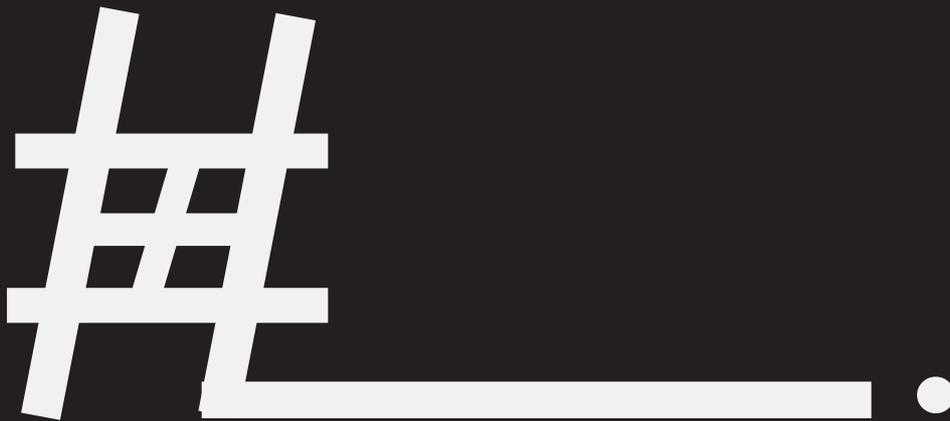


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**Department of Educational Research
National Institute of Education
Maharagama
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DAYANANDA KEPPETIGODA



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2. to disseminate research findings to educational policy makers; planners and practitioners within Sri Lanka as well as internationally;
3. to provide a forum for the interaction of ideas and discussion of research findings.

The Journal contains articles which are the products of educational research based on issues and problems related to the educational system in Sri Lanka.

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4. To ensure anonymity, only the title should appear on the manuscript. Attach a cover page with title, name and affiliation.
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University Selection among Students from Different Streams: A Comparison of Methods

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ABSTRACT

Students can select three different subjects in any one stream for their G.C.E. (A/L) examination in Sri Lanka for university admissions. It is a known fact that intelligent students select more challenging subjects than others. Subject contents and examination papers of the subjects consist of different levels of difficulties, mistakes, unclear parts, examiner differences etc. which are uncontrollable problems associated with the measurements of the student performance. The Common Currency Index (CCI) Method has been designed to select students independent of the said uncontrollable problems that are beyond the students' control.

The selection from CCI method, ZScore and average methods were compared mathematically and also with simulated data based on the Mixed Model concept. It is revealed that the CCI method is considerably better than the other two methods. This method can be equally applied to select students from examinations which contain courses with same or different number of subjects. Also it is a straight forward, simple, arguable and transparent method of selection.

Keywords: Common Currency Index (CCI) method , ZScore Method, Within Course (WC) Competition, Between Course (BC) Competition, Friedman's test, Simulation

1. Introduction:

The students qualify for various University courses according to the results of different subjects they offer at the G.C.E.(A/L) examination. Certain University courses allow students to qualify by offering more than one competitive combination of G.C.E. (A/L) subjects. Hence the admission to University courses is subjected to two types of competitions namely *within course* and *between course* competitions. According to previous studies carried out by the author^[1,2,3] and the other researchers^[4], it has been identified that the ZScore system^[5,6] has ambiguities, and does not eliminate unfavorable advantages gained by offering subject combinations with low within subject variations. This study has two main aims.

The first aim is to propose a selection method which incorporates adjustments to course wise potential differences of the students at the start of the G.C.E.(A/L) course and also various factors that govern the examination of different courses. It is assumed that sets of fairly homogeneous students when allowed to follow different courses during a fixed time period, develop their mental abilities in the same way. This concept is used to convert all the subject average marks in different courses to one type of subject average marks of a course. Then selection to universities can be performed using the converted average marks. Merit and district quota allocation can be done as usual. This method, preserves the average ranking order for within course competitors and does not create an unfair advantage to those who offer courses with easy subjects to enter the university.

The second aim is to compare different university selection methods, using simulation technique based on the generated subject raw marks according to the *mixed effect model*, in order to find the best selection method out of ZScore method, CCI method and the Average method. The study reveals that the CCI method selects students correctly for *within course* similar to average and for *between course* it selects students better than the other two methods.

2. Methodology

2.1 Study of selection methods and the proposed Common Currency Index (CCI) method)

2.1.1 Selection Index for *Within Course* Selection

Any selection index can be expressed as a linear combination of raw marks obtained by any student in within course subjects for a properly designed course.

i.e. Selection Index = $f = k_1x_1 + k_2x_2 + \dots + k_mx_m$, where k_j is the increase of the selection index for a unit increase in subject marks in the j^{th} subject where, $j = 1, 2, \dots, m$.

Impact of a raw mark on the selection index

The selection index f is a function of subject raw marks of m subjects x_1, x_2, \dots, x_m respectively.

i.e. $f = f(x_1, x_2, \dots, x_m) \dots \dots \dots (1)$

Therefore the impact on f by a subject raw mark can be defined as the change in f with respect to a unit change of any subject raw mark. The Impact on f with respect to a raw mark of the subject denoted by I , where $j = 1, \dots, m$. can be defined mathematically as

$$I = \frac{\partial f}{\partial x_j}, \quad j = 1, 2, \dots, m \dots \dots \dots (2)$$

2.1.2 Important factors to be considered at the selection^j

(a) Within Course (WC)

Since all of n students followed all the A_1, A_2, \dots, A_m subjects and sat for each examination paper in the same way, they equally face the following problems.

- difficulty levels of the subject contents (theory, practical work etc.)
- difficulty levels of the exam papers (difficulty levels of questions etc.)
- problems/drawbacks existing in exam papers (mistakes, examiner effects etc.)

(b) Between courses (BC)

Following problems exist in the competition between courses.

- Course differences (different difficulty levels of course contents, exam papers and other problems)

- Students' existing potential levels at the start of G.C.E.(A/L) are different (Bright students select more challenging subjects)

If $\frac{\partial f}{\partial x_j} = k$, for all j , (i.e. the change of the selection index f due to an increase

of a single raw mark of the subject j) then the selection is independent of the said problems explained in part (a) of section 2.1.2. On the contrary, if the above problems are not eliminated, then students will not be selected fairly. It can be shown that the impact on the ZScore by different subject raw marks is different^[2]. Then those who concentrated much on high impact subjects and obtained high marks for those subjects will get an unfair advantage. Therefore ZScore does not eliminate the above said problems in part (a) of section 2.1.2 and does not select correctly *within course*.

2.1.3 Common Currency Index (CCI) method: The concept of this method can be expressed in terms of currency conversion. The values of 200 Rs. and 200 \$, can be compared with each other by converting one currency to the other. Here the course effects are calculated using the course wise average marks of *between course competitors* who have passed the examination. It can be assumed that at the beginning of the G.C.E.(A/L) course, these students had the same chance to follow any of the courses to enter any course at the university. Let \bar{X}_{ij} be the average of the i^{th} Student in the J^{th} course where, $i = 1, 2, \dots, n_j, j = 1, 2, \dots, k$ and τ_j be the calculated course effect (Course average or median) of the j^{th} course, and τ be the highest course effect, $\tau = \max\{\tau_1, \tau_2, \dots, \tau_m\}$ and n_j is the number of between course competitors in the j^{th} course. Let \bar{Y}_{ij} , ($i = 1, 2, \dots, n_j, j = 1, 2, \dots, k$) be the converted mark of the i^{th} student in the j^{th} course, where $\bar{Y}_{ij} = \left[\frac{\tau}{\tau_j} \right] \bar{X}_{ij}$, i.e. Convert all the course marks \bar{X}_{ij} in each course j , multiplying by the corresponding Common Currency Index $(CCI)_j = \frac{\tau}{\tau_j}$, for all j . Then the pooled converted marks, \bar{Y}_{ij} can be ranked and the selection can be performed for WC and BC competitions. The district effects can be considered at the selection stage and sex effect is not considered. If the converted marks become greater than 100, then a linear adjustment to all the converted marks can be made without any effect on the selection.

2.1.4 The Simulation Study: Simulated data was used to compare the three methods, namely the ZScore method, The CCI method and the method based on averaging students' marks. Seven data sets of raw marks were generated, in order to study different distribution patterns of raw marks as well as student effect distribution patterns. Each data set included subjects eligible for the courses (say) Physical Science, Bio Science and Agriculture and data was generated to satisfy the mixed model explained in section 2.2. The parameters used are given in table 2.1. In the mixed model the subject effect was considered as fixed and the student effect was considered as random from some distribution. The error distribution was taken as Normal with zero mean and variance depending on the subject. Then using the subject raw marks generated for the three courses, the **selection index values** were calculated according to the three selection indices. Then the obtained three **selection index values** were compared with the actual student effect values and also their ranks were compared separately for the 7 data sets. The association of the student effects and their ranks with those of selection indices of the three methods were also studied. Histograms, Boxplots, correlation analysis and the Friedman's Test were used for comparing the three methods for within course competition and between course competition.

Table 2.1 : Distributions of the students' ability and the random errors considered in the generation of raw marks for different data sets

Data Set	Student ability	Random errors				
		Combined	Physics	Chemistry	Biology	Agriculture
		Maths				
1	$N(0, 12^2)$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$
2	$\text{Exp}(0.2)$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$
3	$N(0, 20)$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$
4	$G(2, 25)$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$
5	$\text{Sev}(0, 5)$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$
6	$U[0, 20]$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$
7	$U[0, 41]$	$N(0, 10^2)$	$N(0, 8^2)$	$N(0, 5^2)$	$N(0, 7^2)$	$N(0, 6^2)$

The distributions 1 to 7 in the Table 2.1 are Normal(N), Exponential(Exp.), Gamma(G), Smallest Extreme Value(Sev), and Uniform (U) with their respective parameters as indicated.

2.2 Comparison of the ZScore method, CCI method and the Average method

For each data set, the subject raw marks of a student were generated taking subject as a fixed effect and the students' level of intelligence as a random effect according to the model,

$$X_{ij} = \mu + su_i + st_j + e_{ij} \dots\dots\dots(3)$$

It is assumed that st_j has a particular distribution and the error $e_{ij} \sim N(0, \sigma^2)$

The parameter values used are given in Table 2.1. Here, X_{ij} = raw marks of the j^{th} student for the i^{th} subject, su_i = effect of the i^{th} subject. st_j = j^{th} student's ability where, student ability includes his intelligent level and his devotion. e_{ij} , random effect for the i^{th} subject of the j^{th} student (error). The unexplained error variations e_{ij} s are controlled up to certain extent in an examination for WC, because students face subject contents, exam papers difficulty levels, time duration etc. similarly in the examination. The unexplained error variation is made up of other social factors (other than intelligence and devotion) that affect the student and is thus still associated with the student ability in an examination. Hence the error variation is added to the student ability and it is named as the *student effect*.

Seven data sets were generated where in each set, student intelligence effects and random errors were generated as shown in Table 2.1 for 1000 students. Subject effects are taken as 60,50,40,50 and 60 for subjects combined mathematics, Physics, Chemistry, Biology and Agriculture respectively. Then for each set, the raw marks of the students were calculated according to the model (equation (3)). A total set of students made up of 300 Physical Science students, 300 Bio Science students and 400 Agriculture students is assumed as the composition for comparing between course competitions. Each set of passed students were ranked according to each selection index and their rank deviations from their actual student effect ranks were calculated. Then the Boxplot diagrams of the rank deviations by courses were drawn for *within course* and *between course* competitions separately for comparison of the methods. Also Friedman's test was applied to test whether the medians of the absolute deviations from the correct rank (as given by the rank of the student effect) are the same for the three selection methods.

2.2.1 Spearman's Rank Correlation:

Spearman's rank correlation coefficient (r_s) was computed using the ranks of the data. In two data sets X and Y, replace the smallest X value with one, the next smallest with two and so on. Repeat the same procedure on the Y values. Then

$$r_s = \frac{\sum \text{rank}_x - (n+1)/2)(\text{rank}_y - (n+1)/2)}{n(n-1)(n+1)/12}$$

This is infact the Pearson's formula applied to the ranks. The null hypothesis tested is that the population value of a rank correlation coefficient is zero. The test statistic is Spearman's rank correlation coefficient and use the corresponding tables for this test..

2.2.2 Friedman's Test:

This test is used to investigate the significance of the differences in response for K treatments applied to n subjects. The test assumes that the subject's response to one treatment is not affected by the same subject's response to another treatment and the response distribution for each subject is continuous.

In this method, the data can be represented by a table of n rows and K columns. In each row the rank number 1, 2, ..., K is assigned in order of increasing value. For each of the K columns the rank sum R_j ($j=1,2,\dots,K$) is determined.

The test statistics is $G = \frac{12}{nK(K+1)} \sum_{j=1}^K R_j^2 - 3n(K+1)$

If the calculated value of this test statistic exceeds the critical χ^2 value obtained from tables with K-1 degrees of freedom, the null hypothesis that the effects of K treatments are all the same is rejected.

If ties occur in the ranking procedure one has to assign the rank member for each series of equal results. In this case the statistic becomes,

$$G = \frac{12(K-1)S}{nK^3 - D}, \text{ where } S = \sum_{j=1}^K (R_j - \bar{R})^2 \text{ and } D = \sum f_i t_i^3$$

Where t_i is the size of the i^{th} group of equal observations.

3 Results

3.1 Mathematical Investigation

The impacts of the subject raw marks on the selection indices of the methods Average, ZScore and the CCI method (converted marks) are studied for WC and BC selections.

3.1.1 WC Selection:

Here all the students offer the same course with the same 3 subjects at the G.C.E.(A/L) examination and the selection to a University course will be done only from them. Let x_{ij} be the raw mark of the i^{th} student for the j^{th} subject, where $j=1,2,3$.

$$\text{i) Average of the } i^{\text{th}} \text{ student} = \bar{x}_i = \frac{(x_{i1} + x_{i2} + x_{i3})}{3} \dots (3)$$

if the impact on the Average by a raw mark of the subject-1 is $\Delta \bar{x}$, Then,

$$\bar{x}_i + \Delta \bar{x} = \left[\frac{(x_{i1} + 1) + x_{i2} + x_{i3}}{3} \right] \dots \dots \dots (4)$$

$$\Delta \bar{x} = \frac{1}{3} \text{ (From equations (4) - (3))}$$

Similarly it can be shown that the impacts on the average by each of the subject raw mark of the subject-2 and subject-3 are also equal to 1/3. Therefore the impact on the average by any subject raw mark is the same. Hence, use of average eliminates uncontrollable problems arising at an examination and does not create unnecessary advantage among students in the selection. (Note: Similarly it can be shown that any index which is proportionate to the aggregate acts as same as the average does in the WCselection)

ii) ZScore of the i^{th} student = average of the subject wise standardized values of the raw marks of the student. Let \bar{X}_j be the average of raw

marks of the j^{th} subject of the n students who offered that subject and S_j be the standard deviation of the raw marks for the j^{th} subject of the same n students. $j=1,2,3$

$$\begin{aligned} ZScore_i &= \frac{\sum_{j=1}^3 z_{ij}}{3} = \left(\frac{z_{i1} + z_{i2} + z_{i3}}{3} \right) \\ &= \frac{1}{3} \left[\frac{x_{i1} - \bar{X}_1}{S_1} + \frac{x_{i2} - \bar{X}_2}{S_2} + \frac{x_{i3} - \bar{X}_3}{S_3} \right] \\ &= \frac{1}{3} \left[\frac{x_{i1}}{S_1} + \frac{x_{i2}}{S_2} + \frac{x_{i3}}{S_3} - \left(\frac{\bar{X}_1}{S_1} + \frac{\bar{X}_2}{S_2} + \frac{\bar{X}_3}{S_3} \right) \right] \\ &= \frac{1}{3} \left[\frac{x_{i1}}{S_1} + \frac{x_{i2}}{S_2} + \frac{x_{i3}}{S_3} - K \right] \dots\dots(5) \end{aligned}$$

Where K is a constant for all n students in the course. Therefore, Impact on Z -score due to increase of one mark of the subject - 1, will be given by,

$$ZScore_i + \Delta ZScore = \frac{1}{3} \left[\frac{(x_{i1} + 1)}{S_1} + \frac{x_{i2}}{S_2} + \frac{x_{i3}}{S_3} \right] \dots\dots(6)$$

$$\Delta ZScore \text{ of Subject I} = \frac{1}{3S_1} \quad (\text{From equations (6) - (5)})$$

Similarly it can be shown that the impact on the Z -score, by one mark of the subject -2

is $\frac{1}{3S_2}$ and that of by the one mark of the subject- 3 is $\frac{1}{3S_3}$ Usually $S_j \neq S_k$ For or any

$j \neq k$. The impacts on $ZScore_i$ by different subject marks are different. Therefore, $ZScore_i$ index does not eliminate the uncontrollable problems arising at an examination for WC selection. Since, $ZScore_i$ depends on the S_j (Island subject SD) the use of $ZScore_i$ creates unnecessary advantages among students who concentrated more on high impact (low variability) subjects. At the same time the uncontrollable problems arising at an examination explained under 2.1.2 (a) affect the students differently.

The resulted high impact on the selection index is unfair. As such $ZScore_i$ does not select students correctly in WC Selection.

iii) The CCI method was explained under 2.1.3. As such,

$$\bar{Y}_{ij} = (\tau/\tau_j) \bar{X}_{ij} = (J/J_j) \left[\frac{x_{i1} + x_{i2} + x_{i3}}{3} \right] \dots (7)$$

$$Y_{ij} = \left(\frac{\tau}{\tau_j} \right) X_{ij} = \left(\frac{\tau}{\tau_j} \right) \left(\frac{x_{i1} + x_{i2} + x_{i3}}{3} \right) \dots (7)$$

For a particular course j the impact on the selection measure, \bar{Y}_{ij} (or converted marks) due to increase of one mark of the subject-1 is $\Delta \bar{Y}$ and Then,

$$\bar{Y}_{ij} + \Delta \bar{Y} = \left(\frac{\tau}{\tau_j} \right) \left[\frac{(x_{i1} + 1) + x_{i2} + x_{i3}}{3} \right] \dots (8)$$

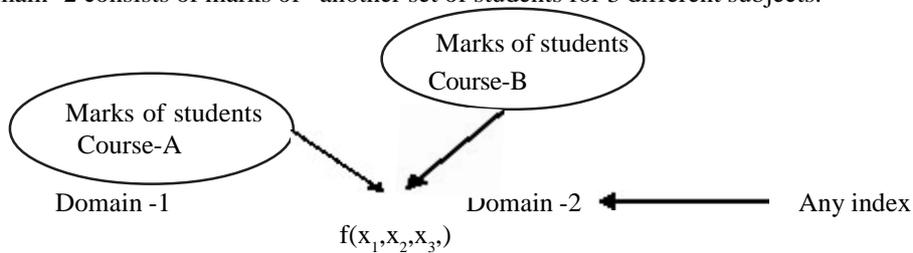
$$\Delta \bar{Y}_j = \frac{\tau}{3\tau_j}, \quad (\text{From equations (8)-(7)})$$

Similarly it can be shown that the impact on the selection index (here the adjusted average mark) of the course j , is same for the increase of the raw mark of the subject -2 or that of the subject- 3, which is equal to $\frac{\tau}{3\tau_j}$ (a constant for the subjects of the j^{th} course).

Therefore the impact on the selection index by any subject raw mark is same for the course j and it does not give unfair advantage among students. Also the use of CCI method eliminates uncontrollable problems arising at an examination explained under 2.1.2 (a) for WC selection.

3.1.2 BC Selection

Consider two domains where Domain -1 consists of marks of students for 3 subjects and Domain -2 consists of marks of another set of students for 3 different subjects.

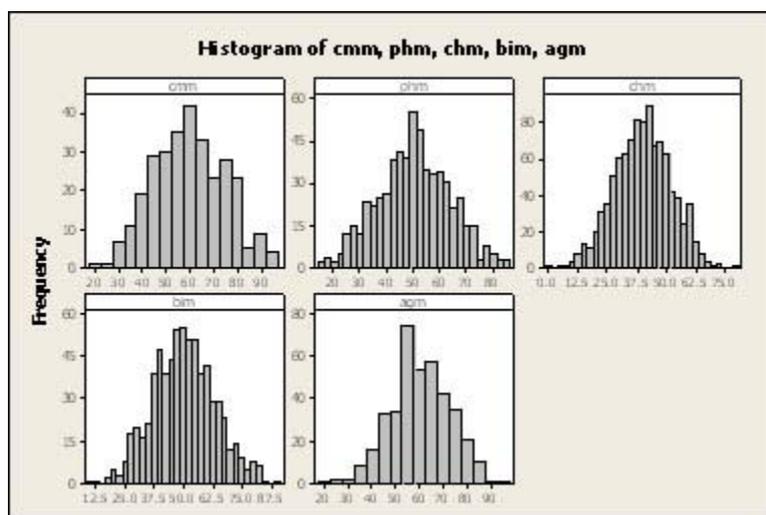


For course B, raw marks were obtained under different circumstances (Subject contents, difficult levels of exam papers etc.) than the circumstances for the course A. Therefore it would not make any sense to substitute those two sets of values in to the same function. Hence there are no common indices existing for comparison of between course performances. (Note: A function gives us a meaningful result only when it is applied to the values in the correct domain for it). As such both, average and ZScore indices do not select students correctly in the case of between course competitions^[3]. But the CCI method was designed to eliminate this by valuing different course average marks and converting their marks in different courses to the same type of marks as converting currency in to one type. This conversion is explained under the CCI method.

3.2 Analysis of the simulated marks:

Although all the data sets explained in table 2.1 were analysed, only results from data sets 1 and 2 are used here for illustration. Figures 3.1 and 3.2 give the histograms of the marks for each subject for data set 1 and data set 2 respectively.

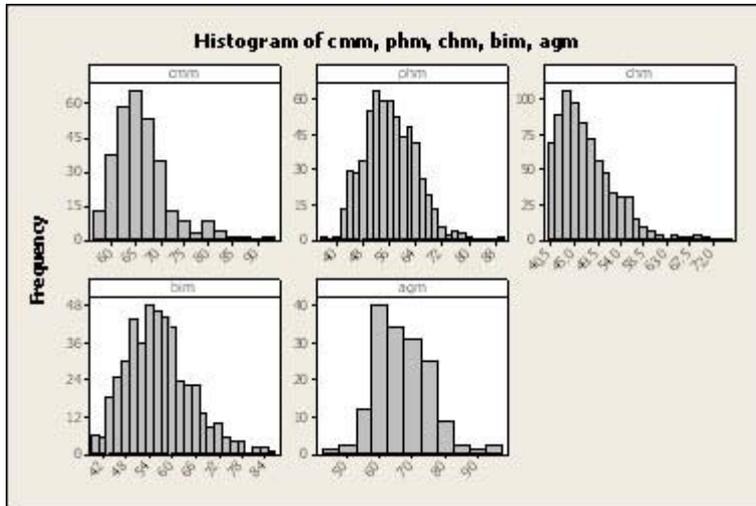
Figure 3.1 – Histograms of subject marks for data set 1 (Symmetric)



Legend

cmm – combined mathematics, phm – physics, chm – chemistry,
 bim – biology and agm – agriculture

Figure 3.2 – Histograms of subject marks for data set 2 (Skewed)



Legend

cmm – combined mathematics, phm – physics , chm – chemistry

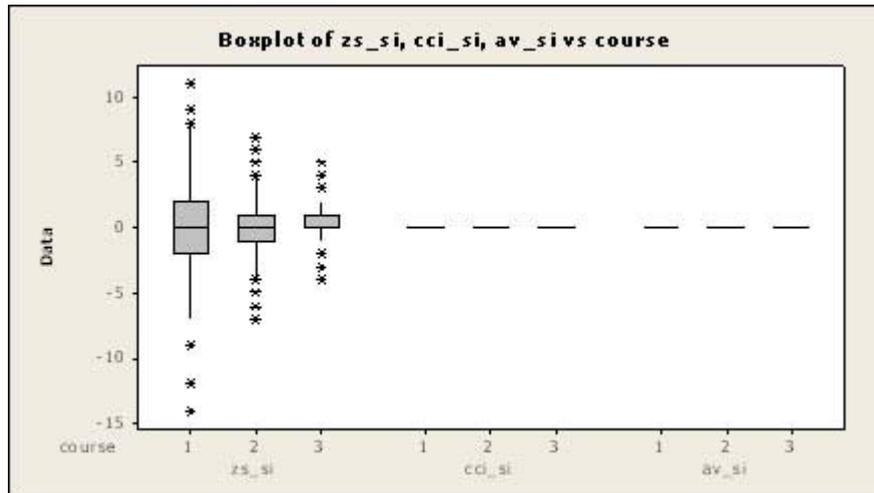
bim – biology and agm – agriculture

The distributions of subject marks in data set 1 are symmetric while those in data set 2 are skewed. Therefore these two cases represent two extreme data sets considered in this study.

3.2.1 Within Course Competition:

The differences between students’ ranks according to each selection method and their ranks according to student effects were calculated by each course and boxplot diagrams were drawn for those differences by each selection method separately for the three courses. The boxplots drawn for the three courses for each selection method for dataset-1 and data set-2 are displayed in figures 3.3 and 3.4.

Figure 3.3 – Boxplots illustrating the difference between each of the three methods and the student effect for within-course for the three courses for **data set 1**



Legend

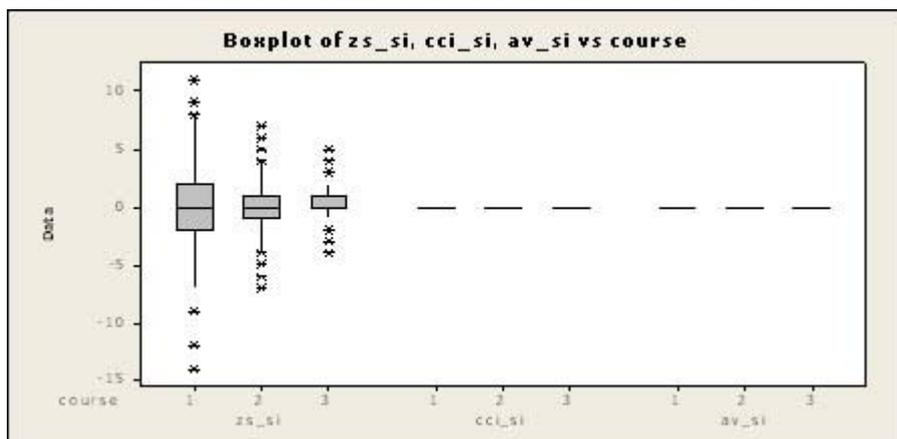
Course 1 – Physical Science Course 2 – Bio Science Course 3 – Agriculture

zs_si=within course rank of z-score – within course rank of student intelligence effect

cci_si=within course rank of cci – within course rank of student intelligence effect

av_si=within course rank of average – within course rank of student intelligence effect

Figure 3.4 – Boxplots illustrating the difference between each of the three methods and the student effect for within-course for the three courses for **data set 2**



Legend

Course 1 – Physical Science Course 2 – Bio Science Course 3 – Agriculture

zs_si=within course rank of z-score – within course rank of student intelligence effect

cci_si=within course rank of cci – within course rank of student intelligence effect

av_si=within course rank of average – within course rank of student intelligence effect

The figures 3.3 and 3.4 show that the CCI method and the average method, both give ranks that are the same as the ranks of students’ effects in all three groups while ZScore ranks are different to student effects for within course selection. Same results could be seen in both data sets 1 and 2.

3.2.2 Between Course Competition:

Assuming that the student’s marks corresponding to each data- set1 and data set- 2 in the table 2.1 are the marks for Between Course Competition, the student **selection index values** were calculated for the three courses, according to each method and pooled together in order to select students from all three courses. Then the method giving least deviation compared with the actual students’ effect was identified as the best method to select student for the university.

(a) Comparison of methods using Spearman correlation coefficient

The Spearman correlation coefficient matrix was calculated between the ranks of the selection values in each method and the ranks of student’s effect and the results are displayed for the two data sets in the table 3.1

Table: 3.1 Spearman correlation coefficients and Prob>r under H₀ :Rho=0

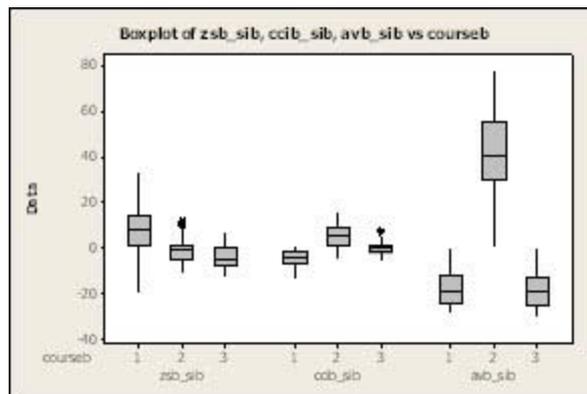
Data set	ZScore	CCI	Average
1	0.99826	0.99927	0.97677
	(<.0001)	(<.0001)	(<.0001)
2	0.99535	0.99910	0.94592
	(<.0001)	(<.0001)	(<.0001)

The results indicate, that ranks of all the three methods are highly correlated (linearly related) with the ranks of student effects. Out of the ranks of three selection indices the student effect is most closely related with CCI method, followed by the ZScore methods and least with the average. Here both data sets (Normally distributed marks and skewed marks respectively) give similar results.

(b) Comparison of methods using Boxplots

For each method, the difference of the rank of the selection value and the rank of the student effect were calculated for all the students and the boxplots were drawn for each method by each course. This is given in figures 3.5 and 3.6 for data sets 1 and 2 respectively.

Figure 3.5 – Boxplots illustrating the difference between each of the three methods and the student effect for between-course for the three courses for **data set 1**



Legend

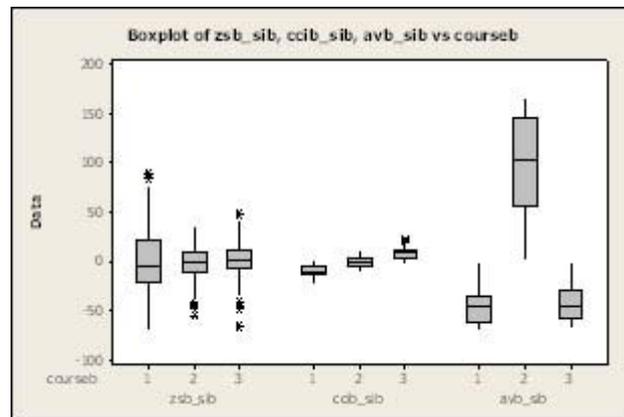
Course 1 – Physical Science Course 2 – Bio Science Course 3 – Agriculture

zsb_sib=between course rank of z-score – between course rank of student intelligence effect

ccib_sib=between course rank of cci – between course rank of student intelligence effect

avb_sib=between course rank of average – between course rank of student intelligence effect

Figure 3.6 – Boxplots illustrating the difference between each of the three methods and the student effect for between-course for the three courses for **data set 2**



Legend

Course 1 – Physical Science Course 2 – Bio Science Course 3 – Agriculture

zsb_sib=between course rank of z-score – between course rank of student intelligence effect

ccib_sib=between course rank of cci – between course rank of student intelligence effect

avb_sib=between course rank of average – between course rank of student intelligence effect

According to figure 3.5 , for the normally distributed marks , ZScore and CCI method ranks are both close to the ranks of student effects while average ranks are not. But for skewed marks ,out of the three methods least differences were associated with CCI method and next with the ZScore and the most with the average method in all three courses.. This pattern was seen through out all the sets. Thus this suggests that the students’ effects are more closely interpreted by the CCI method than the other two methods for between course competitions particularly for skewed data.

(c) Friedman Test for comparing absolute differences of ranks

(i) Comparison of three methods:

Here for between course competitions, the absolute deviations between the ranks of the three methods and the ranks of the students’ effect were considered as

treatments. As the deviations do not show the actual picture of the total deviations due to cancelling of the effects, absolute deviations were taken instead. When applying the Friedman test the absolute values were considered as the response variable, the methods were considered as treatments and the Student as the blocks.

As such, Response for Treatment 1 = I Rank of ZScore - Rank of Students' Effect I

Response for Treatment 2 = I Rank of CCI method - Rank of Students' Effect I

Response for Treatment 3 = I Rank of average - Rank of Students' Effect I

Where Treatment-1, Treatment-2, Treatment-3 are the ZScore method, CCI method and the average method respectively.

H_0 : all the treatment effects are same Vs. H_1 : There exist at least two different effects

Table 3.2 Results of the Friedman Test for comparison of Treatments 1,2 and together

Treatment	Data - Set - 1 (N = 475)		Data - Set - 2 (N = 758)	
	Estimated Median	Sum of ranks	Estimated Median	Sum of ranks
1	5	815.5	13	1393.0
2	3	658.5	8	980.0
3	22	1376.0	48	2175.0

Data set-1 : Friedman Statistic (Adjusted for ties)=615.55, D.F=2, p=0.000

Data set-2 : Friedman Statistic (Adjusted for ties)=990.86, D.F=2, p=0.000

It can be concluded that treatment effects are highly significant in both data sets. In both data sets the medians and sum of ranks is in the order

CCI method < ZScore method < Average method.

(ii) Comparison of ZScore and the CCI method:

H_0 : Treatment 1 and 2 effects are same Vs. H_1 : They are not equal

Table 3.3 : Results of the Friedman Test for comparison of Treatments 1 and 2

Treatment	Data set-1		Data set-2	
	Estimated Median	Sum of ranks	Estimated Median	Sum of ranks
1	6	770.5	13	1307.0
2	4	654.5	8	967.0

Data set-1 : Friedman Statistic (Adjusted for ties)=30.44, D.F=1, p=0.000

Data set-2 : Friedman Statistic (Adjusted for ties)=161.45, D.F=1, p=0.000

As the p values are zero, the differences in treatments are highly significant for both data sets. Also the estimated median and the sum of ranks of CCI method are less than that of ZScore. Thus absolute differences between CCI method and the Student effects are less than those of ZScore for both data sets..

(iii) Comparison of ZScore and the Average method:

H_0 : Treatment 2 and 3 effects are same Vs. H_1 : They are not equal

Table 3.4 : Results of the Friedman Test for comparison of Treatments 2 and 3

Treatment	Data set-1		Data set-2	
	Estimated Median	Sum of ranks	Estimated Median	Sum of ranks
2	7	520.0	18	844.0
3	23	905.0	52	1430.0

Data set-1 : Friedman Statistic (Adjusted for ties)=318.76, D.F=1, p=0.000

Data set-2 : Friedman Statistic (Adjusted for ties)=459.09, D.F=1, p=0.000

As the p values are zero, the differences in treatments are highly significant for both data sets. Also the estimated median and sum of ranks of ZScore method are less than that of Average method. Thus absolute differences between ZScore method and the Student effects are less than those of Average for both data sets.

(iv) Comparison of CCI and the Average methods:

H_0 : Treatment 1 and 3 effects are same Vs. H_1 : They are not equal

Table 3.5 : Results of the Friedman Test for comparison of Treatments 1 and 3.

Treatment	Data set-1		Data set-2	
	Estimated Median	Sum of ranks	Estimated Median	Sum of ranks
1	3	479.0	11	771.0
3	22	946.0	51	1503.0

Data set-1 : Friedman Statistic (Adjusted for ties)= 465.01, D.F=1, p=0.000

Data set-2 : Friedman Statistic (Adjusted for ties)= 712.53, D.F=1, p=0.000

As the p values are zero, the differences in treatments are highly significant for both data sets. Also the estimated median and sum of ranks of CCI method are less than that of Average method. Thus absolute differences between CCI method and the Student effects are less than those of Average for both data sets.

Hence it can be concluded that the absolute differences of ranks between the three methods and the Student effect increases in the following order with respect to medians and sum of ranks.

Data set-1:

CCI < ZScore < Average

Medians 3 < 5 < 22

Sum of ranks 685.5 < 815.5 < 1376.0

Data set-2:

CCI < ZScore < Average

Medians 8 < 13 < 48

Sum of ranks 980.0 < 1393.0 < 2175.0

4. Discussion:

The selection index for a properly designed course, with several subject combinations such as a course for G.C.E.(A/L) examination should be a linear function of raw marks. In order to eliminate the differences in the course contents and the examination papers, the impact on the selection index by any subject raw mark of the course should be the same. As such the impact by each subject raw mark of the course on the Zscore are different and thus it does not eliminate the uncontrollable factors such as the differences of the subject contents and the exam papers, mistakes exist in the examination papers etc. which are beyond the student concerned. Also the students who concentrate on high impact subjects (low variation) will get an unfair benefit. Any index which is proportionate to the average would make the same impact on the selection index by each of the subjects in the course and eliminates those uncontrollable factors within a course. Hence the average and the CCI methods which are proportionate to the average select correctly within course. Here the selection is independent from those uncontrollable factors that affect on the student.

The set of students who select any of the courses at the beginning of the G.C.E.(A/L) courses to enter any university course are the *between course competitors*. So from the between course competitors who have passed, the marks obtained on average in each course are used to equalize and convert all the marks to adjusted marks of the CCI method. CCI method selects the same set of students as average does for within course selection and both interpret the student's effect 100% for within course. This was explained by the figures 3.3 and 3.4. Also for between course competition, CCI method closely interprets the student effect compared to the other two methods and figures 3.5 and 3.6 give evidence for it. Further the correlation coefficients between the ranks of each method and the students' effect ranks show that the highest correlation is given by the CCI method (.99927 and .99910 respectively for the data sets 1 and 2), indicating that the student effect ranks are more closely related to the ranks of the CCI method compared to the other two method. The results of the Friedman's test concluded that the student effect is most closely interpreted by the CCI method, followed by the ZScore and lastly by the Average method. This goes on to show that the simulation study confirms the analytical properties of the selection indices well. As such out of the three methods, for both within and between courses competitions, the CCI method is better than the other two methods for selection of students to universities. Also the CCI method selects students correctly for any subset of the courses since any subset of course marks are also of the same type. Therefore this method correctly selects students for any stream that considers several courses. Hence if it is necessary to select students to a particular course in the university, from a subset of courses, CCI method will give the best set of students.

5. Conclusion:

The selection of students to universities from the G.C.E.(A/L) examination , includes two types of competitions, within course and between course competitions. Both types of competitions should be correctly selected by any selection method. The results obtained by the mathematical study have been confirmed by the simulation study. It shows that Z-Score does not select correctly within course and hence it is not independent from the differences in subject contents and exam paper differences etc., while CCI method and average select correctly within course. For between course competitions, the best method is CCI method compared to other methods. Although two extreme data sets have been used for illustration, this study has been extended to seven different sets of data which includes different distributions of subject raw marks. The application of descriptive methods and inferential methods both indicate that the CCI method is the best method to select students to universities. Hence, CCI method can be used to select students from similar standard, different courses with same or different number of subject combinations. Also this method can be used to select the best set of students from any single course or from any subset of courses or out of all the courses of GCE(A/L) examination..

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Success of Open Book Examination as a Component of School - Based Assessments in Sri Lanka

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ABSTRACT

It is generally accepted that the Open Book Examination (OBE) creates a less stressed environment for students in their assessments, promotes more active learning and creative use of knowledge gaining, while offering the student an opportunity to better understand and respond to a particular question. The context of the present study is on the quality of the OBE, which is one of the test methods of continuous school based assessments introduced to the school system in Sri Lanka after the educational reforms in 1998. The OBE belongs to a main group of essay type tests and until recent past this type of tests were used only in higher educational institutes like Universities and postgraduate institutes in the country. Hence, there is a paramount importance to study the level of adoption of the special characteristics of the OBE in school-based assessments.

In this study, success of the OBE evaluation techniques of three main language subjects: Sinhala, English and Tamil, and Social Studies, Music, Science, Mathematics and Commerce were studied in detail. Grade 10 and 11 subject teachers in a IAB school were used for the investigation. The results showed that the number of teachers, who used the recommended characteristics of the OBE for their evaluations, was very low. Further, the use of aims and objectives for giving an OBE varied from teacher to teacher and subject to subject. Although such variations are common for this type of tests, no one should deviate from the prime objectives of the OBE. Music teachers believe that they cannot use the OBE for their subject even though the suitability of the OBE is independent from the subject matter and depends only on the kind of questions that the teacher wants the students to answer. Most of the teachers, who teach Languages, Commerce and Social Studies, followed the features of OBE and their objectives are at a progressive level.

Although some teachers followed the features of OBE to a great extent, Science and Mathematics teachers have shown a very poor adoption level.

Introduction

School Based Assessments (SBAs) has been introduced to the Sri Lankan school system under educational reforms in 1998. According to SBA system, students are assessed in different ways at the end of every unit or lesson. The aim of these assessing criteria is to, develop teaching- learning process in the school system in Sri Lanka and to develop or bring students into a mastery level in every unit. SBA method introduces a variety of testing methods and test tools to decrease the monotony and stress of the student. Among those tests, Open Book Exam (OBE) is one of the latest tests introduced. However, according to Muthulingam (1979), Perera (1990) and Perera (2002), assignments, take home tests and essays that have been used prior to the introduction of SBA system are also falling into the same category of OBE.

The scope of this study was to identify the specific characteristics of the OBE, investigate the level of application of those progressive qualities in SBAs at present. Although, there is plenty of information available on the other conventional tests used in SBA, there is limited information about the OBE in literature. This study was conducted both in qualitative and quantitative basis to assess the present progressive level of the OBE in schools. Therefore, the information compiled in this study may be very important for the teachers, educational policy makers, planners and other practitioners in Sri Lanka. However, due to the limited resources, the study was confined to a single school.

Objectives

The main objective of this research was to compile relevant specific features of the OBE and investigate the present level of adoption of those features in SBAs in Sri Lanka. Therefore, the following are the two specific objectives of the study.

1. To compile the specific qualitative features of Open Book Examinations (OBEs) using secondary information sources.
2. To investigate the level of application of those features in OBEs conducted in the continuous school based assessment in Sri Lanka.

Methodology

To identify different types of test tools used in the School Based Assessment (SBA), books and instruction leaflets provided by the ministry of education for the introduction of this new method were studied. Further, discussions were held with the teachers, who were engaged in classroom teaching-learning process. As the OBE is one of the most important new test methods of the

assessment technique, information from other secondary sources such as, relevant publications of the ministry of education, textbooks and internet publications were critically reviewed. The specific qualitative features of the OBE were compiled using all those references.

St. Joseph's girls' school (1AB school), which is the largest, and the leading school in the Gampola educational zone having about 3000 students and 300 teachers was used for this study. Eighteen teachers, who teach grade 10 and 11 were used for the investigation. There were five parallel classes for each year in the school and altogether ten classes were considered in this study. To collect information regarding the views of teachers on uses of OBEs, objectives of using OBE for different subjects, pre-preparation of teachers when using OBEs, uses of different teaching methods especially for conducting OBEs and abilities that are expected to be developed in students when giving OBEs or special Intended Learning Outcomes (ILOs), a questionnaire was used. A draft questionnaire was prepared and a sample test was conducted with three teachers and based on their comments, the draft was reviewed before collecting data. All those information were collected from subject teachers like Sinhala, Tamil, English, Mathematics, Social Studies, Science and Commerce.

Further, to gather additional comments and cross check the answers of teachers, an informal friendly discussion was held with all those subject teachers involved in the data collection. Therefore, in this study data collection extended from quantitative to qualitative techniques. The data analysis was conducted using Excel computer software.

Results and Discussion

Qualitative Features of an Open Book Examination

OBE is a kind of test, where examinees are allowed to consult their class notes, textbooks, and other approved materials while answering questions. Although it sounds as very easy test method, the students who have not properly followed and not listened for instructions given by the teacher prior to the test will find it as a very hard and difficult test method (Andritsos, 2001; Anonymous, 2002).

There are two types of OBEs.

1. Restricted type OBEs.

Students are permitted to bring into the examination, one or more specific documents approved by the teacher (Mohanani, 1999).

2. Unrestricted type OBEs.

Students are free to bring whatever they like. They may bring handouts, short notes, or their hand written notes, because the questions will be designed in such a way that the answer will not be found directly in the text books handouts or class notes (Mohanana, 1999).

The Effect of Teaching Method on OBEs

In using this testing method, teacher will teach students how to acquire knowledge or teaching students how to learn. For using OBEs, the lecture method of teaching must be replaced by the workshop method or some other student centred interactive method to trigger the learning ability in students (Anonymous, n.d.; Mohanana, 1999). Because of this, creative, critical and decision-making abilities, and ability to apply knowledge to novel situations will be improved in students (Navarathne, 1996).

If teacher suggests giving an OBE, he or she has to decide it before the lesson is conducted. Teacher will have to design tasks that will provide exercises for appropriate mental skills required in each lesson. Instead of the lecture method, the class will have to apply discussions, questioning, and other active teaching learning processes. In other wards, teaching will be the training of the minds of students in essential intellectual skills (Anonymous, n.d.; Mohanana, 1999).

Learning Strategies Suitable for OBEs

The traditional learning strategy of spotting, preparing and memorizing ready-made answers will not work for OBEs. Instead of that, student will have to practice activities that will develop ability tests by OBEs. Students, who are used to face traditional examinations, usually take long time to figure out how to study for an OBE. It is therefore necessary to help the student to change his learning habits by giving him quizzes and mock examinations. According to this situation, student can develop teamwork or co-operative working environment, apply knowledge to different situations, and manage to simplify complex concepts, experimentations, and generate new knowledge by using present knowledge (Mohanana, 1999; Lio, & Teo, 1999).

Kind of Abilities Tested by an OBE

1. Ability to develop new information and mastery of knowledge with thinking ability.
2. Develop wide rang of higher order abilities (eg. Synthesis, analysis, evaluation).
3. Ability to acquire better understanding through critical reading while in language tests.
4. Master the content of the subject or course content.

5. Ability to analyse probable causes of problems.
6. Application of theories, and suggest factors which affect on them, meaning interpretation, forecasting, test designing, and ability to give ideas through rationale.
7. Ability to solve problems and making decisions through critical thinking.
8. Understanding, synthesizing, evaluating, and ability to use knowledge creatively (application of knowledge).
9. Ability to understand complex concepts pertaining to a cause (Mohanon, 1999; Anonymous, ^a, n.d.).

All those factors should be considered in designing and conducting OBEs in continuous school based assessment. Therefore, the success of the implementation of OBEs mainly depends on the teacher.

The Level of Application of Specific Features of OBEs Conducted in the Continuous School Based Assessment at Present

The analysis of data collected from the questionnaire is discussed in the following paragraphs.

1. Objectives of teachers in using OBEs for different subjects

The objectives of teachers' on evaluating critical thinking ability, testing the memory and testing the knowledge of students in conducting OBEs for different subjects are illustrated in the following figure (Fig. 1). According to the data, Science and Mathematics teachers have carried out this test method without any familiarity or understanding. However, compared to Languages and Social study teachers, Commerce teachers are well informed and more familiar with the above test method. Most important features of OBEs are critical thinking and analytical skills.

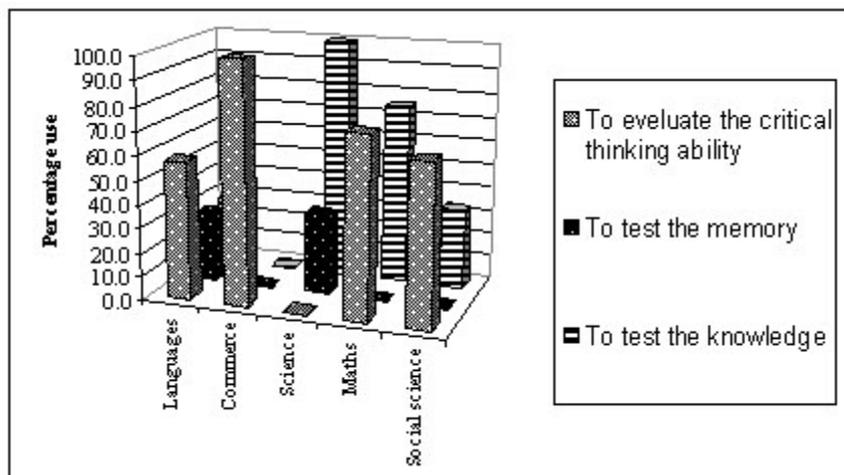


Fig. 1. Different objectives of teachers when preparing their OBE's

The evaluation of the very important characteristic “critical thinking ability” by the science and mathematics teachers when preparing their OBEs is about 0% and 60% respectively. These tests are not suitable to measure knowledge directly, but they are suitable to measure the creative use of their knowledge. Unfortunately, Science and mathematics teachers used OBE's to measure knowledge directly, which is quantitatively about 100% and 70% respectively. OBEs cannot be used to measure or test students memory (Mohanon, 1999). Yet the Science teachers have used OBEs for that purpose too. According to the above data, it shows that science teachers have used OBEs without proper awareness. Therefore, attention must be paid by the relevant authorities to overcome such major drawback in the school system.

2. Pre-preparation of Teachers When Using OBEs

If a teacher hopes to give an OBE for a lesson, it is very important to decide the teaching method, the suitability of a particular unit for an OBE, and make preparations prior to start the lesson. Teaching methods used for lessons, which were used to assess students by OBEs in this school are given in the table below (Table. 1).

Table: 1. Uses of different teaching methods for OBEs

Table I : uses of different leading method for OBE

Teaching Method	Percentage of Teachers
1. Activity based teaching	16.8
2. Discussion method	27.8
3. Group teaching method	5.5
4. Activity based & Discussion	11.0
5. Activity based & Group teaching	5.5
6. Discussion & Group teaching	11.2
7 Activity based, Discussion & Group teaching	11.2
8. Lecture method	5.5
9. Lecture & Group teaching	5.5

According to the above table, 89% of teachers used the correct methods of teaching suitable for OBEs. Only 11% of teachers have adopted unsuitable teaching methods like lecture method and discussion method.

3. Experiences of Teachers about OBEs

Sixty seven percent (67%) of teachers believe that the student score more in OBEs than the other conventional types of tests. By experience, 61% of teachers have found that students prefer this type of test better than the other types of tests. However, the idea of 89% of teachers is, that students are unable to create novel information by their knowledge. It implies that there is really a weakness or unsuitability, either in the teaching method or the method of questioning in the school.

According to the data, 61% of teachers have adopted restricted type OBEs with textbooks and the rest 39% of teachers have adopted unrestricted type OBEs. In this type of a test, it is necessary to restrict time duration to answer the question, but about 17% of teachers were unaware of this important fact. Therefore, there are certain lapses in implementing OBEs in the school.

4. Abilities that are Expected to be Developed in Students When Giving OBEs

The main intended learning outcomes in the open book assessment are; developing thinking ability, application of knowledge in novel situations, solving problems, critical thinking ability, creativity and higher intellectual abilities. According to the results only about 33.3% of the teacher population had a good understanding of above qualities. This is a major negative effect for the present school education and assessment system.

Data Acquired by the Discussion

It was found that the teachers of selected subjects use OBEs to measure different types of abilities and capabilities of students. It clearly showed that it varied from one subject to the other. It was revealed that Sinhala Language teachers adopted OBEs to develop ideas in situations like essay writing and also for testing memory, either with restricted time or unrestricted time. According to the interview, English language teachers used OBEs to measure the ability of understanding of paragraphs and to measure comprehension. Tamil language teachers used OBEs to measure both the comprehension capacity and the thinking ability. About 60% of the teachers of Social Studies, used OBEs to measure critical thinking. Commerce teachers stated that this is a very practical method for their subject.

The idea of Mathematics teachers was also that it is the best type of test, which could be used for mathematics. However, they feel that every student cannot score very high marks even if they are permitted to open their textbooks. Science teachers used OBEs to identify concepts, define concepts, test-memorizing capacity and to measure simple knowledge but they have not used in OBEs successfully.

Conclusions

According to the literature survey; the main characteristics of an OBE are; examinees are allowed to consult their notes, textbooks, and other approved materials, while answering questions. For better progress, more attention must be paid to methods of teaching and learning. The lessons should be well planned for OBEs and consider more when measuring their skills. Teaching method must be active interactive and students should be able to avoid mechanical memorization, mugging and rote learning. Measuring higher order cognitive abilities, hoping for rational answers should also be included. Instead of giving ready-made mechanical answers from textbooks or copying from the textbooks, creative critical and rational answers should be provided.

According to the data acquired from the questionnaire and discussion, Science & Maths teachers are not keen about the qualitative features of OBEs. Commerce, Languages and Social Studies teachers are aware of the qualities and seem to be more interested. Through the experience teachers have gained, they find that students like this type of tests than the other conventional types and their opinion is that the students are able to score more from this type of tests than the conventional tests.

Only about 33.3% of teachers measured abilities, skills that are awakened from students, by using OBEs. Although, most of the teachers change or alter their teaching methods to suite the qualities of OBEs, the qualitative features of an OBE have not been used in a favourable manner in the sample tested.

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The Contribution of Higher Educational Institutes in Promoting Teacher's Professionalism through Action Research

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ABSTRACT

This survey-research is intended to study how higher educational institutes contribute to promote teachers' professional development through action research. Findings have revealed that the majority of the higher educational institutes which conduct teacher education courses are semi-governmental and geographically and hierarchically distant from schools. Absence of regular and constant communication prevents teachers from accessing these courses or programmes. The shortage of such courses/ programmes also does not provide teachers adequate opportunities for benefiting from them to develop their professionalism through action research. These institutes' limited role as advisors and knowledge-providers has kept action research still in its infancy as a regular practice. Lack of a research culture and knowledge of action research in school community also negatively affects this situation. Yet action research is a compulsory component or a choice in various teacher education courses because of its self-directed, life-long aspects of learning. Absence of national level unique vision or institute-level common vision on action research has also become a barrier to promote common understanding to expand opportunities for action research.

Introduction

It is a well-recognized and recommended factor that teachers are supposed to build up a research culture within their immediate institutional background as a part of their professional culture. This aspect is supported by many factors which themselves become motives for teachers to be life-long learners and experimental, explorative and innovative 'agents of change' in the education system.

"Research needs freedom, and closeness of the researcher to the point of impact of his findings. Otherwise research degenerates to a mere academic exercise. It implies deep self examination and introspection. It has the potential of developing both the teacher and the pupil to continuing higher levels of attainment. This we believe is the kind of research that really matters in education."

(Jayathilake, L. 1994. P: 16)

In this regard, it is necessary that the teachers are supposed to be to be well-aware of what they do to bring about desirable changes in their learning-teaching process. For this, action research provides teachers with an immediate atmosphere. It also motivates them to be researchers.

“Action research is a form of self reflective inquiry undertaken by the participants (teachers, students or principals, for example) in social [including educational] situation in order to improve the rationality of justice of [a] their own social or educational practices, [b] their understanding of these practices and [c] the situations [and institutional] in which these practices are carried out.”

(McBride, R and Schostak, J. 2003 J. P: 01)

In Sri Lanka, the National Institute of Education (NIE), Maharagama, National Colleges of Education and a few Sri Lankan Universities have already recommended action oriented educational research as a compulsory component or choice in their teacher education courses.

“In the past, it was sufficient to aim for effective transmission of knowledge; the teaching was ‘filling’ children’s minds. Now we base our understanding of learning on constructivist and socio-cultural models of meaning- making and transformation. In doing so, we need to move beyond universal theory to generating the capacity to create locally contextualized knowledge... action research...can play [a vital role] in improving the application of knowledge gained in other models of teacher professional development...Action research can help one to understand the forces that mould our teaching and learning approach, our practice. Each of us can make something new happen, building on the foundation of other approaches to school development such as the successful development and challenge of effective implementation of the reformed curriculum development at NIE. To end, NIE has incorporated action research in the 2002-2004 NIE corporate plan.”

(Gunawardena, G.B. (2003) P: 02)

Teachers are expected to continuously use action research as a regular practice for upgrading and updating their professionalism. Yet it seems doubtful whether teachers in Sri Lanka do so. On the other hand, recommendation of action research as a compulsory component in teacher education programmes does not insist on teachers to regularly use it in their career.

“... action research is a way of defining and implementing relevant professional development. It is able to harness forms of collaboration and participation that are part of our professional rhetoric but are really effective in practice... [it] starts small with a single committed person focusing on his or her practice. It gains momentum through involvement of others as collaborators. It spreads as individuals reflect on the nature of their

participation and the principles of shared ownership of practice are established. It can result in the formation of a self-critical community: extended professionals best in the sense of the term”

(Action Research in Primary Mathematics, 2004. P: 08)

Awareness of how action research culture ensures teachers’ development leads them to be enthusiastic of gaining empowerment and professionalism. That consequently supports them to be multidisciplinary in their approaches and independently display their professional autonomy.

Various projects like Teacher In- service (TIP) of Basic Education Sector Programme (BESP) implemented by German Technical Co-operation (GTZ) and Primary Mathematics Project have identified action research as an obvious, supportive way of promoting teachers’ professionalism. In collaboration with the National Institute of Education (NIE), these projects have extended their support extensively in a very pragmatic manner. Yet it seems as if the message of action research and information about its benefits related to professional development have not properly reached the teacher community. In their recommendation, the institutes might have meant to popularize action research as a regular practice, but guidance, advice, facilities and requirements available for teachers’ for engaging in action research seem to be hardly a matter of positive remarks.

Nevertheless higher educational institutes have authority in their policy decisions as well as in their recommended courses to support teachers to engage in action research while popularizing it among them. This may be a convenient context to popularize action research further as a beneficial way of promoting teachers’ professionalism as well. It was, therefore, necessary to find out through the survey how higher educational institutes contribute to this at the national level, the reasons for that, how action research empowers teachers to develop their professionalism and to make suggestions for betterment of the current situation.

Objectives

The target study, how higher educational institutes contribute in promoting teachers. professional development through action research, was carried on as a survey- research under the overarching question, ‘How can higher educational institutes promote teachers’ professional development through action research?’

In line with this question, the following objectives were formed to find:

1. information on current situation of higher educational institutes and their reasons for encouraging and guiding teachers to engage in action research

2. higher educational institutes' view/s on contributions of action research for teachers' professional development
3. how teachers' findings of action research are used to develop education at local level
4. relationship of action research with successful implementation of the educational reforms introduced
5. views on the relationship between action research and school-based educational development for teachers' professional development
6. and make suggestions for further development of ongoing and / or new programmes and other related factors concerning action research

Action research is the major topic in this study and the other terms in the in the research question (topic) indicate the latter's relationship with the former. Action research provides teachers an opportunity for making relatively permanent changes which ensure continuous, sound development in their performance. In the survey, this type of desirable behaviour was specified as indicators of teachers' professional development including the needs of demonstrating independence as teachers, commitment and enthusiasm for life-long learning, upgrading and updating their experience with a broad knowledge-base and involving teachers in policy-level decision-making. The term 'teachers' represent especially school- teachers both of the state and private sectors including teacher trainees in their initial and continuing teacher education courses. The phrase, 'Higher educational institutes' represent the universities and other national level teacher educational institutes which facilitate teachers in action research. These institutes have already initiated programmes/ courses by which action research has been introduced to teachers. Thus the term, 'promote' in the topic refers to further development of the current situation expected through implementing these programmes/ courses.

Methodology

A questionnaire and a semi-structured interview were administered to collect data. The sample (Table 01) was selected representing officers from each institute (which encourages teachers to undertake action research) according to their official responsibilities in the field of education. Thus they were of various capacities and responsibilities.

Table 1 Representatives of the Sample and their Numbers

Higher Edu. Institute & its faculty/ department/ attached Organization	Representatives	Sample of the questionnaire	Sample of the interview
University of Colombo			
* Faculty of Education	* Dean, Faculty of Education	01	01
	* Heads of the Departments	02	01
	* Professors and Senior lecturers	02	
University of Peradeniya			
* Faculty of Science	* Senior lecturer	01	01
*Department of Education, Faculty of Arts	* Head	01	01
	* Senior lectures, lectures and probationary lecturers		
National institute of Education	* Director General (DG)	01	01
* Department of Research			
	* Chief Project Officer (CPOs) and Project officers (POs)	03	02
	* International and national consultants	02	01
* Centre of Professional Education	* Assistant Director General (ADG)	01	01
	* CPO, PO	ii	01
* GTZ/BESP/Material Development and Training Unit (MDUT)	* Subject Leaders	04	01
	* Coordinator, TIP - CP	01	01
	* Director	01	01
* Primary Mathematics Unit (PMU)			
* GTZ/BESP Teacher Inservice Project (TIP), Central Province (CP) Kandy	* Project Manage	01	01
	* Project Director	01	01
	* Deputy Director	01	01
	* Master Trainers of Teacher Education	01	01
	* Corrdinator of Monitoring and Evaluation (M&E)		
* Commission of NCOEw _s	* President	01	01
	*Director	01	01
Total in the sample		46	23

The data collected through the questionnaire were of

- a. personal details of the participants in the sample such as experience in the target field, institute, age,
- b. what is done and their sustainability with reasons relating to the practice of action research for teachers' professional development
- c. information on types of action research, expectations, educational reforms, use of action research findings, facilities available, challenges to overcome and ensuring sustainability

Interviews were aimed at collecting data especially on links between action research and teachers' professional development. The data collected were of their ideas on

- a. possibilities of using action research in Sri Lankan context for teachers' professional development
- b. personal views on recommending action research
- c. empowerment through action research
- d. professional development through action research
- e. development of institutional professional culture
- f. positive consequences of using action research
- g. practice of reflection

It was expected to collect data on views as much as possible in an independent and critical discipline on the basis of each officer's official responsibility and experience. This was, in return, supposed to find realistic and pragmatic aspects rather than idealistic views and book knowledge of them. Data were first relevantly categorized focusing on various facets of each question for presenting in frequencies

Findings

Institutes and representatives

97.2% of the higher educational institutes which actually use action research in teachers' professional development are semi governmental. Among the supportive institutes for action research, there are NIE-attached organizations (18.6%) and government institutes (16.3%). NIE's direct support seems comparatively very low (2.3%).

The majority of the representatives in the sample are quite mature in their experience and age. Guaranteeing sustainability of the programmes will, therefore, be a problem in terms of their age and how long they are able to remain in the system.

Support, belief and acceptance regarding action research

The participants' ideas on support, beliefs and acceptance regarding action research are different one from another. 97.2% **use** action research in their programmes expecting quality development in learning-teaching, 95% **believe** in action research as a suitable instrument for promoting teachers' professional development. 80% of them **accept** that their institutes generally encourage school-teachers in action research. Thus their actual support for action research is stronger than their belief and general acceptance and they primarily focus on development of teacher education through action research.

Expectations and recommendation

29.2% of the higher educational institutes which use action research in their programmes, are very distant to classrooms in their association, but they expect quality development in classroom learning-teaching process. 18.8% want to develop research culture and teachers' attitudes and skills. Another 16.7% want to use it as a problem-solving approach. The rest want to enhance professionalism, finding desirable outputs and motivating teachers. Their support is mainly extended as an advisory/ supervisory role targeting teachers and students. This shows their focus is mainly on classroom. Further these institutes indicate the importance of teachers to be experimental in developing their carrier and professionalism with both process-oriented and product oriented outputs and outcomes.

Yet 5% have their doubts because of teachers' lack of know-how, their less independence and bureaucratic autonomy (due to authority of the officers' of higher positions in the hierarchy) in the system and infancy of action research in the Sri Lankan education system.

Only 80% recommend action research as a meaningful strategy in teacher education on the basis of teacher-specific, individual factors and beliefs related to theoretical and practical aspects of action research. Teachers' professional development is not the very target. Yet the practice of action research clears the path for reaching expected aspects of professional development through promoting research culture among teachers.

Conducting action research

A little more than 50% action researches are conducted within academic years/ teaching-practice respectively. Awareness-raising on action research is mostly and formally limited to this period. This situation limits teachers' enthusiasm in action research for a limited period only as a compulsory component in their courses.

Action research and continuing teacher education

Support of higher educational institutes is very low to carry on action research independently and regularly in continuing education. Action research is rarely encouraged beyond initial teacher education courses. This prevents popularity of action research as a regular practice.

Preference

In implementation, the majority prefer individual and classroom level action research to participatory action research which creates a network of communication for sharing experiences. This prevents teachers from displaying their professional capacities in an elite community. Those who are interested in action research-findings have taken it as a personal interest (33%). The way of getting to know about their findings is mainly done by discussing and sharing experiences (37.5%) and conducting training programmes (25%). A proper channel has yet not been developed to continue their communication after their initial teacher education.

Influence on educational reforms

The influence that higher educational institutes expect on educational reforms through action research is focused on problem identification, supporting learning-teaching and evaluation (66.6%). Yet their awareness of school level findings is very low (11.6%). This situation prevents teachers from actively contributing to policy making, curriculum and syllabus design.

Four pillars mentioned in the report, *Learning the Treasure Within* (Dellor et.al, 1996) are believed by the 66.7% of the sample as the possible to promote through action research: they think that action research develops full-potential of researchers as social beings. Action research culture has been identified as a way of promoting togetherness (32.7%) and for improving knowledge (27.3%). This indicates the importance of action research as a way of working in teams and groups, study circles and small communities even in school level.

Facilitation

Higher educational institutes facilitate teachers to engage in action research in several prominent ways: by their supervisory and advisory role (31.8%), conducting workshops, seminars and lectures (30%) and producing modules, using internet and library facilities (30%) , but they do not have direct links with schools.

Availability of resources

57.1% of the higher educational institutes are not satisfied with the resources available to them. They have their worries about lack of human resources, expertise, support and guidance and lack of physical resources including funds. These institutes show difficulties and challenges in two levels: inter-institute level and teachers' level. In the former, lack of time and funds have become the major difficulty. Lack of cooperation and opportunities at the school level and teachers' poor knowledge and interest are the other challenges.

Sustainability

19.6% of higher educational institutes ensure sustainability of their programmes in terms of training and conducting follow up activities to improve knowledge and skills on action research. Thus they mainly concern their work as a knowledge-generating-process. 15.7% believe in motivating and ensuring belief and interest in action research while 13.7% believe in continuation and reorganization of already existing programmes.

Empowerment through action research

Empowerment through action research is mostly expected through self-development, teacher development, capacity-building, and experiential learning. Thus their views focus on teachers' progress rather than students' progress. Self-related factors, adult learner-facilitation and professionalism related modern ideas have been found to be ways of promoting professionalism through action research.

Institutional professional culture and research culture

90% of the sample responded positively about the link between action research and institutional professional culture. 87% of their responses can be categorized under intra-institutional development like human resource development and research culture.

Taking these aspects together, it is possible to say that research culture created through action research provides a suitable social context for human resource development to achieve institutional development and institutional professional culture.

Teachers' professional development

Improvement of quality teacher performance at the classroom level (27.3%) and teachers' self development and professionalism (20.8%), are clearly seen as positive consequences of action research. It is, therefore, important to see that action research is recognized as a way of bringing about professional success through practically important output-development and self-development together. The expected outcome of reflective practice in action research is mainly identified as an individual's cognitive developmental process to gain pragmatically successful outputs and outcomes. This is also seen as an evidence of teachers' professional development through action research.

Influence on 'modern' aspects of learning

Influence of action research on the modern aspects of learning like active participation and contribution (16%), cooperative and collaborative learning (18%) and self-directed learning and life-long learning (44%) are identified as ways of ensuring life-long and life-wide education. This shows that action research is an androgogically supportive method suitable for continuing education.

Discussion

Action research as a regular practice

According to the findings, it is suggested to introduce action research as an important course-component in teacher education curricula. Such courses will then be able to continue their contribution in cooperating with teachers to use action research as a regular practice rather than as an academic component alone. It is also necessary to guide teachers systematically with set targets for exploration.

Sustainability

In implementation of their courses/ programmes, the higher educational institutes need to assure sustainability. As the findings have shown, enrolling academics (facilitators) as a mixed age group (of peers) is another necessity. Thus they are able to remain in the system for a fairly considerable time beyond the target ends of projects/ programmes implemented on action research.

Communication Network through Action research

It is suggested to build a close relationship with the school community irrespective of geographical and hierarchical distances by extending programmes/ services

directly to deal with school community. This provides possibilities for ensuring quality enhancement of school teachers' professional development in planning, implementation and gaining desirable outcomes through action research.

Research Culture:

Establishment of a research culture through action research at school level is suggested as a feasible way of inculcating an experimental behaviour in working and learning beyond formal instructional courses. Therefore it is necessary to intrinsically motivate teachers towards this target by developing their attitudes to appreciate the need and importance of action research in the school community. This will allow them to be aware of futuristic aspects of education in an experimental manner. Forming a national vision based on (action) research culture is also suggested for guiding teachers to ensure positive consequences of explorative behaviour in professional development in national level.

Participation in Acton Research

It was found that individual level action research is more popular than participatory ones. Thus it is suggested to encourage the latter in addition to the former. It is also suggested to establish study-circles/ formal teachers' associations in school-family- level to share teachers' experiences in a comprehensive manner. This would let teachers use outcomes of such programmes more at community level than at individual level. In addition, it is important to establish associations of action research leaders who can immediately and directly guide the school community. There are associations of both these types at international level for action research. It is suggested to introduce teachers to these associations to be active members of global research culture. They can further be exposed to the use of information technology for widening their contacts.

Teacher's role

Teachers nowadays are supposed to go beyond the classrooms. They need to be partners of policy decision making in the education system. Thus it is suggested to guide school teachers to forward their findings of action research through a proper channel to make policy decision makers and others aware of the classroom. Their findings, feedback and assessment can be used for making modifications necessary in various fields of the system of education. Appointing a set of coordinators, ie: in-service advisors to maintain links between schools and higher educational institutes is also suggested for this purpose.

Facilities

It is necessary to develop and increase facilities available in higher educational institutes for implementing action research. For this, the higher educational institutes can work closely with other institutes to implement projects to support them financially and in other necessary ways. A guideline on action research is suggested to be provided with school libraries for teachers' use.

Reflective practice of action research can be suggested as a practically important, integral component to ensure the value of process-oriented changes to influence product oriented changes. This will also enhance the professionalism of teachers. It is also suggested to popularize journal writing as an initial step towards action research.

Publicity

Another suggestion is to ensure popularity of action research providing publicity for it through different media in collaboration with teachers. This would assure acceptance of teachers' findings.

Empowerment through action research

Practising action research with modern concepts of learning to develop teachers is another possible suggestion to empower teachers politically, socially, in knowledge and in professional skills. For this, self-directed learning can be encouraged through action research assuring life-long learning. Through participatory action research, cooperative and collaborative learning can be encouraged. Teachers, consequently, are able to be active participants and contributors as "context experts" rather than "content experts". It is suggested to produce a self-directed learning module in this aspect. Cyclic and spiral processes of action research can also be introduced to help teachers to be aware of what is done rather than what is thought. They can also be successful decision makers and admirers of changes in developmental process. It is, therefore, necessary to introduce action research as a medium for teacher empowerment.

Conclusion

Research culture in the school system in Sri Lanka is very rarely observable, but it is a vital aspect needed in individual and social development. Use of action research which has been comprehensively discussed in this article is a rich medium to introduce research culture to the school system.

Higher educational institutes which encourage action research in their teacher education courses are able to expand their programmes and extend them to schools minimizing geographical and hierarchical distances. At present, their contribution does not seem sound enough to attract teachers to use action research as a regular practice. The findings and suggestions of this survey would, therefore, be helpful for them to establish research culture collaboratively and cooperatively within the school system to gain its multifarious benefits.

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THESES ABSTRACTS

An Investigative Study of the Nature and Development of the School - Based Process of Assessment with respect to the G.C.E. (O/L) Science and Technology Curriculum

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*Abstract of the thesis submitted to the University of Colombo
for M. Phil Degree, 2006*

The school - based assessment process was introduced to the schools system of Sri Lanka through the Education Reforms implemented in 1998. Indices indicative of the fact that inputs introduced to education after independence with the hope of developing. Sri Lanka through education have rather effected quantiative than qualitative growth can be identified in the schools system. These indicators are the increased number of repeaters in classes, increase in the number of school drop - outs and the increasing percentage of those failing to reach even the minimum levels of achievements at examinations.

The background to the “Youth Uprisings” of the 1980 was the conflict situation in the education system. The need for reforms in education had been pointed out in the first report published in 1992, in accordance with the recommendations of the commission on “Youth Unrest” appointed to inquire into the uprising above. Apart from this the theoretical foundation regarding an “Essential Learning Continuum” put forward on the recommendations of the Universal Declaration on “Education for All” expressed at the Jomtiem Conference of 1990, provided support in this regard.

It was against such a backdrop that the school based Assessment process came to be implemented in the education system of Sri Lanka from 1998 in relation to the educational reforms.

There are four aims expected to be achieved through this assessment process

1. Improvement of the student's learning process.
2. Improvement of the teacher's teaching process.
3. Improvement of the assessment process to ensure efficiency in learning teaching.
4. Making provision for the transfer of the school system from the evaluation culture to an assessment culture.

Although the school - based assessment process is being implemented through the provision of the necessary financial assistance in the form of quality inputs, it is doubtful whether its aims are achieved in the expected form within the classroom process. Teachers who, from the beginning, evinced reluctance to pursue the student-centered learning teaching approach on grounds of ignorance, have come to interpret assessment as an additional burden placed upon them. Although assessment is a task that should be integrated with learning - teaching, there is no evidence of this happening in the classroom.

Every other assessment takes place during a different period through a written test or some other type of assessment. The large numbers of students in the classrooms of popular schools is another reason why the aims of this task are not achieved as expected.

Therefore, this study implemented with regard to the manner in which the process of assessment in relation to the implementation of the G.C.E (O/L) Science and Technology curriculum, the identification of related problems and also its development, was carried out based on the following objectives.

1. Identification of the existing nature of the process of assessment of the G.C.E (O/L) Science and Technology curriculum.
2. Identification of problems encountered by science teachers in the implementation of the assessment above.
3. Identification of the strengths and weaknesses of the assessment above and putting forward suggestions for the solution of same.
4. Construction and development of a set of instruments appropriate for the implementation of a process of assessment of that can be integrated with learning - teaching.

For purposes of this study 278 schools belonging to 1AB National, 1AB non-national, 1C and 2 type from four zones in the Colombo district where teaching was done only in the Sinhala medium, were selected as the target population. Using stratified sampling, a sample of 30 schools representative of the four education zones, four school types, urban as well as rural schools and 10% of the target population were selected from among the above.

While for classroom observation, an observation schedule was used, a check list, for the examination of files, an attitude rating scale including a questionnaire, for purposes of obtaining particulars regarding the teacher, a student questionnaire, an interview schedule, in order to elicit information regarding the assessment procedure and a student questionnaire to investigate the feasibility of the instruments of assessment were used, while the main data collection instrument was the observation Schedule.

While descriptive analysis was used in the analysis of the data collected Chi-Square test was used to analyse data in addition to an attitude rating questionnaire.

In a majority of urban, national schools, practical work was also taught through the lecture method and practical work was used only to check whether the conclusions arrived at were correct.

Assignments, practical work, observation work, activities and written tests were predominantly used for assessment purposes, while student centered varieties of assessment like projects explanations, field studies and creations were not used by teachers.

Problems related to the use of teaching methods associated with different types of assessment of knowledge and practical abilities related to subjects areas included in recent years. Provision of feedback and problems related to the process of evaluation as well as problems associated with the school-based assessment process, the increased number of students in classrooms, the negative attitudes held by both parents and students and the increase in the subject content, were some of the problems identified.

The process of assessment can be raised to a higher level through, the re-education of teachers on the various areas of school-based assessment and the introduction of examples, lowering of numbers in the classroom, provision of teaching aids thereby eliminating the task of writing through the supply of print material and revival of the function of supervision and appreciation of the teacher's task as well as the competencies of students.

BOOK REVIEW

QUALITATIVE RESEARCH FOR EDUCATION

(Adyapanaya Sandaha Gunathmaka Paryeshana)

Dr. Dayalatha Lekamge

Deepani Publishing Company, Homagama

Eleven Sinhala books pertaining to 'Educational Research Methodology' have been published during the fifteen years period since the publication of the first book on 'Educational Research Methodology' in 1990. Of these, seven deal, more or less, with material relevant to qualitative research. While, in the list of references, in five books, there is reference to the sources on qualitative research, the term "qualitative research" appears in the index of five books. One book has devoted a chapter to qualitative research. Another book has two chapters each on anthropological research and action research. There is one Sinhala book on action research. But none of these books provide either adequate or in-depth thinking relevant to the entirety of the significance of 'Qualitative Research'. The reason for this is that much of the content of these Sinhala books is presented as quantitative descriptions rather than as qualitative interpretations that ought to be used in qualitative research paradigm. Similarly the absence of the first person and inductive approach of writing to suit the qualitative research approach, in the presentation of subject matter is evident. It is only in a few pages of Godwin Kodituwakku's work on Action Research and in the chapter 'The Teachers as a Researcher - Introduction' contributed by Dr. Sunethra Karunaratna to the work "An Introduction to Educational Research", published by the National Institute of Education that even an explanation of Qualitative Research in terms of the latter criterion, is evident. Against such a backdrop, the publication of the work titled "Qualitative Research for Education", in 2006, can be considered a very important step forward in the literature on qualitative research in Sri Lanka.

Commencing with the presentation of a composite picture of Educational Research Methods, it proceeds to branch out along themes of the nature of qualitative research. its characteristics, types of qualitative research., data collection techniques and analysis of qualitative data.

The initial aim of the author has been to compile material on the selected theme, available in English. This might be an aim engendered in the author as there was no work published in the Sinhala Medium representative of the entirety of qualitative research. When this is taken into consideration, it is evident that this work renders substantial service in providing basic clues and some ideas in the

Sinhala medium necessary for qualitative research as well as an introduction to primary and secondary sources, in order to identify qualitative research paradigm.

The fact that the work is written in the style which is more appropriate to the quantitative research paradigm, merits discussion. One might even have the hunch that it was on account of the writer's quantitative research base and also the quantitative research bent prevalent in the field of Sri Lankan education system that it has failed to be written in the first person style and in a manner that the readers' grasp of the subject matter inductively, two characteristic of the qualitative research paradigm. While this can, in one way, be identified as a bridge built to link the Quantitative-Qualitative research paradigms, it is from the direction of the quantitative research paradigm that both the writer as well as the reader has to access the bridge. There is no doubt, a research work that highlights the 'qualitative paradigm' will come to be written in the future by those who establish themselves in the qualitative research paradigm from among the Sri Lankan researchers who enter the field of qualitative research through this approach. Hence, the bridge set up by Dr. Lekamge renders an immense service to elicit new perspectives in the field of Sri Lankan educational research.

The endeavour to employ the qualitative research paradigm in post-graduate theses on education at Sri Lankan University level was made in 1984 with the employing the "Participatory approach" in her Master of Education thesis on "Basic educational needs of rural women for effective participation in an integrated rural development process in Sri Lanka" by D.R.E. Gajanayake. Subsequently, a number of theses written for the post graduate degrees in education, of the University of Peradeniya, under the guidance of Dr. Ashoka Jayasena in the 1990's have been influenced by the qualitative research paradigm. At the same time, an action research where the quantitative research model is strongly emphasized was submitted for the M. Phil in Education degree of the University of Colombo. A thesis completed using qualitative research methodology in its pure form on the topic "An inquiry into misconceptions of students in learning Science" by S.A.M.C. Samarasinghe, under the guidance of Dr. Sunethra Karunaratna, was awarded the M. Phil degree by Education Department of the Arts Faculty of University of Peradeniya in 2000. The Science Education Unit of Science Faculty of the same university have awarded two Ph D degrees for theses completed using the qualitative research paradigm.

Apart from this, in a considerable number of post-graduate theses conducted along the quantitative research approach have used qualitative data. It can be concluded that the most powerful feature in the use of the qualitative

research approach in Sri Lanka is the use of qualitative data in quantitative research to complement quantitative data. At times there may also be occasions where the use of qualitative data is erroneously treated as adherence to qualitative research. The use of qualitative data alone is not sufficient for a qualitative research. The use of qualitative data in a research based on the quantitative research approach and the process of arriving inductively with the process of collecting data in a qualitative research are two different characteristics. This, in one way, might be stated as a characteristic feature of the Sri Lankan field of research oscillating between the quantitative-qualitative paradigms. Even when considered on this basis, the publication of a work that analyses the dimensions of the qualities of qualitative research becomes an important step forward because it provides resources to identify the differences between the two research paradigms.

The Department of Research and Development of the National Institute of Education has been implementing Action Research and Qualitative Research since 1988. While among these, the series of researches titled “The Teacher as a Practitioner” initiated by Dr. G. B. Gunawardena, is a pioneering effort regarding how grass-roots level experiences can be made to contribute in the formulation of education policy. The three stages of the series of research titled “Teacher Learning in the Classroom” conducted under the leadership of Dr. Sunethra Karunaratna was an exercise to add a range of grounded theory-based qualitative research paradigm to Sinhala research literature. The Sinhala reader would have been benefitted if these material were cited in the work under discussion as examples. In the book, the only research related to Sri Lanka, quoted was “The Blackboard in the jungle” by Victoria J. Baker. Perhaps it is as a result of the fact that lack of literature on qualitative research in the field of Sri Lankan education, has directed the author to undertake the strenuous task of filling the lacuna in subject matter on Qualitative Research in the Sinhala medium, that she has failed to mention material in Sri Lankan qualitative research, that can synthesize with the content in the book

The work, qualitative Research for Education (Adyapanaya Sandaha Gunathmaka Paryeshana) by Dr. Dayalatha Lekamge will serve as a “spring board” for research institutes as well as researchers in the field of education in Sri Lanka in which the Qualitative Research paradigm is endeavouring to take root.

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