes [3]. The obvious change before the reform is that Mathematics was taught in Bahasa Melayu or the Malay Language (the students’ mother tongue and the official language in Brunei) during the students’ lower primary classes. However, the language of instruction of Mathematics has been changed to English since 2009 right from Year 1. Therefore when this study was conducted five years after the reform, the sample students from the sampled schools have all been taught Mathematics in the English Language since they were in Year 1. It would be interesting to examine those students’ performances in Mathematics and to identify any factors that may contribute to their better performance in schools categorized as high and medium performing, and subsequently to ascertain any problems associated with the less performing school.

2. Method
The aim of this study is to explore the environment of three purposively chosen schools of high performing, middle performing and low performing performance, identified from the passing rate results in mathematics of the 2012 Year 6 National Examination (referred to in Brunei as Penilaian Sekolah Rendah or PSR). This study was part of a bigger nationwide survey on mathematics teachers and the teaching and learning of mathematics[3]. The visits to these schools hoped to provide snapshots of the school culture in what entails of the teaching and learning of primary mathematics in the nation. The questions that guided us in this study are as follows:

- What are the key features of mathematics lessons across the three different schools?
- What are the significant factors affecting students’ performance in mathematics?
- Are there any apparent differences and/or similarities of these factors between schools with different mathematics achievements?

In this study, Schools A, B and C all follow the same centralized curriculum, are situated within two neighbouring districts in Brunei, and the students come from different socio-economic background. School A from Tutong district is of very urban location. The school was identified as a high performing school in Brunei. School B in Brunei-Muara district, from a resettlement area was considered to be an average performing school while School C also from Brunei-Muara district, located in a semi-urban area considered as less performing school.

Prior to the main study, the case studies were conducted in nine primary schools. There were three schools each for the three subjects, Bahasa Melayu, English Language and Mathematics, which were selected to include a high performing school, a performing school and a school performing below expectations based on the 2012 PSR examination results in the relevant subject. The high performing school, School A reported a 97.2% pass rate with 6 out of the 36 candidates obtaining the grade ‘A’ in their Mathematics results for PSR; the performing school, School B achieved a 85.1% pass rate with 7 out of the total of 74 candidates obtaining the grade ‘A’, while for the relatively low performing school, School C, the pass rate was 51% with 4 out of the total of 100 candidates obtaining the Mathematics PSR result of grade ‘A’. Another consideration in attempting to capture a diversity of school contexts included the selection of urban and rural schools. The three schools that comprised the cases for Mathematics were located in the Brunei-Muara and Tutong districts. It must be reiterated that the findings of the case studies are to supplement the results of the larger survey by providing qualitative data in the form of vignettes of practice and perceptions of participants obtained through class observations and interviews. These findings would also inform the construction of the teacher questionnaire for the main survey [3, 4].

The data collection included observations of Mathematics lessons (refer to Figure 1) at the Year 5
and Year 6 levels in the selected schools. The lessons were video-recorded and transcribed. In addition, the teacher interviews were conducted to explore teacher thinking in relation to the lessons observed. The study also obtained the perspectives and views of the respective school principals, the subject coordinators and the groups of focal students from the classes observed through interviews. This phase of the study on Mathematics lessons in the upper primary levels of schooling, that is the teachers of Years 5 and 6 in government schools, covered a total of six classes from six teachers in three schools (Schools A, B and C).

The main focus of the teaching process was on the lesson taught capturing the practices of teaching and learning. Meanwhile, the interviews were conducted to elicit the perceptions of the teachers with a focus on the thinking in relation to their respective lessons. The student interviews focused on their learning of the subject including experiences during the lesson. Additional data included the collection of the teacher’s lesson plans and the outputs produced by the focal students for the lesson. In order to obtain insights into the teaching situation in the context of the sampled school, interviews were also conducted with the principal and the subject coordinator.

All the data obtained were analyzed qualitatively. The transcripts and the field notes were coded and emerging themes were discerned. Based on the data obtained, portraits of practice with regards to the teaching and learning of Mathematics in each school were developed. These included descriptions of the school context, profiles of the students and the teachers, descriptions of sample lessons taught including the insider perceptions of the teachers and students, and a discussion of key issues and challenges faced, as well as initiatives to promote the learning of Mathematics in each case study school.
3. Results and discussion
Presented below are the key features observed from the mathematics lessons from the three case study schools. Following the lesson observations of the six upper primary mathematics lessons, we also provide suggested factors that may have affected the students’ performance in Mathematics.

3.1. Observations of the mathematics lessons
In all the observed Mathematics lessons, there is a mixture of teacher centered and student centered Mathematics learning. All the lessons started with recapping on previous lesson or a recollection of students’ previous knowledge on the topic to be taught. All lessons proceeded with the teachers demonstrating and showing to the students the computation skills on the mathematics problems in that topic. The difference between School A and the two Schools B and C are that the seamless connections the teachers made between their introduction set and their main lesson content. The students will then try to compute the problems either individually or in groups. The lessons that were inclined towards student centered learning had the students to actually do the practical activities that can be done in the topic taught. In addition, the students had more interactions in the practical activities that required them to manipulate the resources and do the work together. Most of the lessons that were observed had their students do practice sheets as a way of reinforcing the knowledge the teacher had presented. The summary of these key features in the mathematics teaching between the three schools are given in Table 1.

| Features                              | School A | School B | School C |
|---------------------------------------|----------|----------|----------|
| Recap on previous lesson              | ✔        | ✔        | ✔        |
| Teacher demonstration                 | ✔        | ✔        | ✔        |
| Student written work                  | ✔        | ✔        | ✔        |
| Use of manipulatives or concrete      | ✔        | ✔        | ✔        |

3.2. Factors affecting students’ performance in mathematics
The enabling factors that may have affected the students’ performances in Mathematics, based on the three case study schools, are observed to originate from a combination of different reasons. The high support and involvement of the principal, both directly and indirectly to the Mathematics teachers, in some ways, may have affected the students’ performance. In effect, it increases the teachers’ commitment to teaching by agreeably giving extra help to the students outside their normal school hours, readily support school’s extracurricular Mathematics activities, and be well informed with the teaching and learning of Mathematics through professional practice developments.

Moreover, the Mathematics teachers that were observed considered that their students’ understanding of conceptual and procedural knowledge in the four main operations of addition, subtraction, division and multiplication will enable or hinder their performance in Mathematics. It was also observed that the students’ literacy abilities in understanding the mathematics problems may also play an important factor to their Mathematics performance. Parental involvement, on the other hand, is another factor that may have affected students’ performance in Mathematics. The parents’ dedication to support their child’s extra mathematics activities, obligation to school’s Parent Teacher Meetings, and their effort to understand mathematics concepts may also have some influence to their child’s learning of Mathematics. The factors of that might affect students’ performance in mathematics is summarized in Table 2.

| Factors                              | School A | School B | School C |
|--------------------------------------|----------|----------|----------|

Table 1. Key features in classroom mathematics lessons.

Table 2. Apparent factors affecting students’ performance in mathematics.
3.3. The case study of school A
The high performing achievements by the students in the case study School A seems to be attributed to firstly, the Principal, and secondly, the teachers’ commitment, both of which were classified as the enabling factors. The school is very much centered on the Principal who listens to the teachers’ feedback. With the weekly quizzes done during school assembly, the Principal will allocate budget for student prizes and the teachers would prepare the activities or questions for the quiz for all the primary class levels. In the first half of the year, the school will have ‘fun’ subject activities. Subsequently, in the second half of the year, the school will be geared towards the students who will sit for the PSR Year 6 National Examination. Daily extra activities will also take place with proper scheduling. In addition, the teachers in this school will teach the low achievers on a one to one practice of the past year PSR papers. Interestingly, the Principal will join in to teach the students in need. The extra activity started as early as 7.00 a.m. and the Principal will be in the library to teach them Mathematics. The school will send memos to the parents to start sending their children to school early for extra classes starting July to prepare them for examinations, which the parents willingly complied. The Principal would lend an extra hand when needed, for example buying extra papers using her own budget for the school. Furthermore, the Principal, as the head of school administration provided big support to the teachers in this school. The teachers in this school are also committed due to the support from their school administration. The teachers are given a chance to voice their opinions which was heard by the Principal. The teachers are given a sense of ownership on their activities and the Principal was willing to take their suggestions or opinions. They were also committed because they can see that their Principal was also committed in helping and contributing to the students’ well-being. The teachers were dedicated to give extra lessons on Fridays in this school because the Principal would also be in school to help the students on Fridays. Note that in Brunei, the schooling days for all the government schools are from Monday to Thursday and Saturday, with schools generally closed on Fridays and Sundays. The parents also support the teachers by sending their children to school earlier during school days and on Friday extra classes. This shows the commitment of the parents by being involved and committed to the academic well-being of their children. Based on our observations of School A, both the Mathematics teachers are committed to their students. Since they are with their current students throughout their upper primary years, the rapport between both the Mathematics teachers and their respective students was very good. The teachers understood very well the needs of their students. Both teachers believed that the students’ foundation on the four main operations of addition, subtraction, division and multiplication are crucial for mathematics learning.

| Enabling | Principal’s role | Principal’s role | Principal’s role |
|----------|-----------------|-----------------|-----------------|
| Constraining | Teacher’s commitment | Teacher’s commitment | Teacher’s commitment |
|          | -               | -               | Student’s ability |
|          | -               | -               | Parents |

3.4. The case study of school B
The performing achievements by the students in the case study School B also seems to be attributed to firstly, the Principal, and secondly, the teachers’ commitment, both of which were categorized as the enabling factors. It would seem that the administrative proactive on-goings of the school is centered towards the Principal’s directive instructions. These instructions included additional measures in reaching out and disseminating the information conducted within the school to the outside school community. These were done virtually through avenues such as the school’s own blogs and Facebook, as well as inviting parents to participate in classes especially geared in their own involvement with their child’s academic well-being. Based on our observations of the teachers in School B, in general, they appeared to be very committed in organizing and implementing the several different types of
activities planned in this school. In relation to the two observed Mathematics teachers, they both seemed to have good relationship with their respective students.

3.5. The case study of school C
The low performing achievements by the students in the case study School C seems to also be attributed to firstly, the Principal, and secondly, the teachers’ commitment, both of which were classified as the enabling factors. Meanwhile, the constraining factors are, the students’ ability and the parents. The current Principal, at the time of study, was recently transferred to School C early on in the year, and she was still adapting to the new school environment. Nonetheless, under her leadership, there had been many positive changes to the school. A lot more new initiatives and activities were to be conducted and planned within her management for that school year. The Principal hoped that with the changes being made in the school, there will be fruitful outcome towards the improvement of the students’ and in turn the school examination results. In addition, the Principal also strives in being a good role model to her staff, may it be the teachers, administrators and the school cleaning staff. She also cares very much in the well-being of her teachers and students in the school. With the arrival of the current Principal, her leadership ways are somewhat different from the previous Principal, and this may likely have the desired improvement in the students’ attitude to learning.

There has been a sudden shift in the teachers’ commitment in this school. This may had been attributed mainly to the newly found support from their new Principal. The teachers in this case study School C are working together in the successful implementation of the new initiatives planned in the school, such as the renovation of the school library, carrying out other teaching tasks assigned, for example, one teacher will get to monitor four students in their reading during the two days a week reading program organized by the school, assigned supplementary non-teaching or administrative responsibilities, and other planned staff development activities. Based on our observations of both the Mathematics teachers in School C, in general, they appeared to be very dedicated in organizing and implementing the several different types of activities planned in their respective lessons. They both also seemed to have good relationship with their respective students.

One of the constraining factors that may have affected the students’ performance in Mathematics, as perceived by the Principal, was that some of the students do not know how to read, hence affecting their reading ability of Mathematics questions, in their exercises as well as in the School Based Examinations. Another constraint was that the students do not understand the concept underlying a certain Mathematics topic such as Addition and Subtraction, and Decimals. The Subject Coordinator believed that once students understood the concept of mathematics, then their results would improve automatically. Among the challenges mentioned by the Subject Coordinator was on the knowledge retention of the students. In the teachings, the students were able to understand and perform well in their activities and tasks; however when it comes to doing tests, they no longer understand and remembered what they have learned previously. For this case study, School C is considered to be one of the low performing schools in relation to the overall Mathematics 2012 PSR examination result performance in the nation. While majority of the students do not understand the mathematics concept at the required year level, there were some who are still struggling with the basic additions and subtractions. Even though the teachers in this school had been willing to give extra classes for the Mathematics subject, and the students themselves are willing to learn, the constraining factor that seemed to hinder them to move forward was the lack of cooperation from their parents. For example, purposely sending their children late to school between 7.45 to 8.00 a.m. where the first period of lesson has ended, lack of monitoring in their children’s schoolwork such as homework, and not even bothering to buy their children books for their subjects. The students themselves were very keen to learn and some of them do want to be in school early but based on their parents’ lack of support and cooperation had made their children inadvertently demotivated in their studies.

The present study reveals key features of the respective schools and mathematics lessons that may explain the differences in the schools’ achievements of the students’ mathematics performance at a macro-level. What all the three schools have in common is having a principal as the enabling factor
towards the performance of students’ mathematics. Although the correlation may be superficial and limited, there were several different studies that saw it as a factor. Based on qualitative meta-analyses study, there is a significant and positive effect between the principals and the student achievements, particularly in primary schools [10]. A school leader’s influence towards the students’ performance may be a direct or an indirect effect [10, 11], particularly when innovative and beneficial initiatives are to be brought forward by the new incoming principals [12]. In agreement, Cheng and Townsend [13] summarized that school-based management is an effective way to ensure that schools have quality education in a reform context. However their definition of school-based management implied greater autonomy for school members to implement educational activities as they see fit. This is in contrast with Brunei’s own centralized education system where the schools have to answer to the Ministry of Education, thus indicating a tradition of external control management [13]. For Brunei to successfully develop the education quality as targeted, the policy-makers have to find a balance to consider autonomous and accountable responsibilities from the school leaders to manage their schools in regards to different school idiosyncrasies and contextual factors [14].

Another factor that needs more focus goes beyond individual and institutional levels, that is specifically at the community level. Cheng and Townsend [13] proposed that there is a need to study a school function from multi levels to assess and implement education reform. To date, Brunei’s education reform has focused on individual (students and teachers) and institutional levels, within the school sites. As shown from case study School C, the function of parents can be a factor in effective, or in this case an ineffective quality of education. In a study by Abdullah [15], she found that Bruneian students’ educational achievement has a positive correlation with their parents’ involvement, especially from home. The author also found that parents of students who are high achievers were supportive of their children’s school activities. It is also reasonable to expect that parents being the partners of their child’s school assessment at the primary and secondary school level [16-26]. These corroborates with the parental involvement environment found in the case study School A. Perhaps, there is a need to make further collaborative efforts by the teachers and the schools to invite parents and include them in any fundamental developments and a transformation pertaining to their children’s learning [27-30]. It has been suggested that if we want to produce a better educational system, a good, well-planned and established relationship will need to be weaved between the teachers, schools, parents and guardians [30-38].

Educational reform at the community level may take time to be implemented especially in a small nation like Brunei. Few researchers [39-41] are skeptical in Brunei’s distinct socio-cultural values to fully adapt education reform in that they believed held different ideologies from the nation.

4. Conclusion
Leadership support is highly regarded by the teachers to be a motivation for them to give their best effort to their work on hand. This can be seen in the case study schools where the quality of teaching are affected by the support given by their respective school leaders. Acknowledgement, recognition and appreciation are tokens or acts that are importantly expressed to recognise teachers’ contribution in their students’ education. Parental involvement is also valuable enabling factors that may help to ensure the quality of students’ learning. Teachers are able to persevere through the challenges in realising SPN21 visions because they strive for the future of their students and this is doubled with the support from parents who are involved with their children’s academic performance.

The limitation of this study is apparent in which these are just vignettes of the school culture in Brunei. However, this present study could give rise to preliminary explanations on the possible factors towards students’ mathematical performances. We do acknowledge that more systematic research, and larger sample and longitudinal data are needed, supplemented with in-depth investigations to explain further the reasoning behind such phenomena.
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6. References
[1] Ministry of Education 2013 *The National Education System for the 21st Century: SPN21 (2nd ed.* (Bandar Sri Begawan: Ministry of Education).
[2] UNESCO 2015 *Education for all 2015 National Review Report: Brunei Darussalam* (Incheon: UNESCO).
[3] Shahrill M, et al 2014 *Teachers and Teaching of Mathematics in Primary Schools in Brunei Darussalam*, Unpublished Research Report (Bandar Sri Begawan: Department of Planning, Development and Research, Ministry of Education).
[4] Shahrill M, et al 2014 Informing the practice of teaching mathematics in upper primary classes *Proceedings of the International Conference on Education in Mathematics, Science & Technology* (Konya: Necmettin Erbakan University) p. 168.
[5] Suhaili H A S, et al 2014 The impact of lesson study on primary mathematics teachers’ instructions in Brunei Darussalam *Proceedings of the International Conference on Education in Mathematics, Science & Technology* (Konya: Necmettin Erbakan University) p. 197.
[6] Suhaili A S and Shahrill M 2015 Comparing Bruneian primary mathematics teachers’ perceived learning in lesson study *Proceedings of the 7th ICMI-East Asia Regional Conference on Mathematics Education* (Quezon City: Philippine Council of Mathematics Teacher Educators (MATHTED) Inc.) p. 267.
[7] Suhaili H A S H, et al 2016 The Impact of the different stages of lesson study on teachers’ learning: The Bruneian context *The Lesson Study Seminar and Practice 2014: Reflection on the Lesson Study Practice in Brunei Darussalam* (Brunei Darussalam: Sultan Hassanal Bolkiah Institute of Education, Universiti Brunei Darussalam) p. 113.
[8] Wood K, et al 2017 *International Journal for Lesson and Learning Studies* 6 151.
[9] Wood K, et al 2018 Lesson study in Brunei Darussalam: Changing the paradigm for teaching and learning *The Routledge International Handbook on Schools and Schooling in Asia* (Routledge: London and New York) p. 976.
[10] Witziers B, et al 2003 *Educational Administration Quarterly* 39 398.
[11] Nettles S M and Herrington C 2007 *Peabody Journal of Education* 82 2724.
[12] Dhuey E and Smith J 2015 *Empirical Economics* 54 851.
[13] Cheng Y C and Townsend T 2000 Educational change and development in the Asia-Pacific region: Trends and issues *Educational Change and Development in the Asia-Pacific Region: Challenges for the Future* Lisse: Swets & Zeitlinger p. 317.
[14] Tajuddin S Z K 2015 *The Impact of School Leadership on Student Achievement: A Gap Analysis*, Doctoral Thesis (California: Rossier School of Education, University of Southern California).
[15] AbdullahNZM 2015 An investigation on students’ educational and occupational aspirations in brunei darussalam: teaching and learning implications *Doctoral Dissertation* (Brisbane: University of Queensland).
[16] Mundia L 2010 *International Education Studies* 3119.
[17] Mumu J, et al 2018 *Journal of Physics: Conference Series* 943 012011.
[18] Yatab R S and Shahrill M 2014 *International Journal of Science and Research* 3 685.
[19] Rashid R A and Jaidin J H 2014 *International Education Studies* 7 69.
[20] Botty H M R Hand Shahrill M 2015 *International Journal of Education and Practice* 3 17.
[21] Damit A H, et al 2015 *Mediterranean Journal of Social Science* 6 214.
[22] Botty H M R H, et al 2015 *Mediterranean Journal of Social Sciences* 6 113.
[23] Mohammad H H, et al 2017 *Turkish Online Journal of Educational Technology* 12 281.
[24] Roslan R, et al 2018 *On the Horizon* 26.
[25] Omar S N P, et al 2017 European Journal of Social Sciences Education and Research 5 203.
[26] Lombardo P A 2016 A qualitative study of K12 teacher perspectives of classroom assessment for learning strategies Doctoral Dissertation (Arizona: Northcentral University).
[27] Zakaria A R, et al 2013 International Journal of Asian Social Science 3 1063.
[28] Borich G D 2014 Effective Teaching Methods: Research Based Practices (New Jersey: Pearson).
[29] Muhtadi D, et al 2018 Journal of Physics: Conference Series 943 012020.
[30] Tapa H, et al 2017 Turkish Online Journal of Educational Technology, October Special Issue for INTE 2017 10792.
[31] Halim N L A, et al 2018 Journal of Physics: Conference Series 943 012041.
[32] Sulisworo D and Permprayoon K 2018 International Journal on Emerging Mathematics Education 2 39.
[33] Shahrill M, et al 2018 Journal of Physics: Conference Series 943 012001.
[34] Panthi R K, et al 2018 International Journal on Emerging Mathematics Education 2 17.
[35] Shahrill M, et al 2018 Processes involved in solving mathematical problems AIP Conference Proceedings 1952 (New York: AIP Publishing) p. 020019.
[36] Chong M S F, et al 2018 Teaching problem solving using non-routine tasks AIP Conference Proceedings 1952 (New York: AIP Publishing) p. 020020.
[37] Sahat N, et al 2018 Journal of Studies in Education 8 18.
[38] Shahrill M 2018 Journal of Physics: Conference Series 1028 012158.
[39] Minnis J R 1999 Australian Journal of Education 43 172.
[40] Minnis J R 2000 Asia-Pacific Journal of Teacher Education 28 179.
[41] Prescott D L 2002 Reflective discourse in teacher education in Brunei Darussalam Englishes in Asia: Communication, Identity, Power and Education (Melbourne: Language Australia Ltd) p. 245.