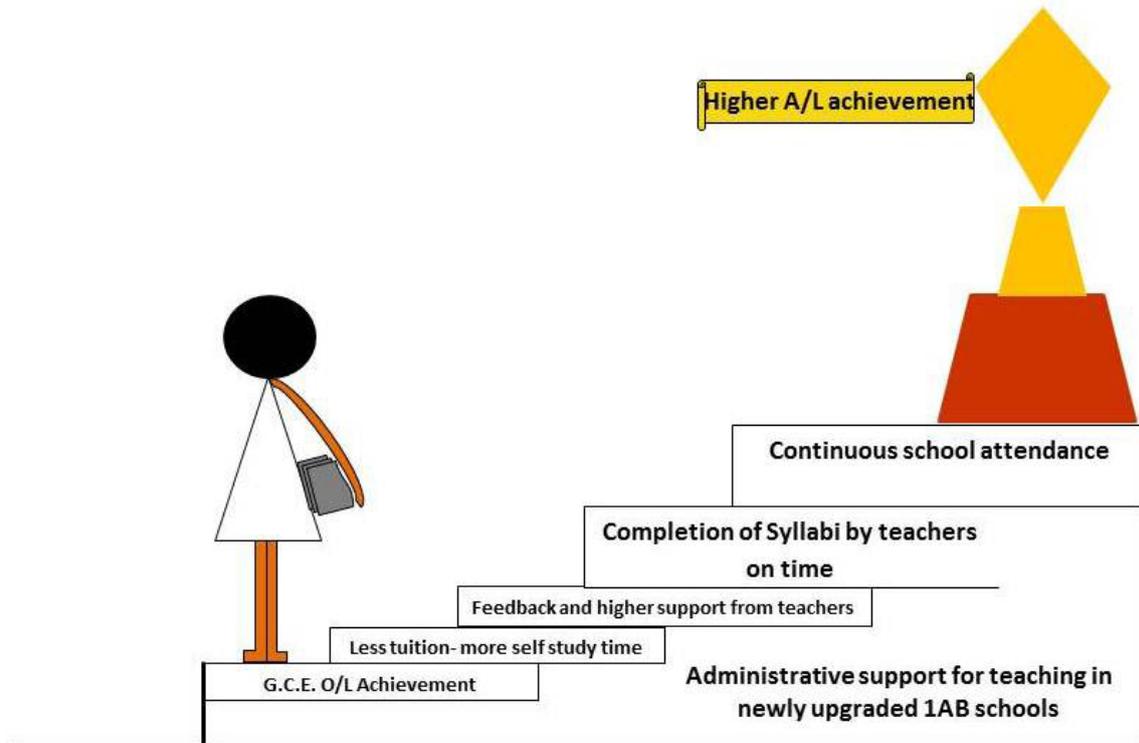# Factors affecting student performance in science at G.C.E. (A/L): A case study from newly upgraded secondary schools in the Kurunegala educational zone

N.R. Somarathne[*] and K.M.G.G. Jayasuriya

Higher A/L achievement

Continuous school attendance

Completion of Syllabi by teachers on time

Feedback and higher support from teachers

Less tuition- more self study time

G.C.E. O/L Achievement

Administrative support for teaching in newly upgraded 1AB schools

Highlights

- Student behavior of upgraded schools is different from that of other schools.
- High student attendance and completion of the syllabus, contribute for high student achievements.
- Extracurricular activities do not negatively affect student achievements.

RESEARCH ARTICLE

Factors affecting student performance in science at G.C.E. (A/L): A case study from newly upgraded secondary schools in the Kurunegala educational zone

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Abstract: Higher student achievements for science were reported in upgraded schools under the 1000-schools programme compared to other 1AB schools in the Kurunegala education zone. Thus, reasons for these higher achievements at G.C.E. (A/L) science subjects in nine upgraded schools were explored in comparison to three other 1AB schools. Subject teachers (36), students (100) and parents (36) were chosen for the questionnaire-based survey. Ten subject teachers were interviewed. Data were analyzed with principal components analysis (PCA) and ordinal logistic regression procedures (LRP) to reveal the factors affecting the higher achievements. PCA indicated many differences between the students in newly upgraded schools and students in other schools. Students from upgraded schools showed higher O/L achievements (O/L results index of 3.25 ± 0.90 compared to 2.85 ± 1.13 of other schools), and school attendance. Further, they participated less in tuition (2.56 ± 0.31 hrs. vs. 3.22 ± 0.18 hrs. of other schools); their syllabuses were completed on time and got feedbacks from teachers more often. According to the LRP, student attendance and completion of the syllabus on time were the only factors affected the A/L achievements. Thus, we recommend that school administrators to have good plan to encourage students to attend schools and teachers to complete the syllabus on time.

Keywords: School attendance; study programme; syllabi.

INTRODUCTION

The Sri Lankan government has introduced a program to upgrade schools by introducing classes for Science and Mathematics for G.C.E. A/Ls in 1,000 selected Schools island wide (Ministry of Education, 2013). Accordingly, those selected schools were eventually upgraded from 1C level to 1AB level. Under this programme, the schools were given laboratory facilities and other resources to develop Science and Mathematics subjects. Further, under this programme teachers were empowered with ICT training. National education development targets linked with the state policy frame work and with "*1000 school programme*" are to ensure the access to education for all children until the age of compulsory education. Further, these programmes also aimed to increase the percentage of students to study up to the G.C.E. (O/L) from 85% to 90% (Ministry of Education, 2013).

These improvements, in the newly upgraded schools, have been taken place since 2012. The students from these newly upgraded schools have sat, G.C.E. A/L examinations starting from 2014. According to the analytical reports on results carried out by the provincial education office, students in Science and Mathematics streams from upgraded schools in the Kurunegala district have shown higher achievements compared to the students from other 1AB schools. However, it is difficult to determine the reasons for better performance of students in relatively newly upgraded schools at the G.C.E. A/L in comparison to other 1AB schools, who have similar facilities for a longer period. Nevertheless, if these reasons for better performance of highly upgraded schools could be elucidated, these findings could be used to improve the performance of students in other schools too.

Many factors influence the educational endeavors of students. Children themselves play a central role in their achievements. However, parents, siblings, teachers, peers and other social groups (e.g. clergy, celebrities and social organizations) are also can be considered as contributors to the success of students (Sirin, 2005; Dankenda and Sooriyapathirana, 2011; Gupta *et al.*, 2015). Adequate resources are also needed to increase student achievements. Kalita (2016) stated that a students' emotional stability and their academic achievements showed a high correlation. Thus, it is important to encourage parents, teachers and policy makers to take necessary action to develop children's emotional stability. James and Jessica (2008) observed that properly implemented student self–assessments can also promote intrinsic motivation. James (2006) has stated that influence of family members, peers and pre-secondary teachers, affect student success during the post-secondary education. Studies have shown a positive relationship between parents' engagements in their children's education and student outcomes (Blooms, 1984; Fehrmann, 1987; Eisner, 2000). However, Steinberg (1992) compares the strategies used by parents of successful and unsuccessful students but did not find any differences. Level and the way of involvement of parents in their children's education depend on many factors like parents' gender, educational level, income and living area (Dankenda and Sooriyapathirana, 2011). School-sponsored extracurricular activities (Branch, 2003) and teachers performances (Harold, 2001) were also identified as factors affecting

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students achievements.

Thus, the aim of the current study was to identify the factors contributing to better performance of students in Science and Mathematics in newly upgraded schools in comparison to other 1AB schools.

MATERIALS AND METHODS

Study area

The survey was conducted in Kurunegala educational zone from May to December 2018. Kurunegala educational zone is located in the Kurunegala district, North Western province of Sri Lanka. The district consists of approx. 1.6 million population (Department of Census and Statistics of Sri Lanka, 2012), while the Kurunegala educational zone has the highest student population among the other zones (Department of Education, 2017). This educational zone covers both urban areas as well as rural areas in the province. The zone was selected purposively among the eight educational zones in the North Western province, Sri Lanka as it is easily accessible to the researcher.

Study sample

All the nine newly upgraded 1AB schools in the Kurunegala educational zone and three other 1AB (out of 12 schools) were selected to conduct this study. From each school students who have sat for the G.C.E. A/L examination was selected randomly. Of the student sample, 70 students were from newly-upgraded 1AB schools while thirty were from other 1AB schools.

Further, twenty seven randomly selected parents of students from newly upgraded 1AB schools and nine parents from other 1AB schools participated in the survey. Similarly, twenty-seven and nine subject teachers participated in the survey representing newly upgraded 1AB schools and other 1AB schools, respectively.

Data collection

Both qualitative and quantitative data were gathered using the mixed experimental methodology. Questionnaires were used to gather information from three target groups *viz*., students, parents and subject teachers. The semi-structured interviews were also conducted to collect information from subject teachers.

The questionnaires were validated using 30 students of three newly upgraded 1AB schools, 10 parents and three subject teachers. The modifications to the questionnaires were done according to their comments. There were 22 questions in the student questionnaire with 16 open-ended and six closed-ended questions. In the parents' questionnaire, there were 19 questions, of them, 13 were open-ended and six were closed-ended. The subject teachers' questionnaire was consisted of 18 questions with ten open-ended and eight closed-ended questions.

The semi-structured interviews conducted with subject teachers were used to collect information about teaching methodology and assessment-planning. Interviews were conducted with a pre-planned structure. However, whenever necessary, additional questions were asked from subject teachers to verify the information given by them during the interview.

Data analysis

Descriptive statistics were used to explain general information of the samples. Excel statistical software was used to prepare graphs. Answers given for each question were coded separately prior to use them in quantitative analysis. Information extracted from 22 questions in the students' questionnaire were used as independent variables in the analysis while, 19 independent variables were present in parents' questionnaire and 14 independent variables were contained in the questionnaire given for subject teachers. G.C.E. A/L and O/L examination results were used to calculate the G.C.E. A/L and G.C.E. O/L index. G.C.E. A/L indexes were used as the response variable, while the G.C.E O/L index was used as an independent variable. G.C.E A/L and O/L indexes were calculated using the following equations,

$$G.C.E\ (O/L)\ index = \frac{science\ index + mathematics\ index}{2}$$

$$G.C.E\ (A/L)\ index = $$
$$\frac{biology\ index + chemistry\ index + physics\ index}{3}$$

Index for each subject was calculated based on students' grade obtained for each subject; where, A, B, C, S and F were assigned 4, 3, 2, 1 and 0, index values respectively. The A/L and O/L index values were calculated to make the analysis easy. Especially, one response variable could be used when index was calculated instead of conducting the analysis three times separately for student performances on biology, chemistry and physics.

Data gathered from students, parents and subject teachers' questionnaire were analyzed separately. All the variables except A/L index were used in the principal component analysis to identify the principal components that determine the patterns of the ordination diagram. MINITAB Statistical software (version 17.1, Minitab Ltd., Coventry, UK) was used to conduct the principal components analysis.

If newly upgraded schools were separated from other schools in the three ordination diagrams, principal components determining the separation were selected using Eigenvalues (Anderson, 1989). Variables contributing significantly for selected principal components were selected using the coefficient values. Variables with > 0.3 coefficient value were selected as significant variables. These variables were selected as predictor variables in the ordinal logistic regression analysis, while A/L index was used as the response variable in the ordinal logistic regression analysis. Ordinal logistic analysis was conducted using MINITAB statistical software.
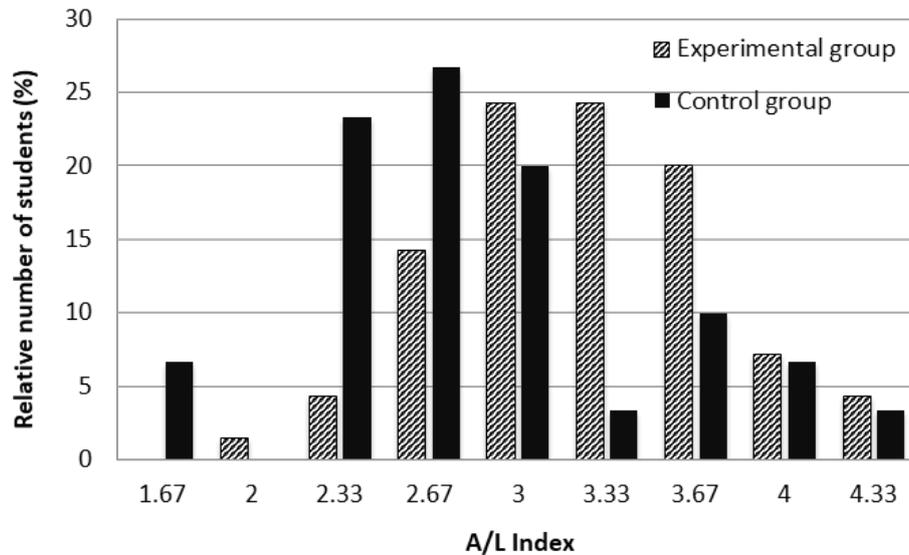
Figure 1: Class intervals of A/L index of students from newly upgraded 1AB schools (experimental) and other schools (controlled) showing that higher number of students from newly upgraded 1AB schools with higher A/L index.
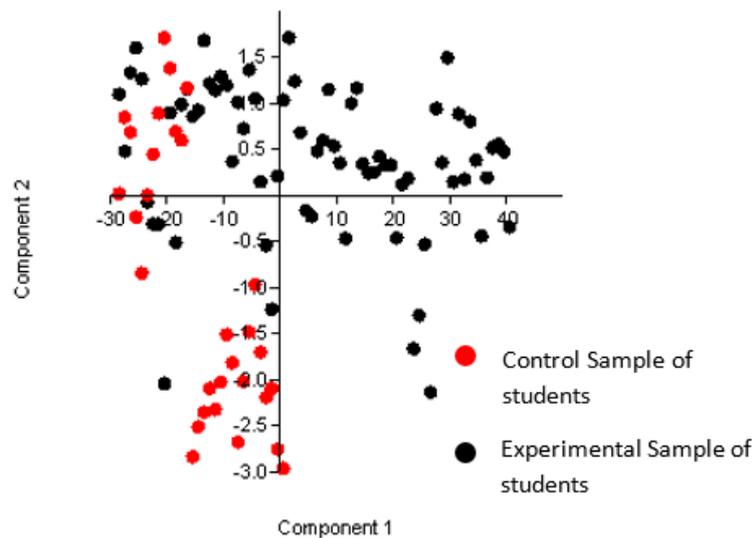
Figure 2: Ordination diagram of the first two components generated in the PCA showing the distinct separation of the students of newly upgraded 1AB schools as an experimental sample and students in old 1AB schools as a control sample.

## RESULTS

General information about the study sample

Forty percent of the students of the newly upgraded school group were males, while the rest was girls. Similarly, 41% of the students from the other school group were boys. Forty percent of the parents in the other school group and 33% of the parents in the newly upgraded school group were males. Fifty-two percent of the subject teachers in the newly upgraded school group were males, while 56% are males in the other school group. As revealed in Figure 1, students from new 1AB schools had a higher A/L index than that of students in other 1AB schools.

Student related factors

As revealed in the ordination diagram, students from newly upgraded schools and the students from other schools were separated slightly (Figure 2). According to the results of the principal component analysis, three principal components

(Figure 3, with > 1.5 Eigen value) were selected as the most significant principle components determining the clustering in the ordination diagram (Figure 2). Variables having more than 0.3 coefficient values (even in one of the first three principal components) were selected as the variables significantly contributing for the pattern in the ordination diagram (Figure 2). As shown in Table 1, seven variables were selected as the variables significantly contributing the separation of the students from two types of schools in the ordination diagram. These variables were O/L index, participating in tuition classes, school attendance, completing the syllabus on time, getting feedback from the school teachers for answers for past papers, participating in revision classes and support from subject teachers (Table 1).

The ordinal regression analysis was conducted using A/L index as the response variable and above seven selected variables as the predictor variables. Ordinal regression analysis revealed that the response variable
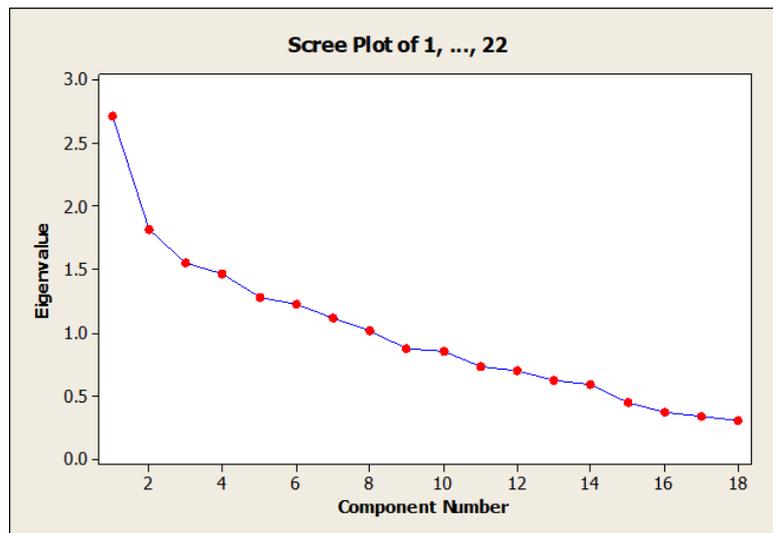
Figure 3: Eigenvalues of each eighteen principal components that determine the clustering pattern of the data set of students.

Table 1: Coefficients of each variable in each principal components obtained from the PCA analysis of students data set

Variables	PC1	PC2	PC3
Gender	0.043	-0.267	-0.147
A/L section	0.074	-0.172	-0.299
Grade 5 scholarship exam results	0.157	-0.053	0.295
O/L Index	0.033	0.406*	-0.119
A/L Index	-0.295	0.313	0.229
Participating tuition	-0.022	-0.457*	0.250
Number of hours spent in tuition classes per week	0.093	0.050	0.006
self-study hours per week	-0.014	0.269	-0.160
Covered the syllabus before 2 months	-0.147	-0.335	0.181
School attendance	-0.428*	0.107	-0.021
Finishing syllabuses before the exam	-0.160	0.227	0.531*
Feedback from the school teachers for writing answers for past exam papers	0.344	0.142	-0.362*
School attendance	-0.289	0.120	-0.280
learning the methodology of writing answers to the past papers in school	-0.018	-0.057	-0.048
Participation for revision classes,	0.393*	-0.045	0.076
Learning the methodology of writing answers to the past papers in tuition classes	0.127	0.122	-0.294
Money for tuition classes	-0.254	-0.336	-0.090
Support from subject teachers	0.451*	0.077	-0.140

* Coefficient > 0.3, Variables within coefficients were selected for the regression

(A/L index of students) is significantly affected only by school attendance (Z value = 2.23, P-value = 0.026) and completing syllabuses on time (Z value = -2.22, P-value = 0.027).

Parent related factors

According to the ordination diagram, parents of the students from newly upgraded 1AB schools were not separated from the parents of the students from other 1AB schools that of the control group, indicating no clear involvement of parents in students' performances (Figure 4).

Teacher related factors

As shown in the ordination diagram, subject teachers of other 1AB schools and the subject teachers from newly upgraded 1AB schools were separated, slightly (Figure 5). According to the scree plot, two principal components (Figure 6) were selected as the most significant principle components determine the clustering pattern observed in the ordination diagram in Figure 5. As shown in Table 2, eight variables (with coefficient values > 0.3) were selected for further analysis. These variables include; section, highest educational qualification, reading extra books related to subjects, train students to write answers to questions, students' attendance, revision program, attractive environment and facilities identified as the variables that were significantly determined the clustering pattern of the data set (Table 2).
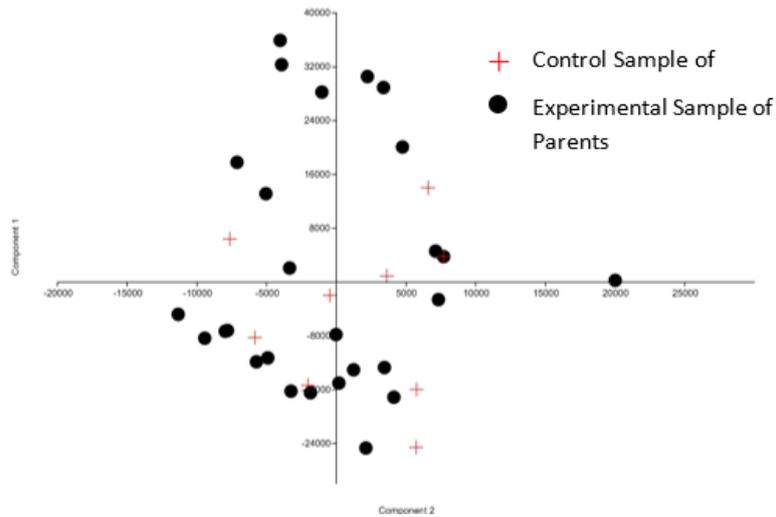
Figure 4: Ordination diagram of the first two components generated in the PCA of the parents of newly upgraded 1AB schools as experimental sample and parents in old 1AB schools as a control sample.
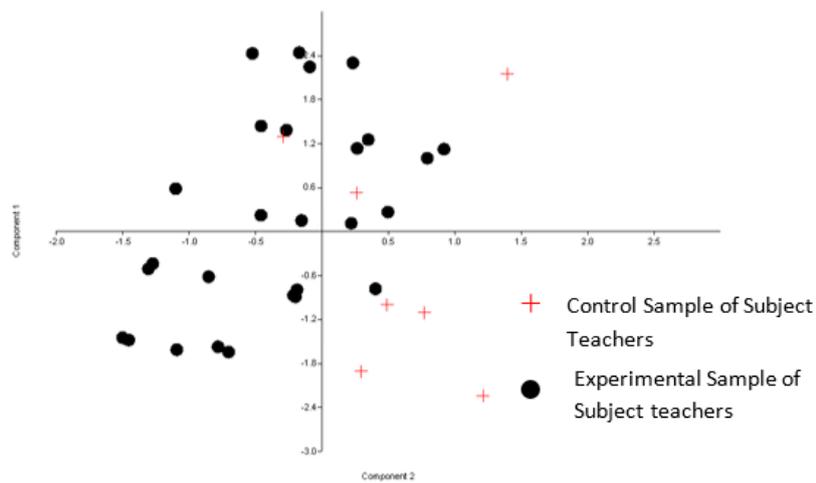
Figure 5: Ordination diagram of the first two components generated in the PCA showing the distinct separation of the subject teachers of newly upgraded 1AB schools as an experimental sample and subject teachers in old 1AB schools as a control sample.
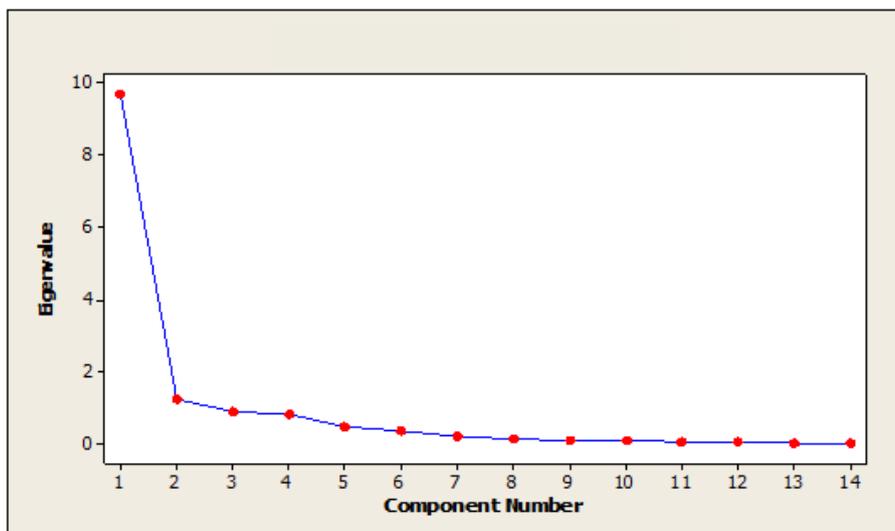

Figure 6: Eigenvalues of each eighteen principal components that determine the clustering pattern of the data set of subject teachers.

Table 2: Coefficients of each variable in each principal components obtained from the PCA analysis of subject teachers data set

Variables	PC1	PC2
Section	0.047	0.620*
Highest educational qualification	0.033	0.658*
Highest professional qualification	-0.220	-0.229
Cover the syllabus	-0.182	0.303
Doing revision before the exam	-0.275	0.043
Promote positive thinking program	-0.292	0.085
Evaluate type	-0.291	0.094
Give feedback	-0.292	-0.116
Extra subject related books	-0.310*	-0.057
Practice to write the answers	-0.314*	-0.024
Students' attendance	-0.312*	0.046
Revision program	-0.312*	0.020
Attractive environment	-0.311*	-0.021
Facilities for successful study	-0.313*	-0.026

*Coefficient > 0.3, Variables within coefficients were selected for the regression
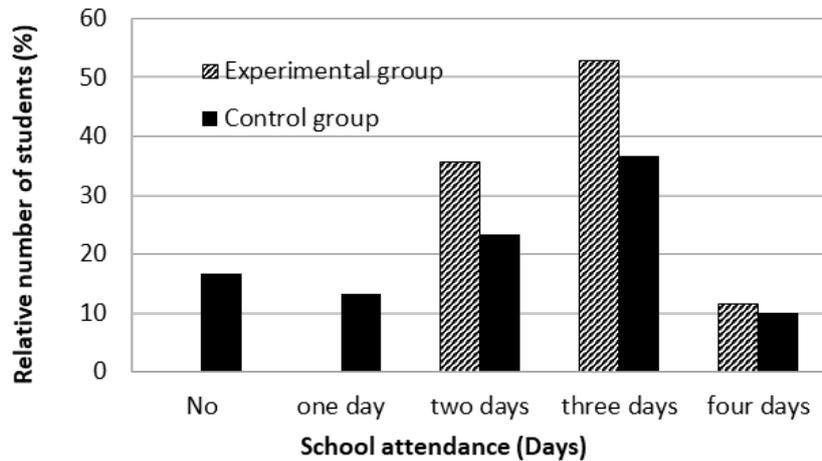
Figure 7: School attendance after filling the application for G.C.E. A/L examination by the students in newly upgraded 1AB schools (experimental group) and in other 1AB schools (controlled group).
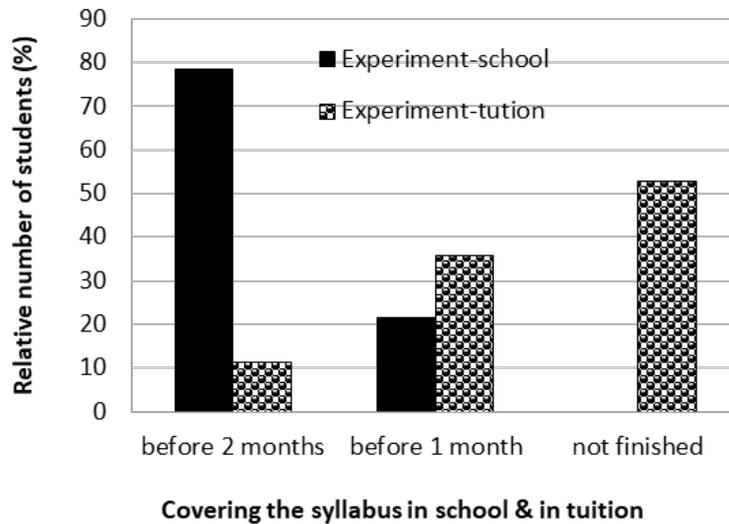
Figure 8: Completing the syllabus in school and in tuition of the students attended to newly upgraded 1AB schools.

When the ordinal regression analysis was conducted for teachers data set using the above selected variables as predictors, the response variable (A/L index of the students) was significantly affected by the student's attendance of the last few months (Z value = 3.15, P-value = 0.002).

As shown in Figure 7, school attendance after filling the A/L application of newly upgraded 1AB schools was higher than that of other 1AB schools (T = 0.83, p = 0.03). Further, Figure 8 clearly revealed that the A/L syllabus was completed two months before the exam in newly upgraded 1AB schools. However, in tuition classes syllabus was covered during the last two months.

Structured interview with subject teachers

All nine interviewees agreed that the student performance in Science and Mathematics in G.C.E. O/L are important in performing well at the G.C.E. A/L examination, as these subjects enhance logical implication that is highly required at G.C.E. A/L. All teachers interviewed mentioned that the daily school attendance is important because of accurate revision of the subjects is conducted after the completion of the syllabi. All the interviewees had a common idea that self-study by students is needed for their higher achievements. Further, teachers were of the view that most of the students stop their extracurricular activities when they come to the G.C.E. A/L class. Because the subject teachers guide students after analyzing the marking schemes and giving facts in brief, students can reach high achievement.

DISCUSSION

A/L index value comparison between newly upgraded 1AB schools and other 1AB schools revealed that general perception, that students in newly upgraded schools have higher achievements, is true. Further, ordination diagram showed that answers given by students in the newly upgraded is different from that given by the students in other 1AB schools. This indicated that behavior of students in newly upgraded 1AB schools is different from that of the students in other schools. However, there is a certain amount of overlap between the two groups as it can be expected where both schools can have students who deviate from general pattern. The PCA analysis showed that among the factors tested, only seven factors; O/L Index, participating in tuition, school attendance, completing the syllabuses on time, feedback from the school teachers for written answers for past exam papers, participation for revision classes and support from subject teachers were responsible for separating the two clusters. If it is explained further, students from newly upgraded schools have higher O/L index, they participate on less number of tuition classes, have higher school attendance, their syllabi is completed on time, they get feedback from teachers more often, participate in more revision classes and get more support from subject teachers in the school compared to the students in other 1AB schools.

However, the ordinal regression analysis revealed that only students' school attendance and completing the syllabus on time have affected the A/L index of students. In contrast, the general opinion of the parents and students is

that school attendance does not affect the A/L achievements (Personal observations of the researcher). If the syllabus is completed on time, teachers get time to discuss questions with students with their experience on past marking schemes. The ability to synthesize an answer to a question is significantly important to get a higher achievement from an exam. This may be the reason why completing the syllabus has affected the student achievements at the A/L examination. However, the attendance of students in the last few months is also critical, as this is the period that teachers get time to discuss past papers and target questions with students. Thus, this may be the reason why school attendance of students affected their achievements. Unfortunately, the current tuition culture affects badly on students' school attendance. In most tuition classes, teachers only pay attention to complete the syllabi, but do not pay attention to prepare students to synthesize answers for possible exam questions. According to the child Psychology, the education should be built step by step. The child can not be filled with knowledge within few days. Gradually, a child should be given the ability to synthesize, after that the ability for analysis is gained automatically (Blum and Niss, 1991; Karunanayake, 2006). This is being properly done in the schools. However, the students' school attendance is crucial in properly conducting this process. Thus, the school administrative body has to take the results of this research seriously. They should have to plan different activities to retain students in schools and to improve their attendance. Further, they should encourage teachers to complete the syllabus on time and train students to synthesize answers during the remaining period.

The answers given by parents of students in newly upgraded and in other 1AB schools were not significantly different as shown by the ordination diagram. Thus, it seems that the parent factors that we have studied have no effect on determining the changes between the two types of schools. In contrast, analysis of teachers' responses to the questions revealed that highest qualifications teachers have, reading extra subject related books by students, training students to answer questions, student attendance, revision programme, attractive environment in the class and facilities for successful study in newly upgraded 1AB schools are different from those of other 1AB schools. However, among these factors only the student's attendance has significantly affected the high A/L achievements. The importance of students' school attendance has been discussed above. The findings from the teachers' data set reiterate the significance of this again.

Results of the principal component analysis revealed that the results of G.C.E. (O/L) Science and Mathematics of students in two types of schools are significantly different and thus these results may be affecting the students' A/L achievements. Although, this factor was not found as a significant factor affecting A/L achievements according to the results of the ordinal regression analysis, it is important to further discuss about this factor. Mathematics has no straight connection to A/L biology syllabi. However, it could be assumed that the logical and analyzing ability developed through Mathematics learning may affect the higher achievements in Physics and Chemistry. It has

been shown that mathematics improves the logical skills of students which may improve the learning abilities of many other subjects (Bium and Niss, 1991). The link between G.C.E. (O/L) Science and G.C.E. (A/L) Biology subject achievements may be the memorizing ability. Higher achievement in G.C.E. (A/L) Biology students have to have a high memorizing ability (Tharmaseelan, 2007). A student must be able to memorize the information and use it appropriately whenever necessary.

The general belief of G.C.E. (A/L) students is that tuition classes help in achieving good results at the G.C.E. (A/L) examination (Pallegedara, 2012). So there is a trend among students to attain tuition classes without going to schools. In this study, it showed that attending tuition has no effect on A/L achievements. However, this may be wrong interpretation as very few students in the data set analyzed in this research have not participated in tuition. Students themselves say that there is no time for them to do self-studies due to tuition classes. It is also confirmed by the parents. Unfortunately, both students and parents value tuition. Some quantitative data shows that students had not identified the importance of school education and sometimes they attend tuition classes avoiding schools (Nanayakkara and Ranaweera, 1994).

Some qualitative data showed that the students A/L achievements have significantly affected by the self-study time. However, again students in both the newly upgraded and other schools samples have spent more or less similar time for self-study. Nevertheless, the amount of time spent on studying only had no direct influence on academic achievement (Nonis and Hudson, 2006). Nonis and Hudson (2006) showed that it is the way that students utilize the time, matters more than the time spent, on their achievements. This suggests that students need more guidance on how to spend their study time effectively targeting the G.C.E. (A/L) examination.

The importance of co-curricular activities was highlighted in the study. The majority of the interviewees stated that extracurricular activities are important in enhancing human values than enhancing educational achievements. Further, the analysis showed that engage in extracurricular activities have neither improved nor retarded the A/L achievements of students. Thus, it is important to encourage students to do at least one sport activity to some extent as it is not negatively affecting the students A/L achievements and moreover, there are many other benefits from them. According to our view, we think the time should be managed under the guidance of the teacher and the parents in a well-planned timeline during the two years of A/L education to have a high achievement.

CONCLUSION

There were several differences between students in the two types of schools, newly upgraded 1AB schools and other 1AB schools. Newly upgraded school students had higher O/L Index and school attendance. They participate less in tuition classes. Teachers in newly upgraded schools complete the syllabus on time, give feedback for answers written for past paper questions and support students more in education. However, students' attendance and completing the syllabi on time by teachers determine the high achievements of students in newly upgraded 1AB schools.

ACKNOWLEDGEMENTS

DECLARATION OF CONFLICT OF INTEREST

The authors declare no competing interests.

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