Value Added Methodology - An Alternative Approach to Quality Measurement in Higher Education

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Abstract
This sought to present research evidence in support of 'value added' methodology as an alternative approach to quality measurement in higher education. The study was informed by several issues including the need for modern methods of measuring quality in higher education. Hence, a dataset of over 6,000 students was used in demonstrating how 'value added' methodology and multilevel modelling statistical techniques could be used to measure quality. The dataset was created using secondary data (examination scores and prior attainment in English) and administrative records (cohort) from 16 academic departments. The issues explored include the strength of adjusted scores using the value added approach as against 'raw' (unadjusted) scores. The overall finding was that a 'value added' methodology is relatively more informative and fairer with respect to the measurement of quality. Also highlighted in this report do issues need policy, practice and research direction in accordance with the study findings.
Keywords: *prior attainment, value added and raw scores multilevel modeling, quality*

INTRODUCTION

Research methodology is concerned with how a research problem is systematically solved, that is, the various steps generally adopted by the researcher in studying the research problem and the logic behind them in the context of the study. Key to the selection of the best methodology for a research project is recognising the available methodologies and understanding their relative strengths and weaknesses to select the methodology that best supports the objectives of the study (Kothari, 2006; Creswell, 2009). Hence, this article starts by looking at how quality has been measured previously in Higher Education (HE) and why an alternative methodology is necessary. This is followed by the discussion of 'Value Added' (VA) methodology, Value Added Measures (VAMs) and multilevel statistical modelling. Next, the methods employed by the study, the subsequent findings, discussion of key issues emerging from the study and the conclusion and recommendations are presented.

Although many researchers agree that quality in education is important, agreeing on how the concept should be measured has proved difficult. Methodological questions about how quality should be evaluated effectively in context have thus been raised (Coates, 2006). This is because methods and approaches to quality measurement in HE vary (e.g. indicator systems, peer review, etc.). The economist paradigm, for example, emphasises effectiveness in the sense of productivity and increased output at the 'least costs' (Breen & Jonson, 2005). The resulting effect of this has been a public ranking of academic programmes and rating of tertiary institutions based on graduation and completion rates (e.g. Johnes & Taylor 1990; Smith & Naylor, 2001a and b).

Nevertheless, the economist approach to educational quality measurement may not be the best because the HE sector has characteristics that make it difficult to measure its efficiency - it is non-profit making, there is an absence of output and input prices and institutions produce multiple outputs from multiple inputs (Johnes, 2006). Besides, looking at quality primarily in economic terms may lead to ignoring the social, moral and aesthetic dimensions of teaching and learning as well as some important non-cognitive student characteristics (e.g. student background, SES, etc.). See Hulpia and Valcke (2004).

The school improvement paradigm, on the other hand, argues for the reviewing of teaching and learning processes in the context in terms of key elements of "good" and "best" practices (Motala, 2001). As a result, institutions have been described as effective (e.g. Chetty, 1992), ineffective (e.g. Chisholm & Vally, 1996) and resilient (e.g. Christie & Potterton, 1997) with much emphasis on quality indicators. Nonetheless, while the benefits of such moves cannot be underestimated, it is important to move away from the distinction between 'good and bad' institutions and focus on individual institutions if we are to broaden our

understanding of quality issues in individual institutions and allow organic changes (suggest broad principles or general strategies for improvement) that are in line with institutional context, setting, resources, and experiences.

Another approach to quality measurement is the transformation notion which describes the `growth' and `impact' HE institutions have on students. It, therefore, measures the pre-and-post-differences in students' achievement at different points in time as students pass through a system of education (Tam, 2001; Astin, 1993). This notion, according to Harvey and Knight (1996), is the most appropriate for HE institutions because the sector is expected to add value to students by developing in them generic competencies critically including oral communication, teamwork and interpersonal skills, self-management, problem solving and leadership skills so that students could be better prepared for the world of work (Marginson, 1993; Bradshaw, 1992).

It is, therefore, not surprising that, currently, there is a greater degree of agreement among educational researchers about the need to focus explicitly on student outcomes and the concept of 'value added' (Johnes 2006; Smith & Naylor, 2001a). This is because VAMs rests on the assumption that institutions add `value' to students. VAMs are, also, used to describe the extra value institutions add or the impact institutions have on students. In other words, VAMs focus on measuring the relative gains made by a student from his/her own starting point (Ballou, Sanders & Wright, 2004).

VA methodology often involves the choice of a: (1) dependent variable (e.g. test scores), (2) conditions that need to be controlled/adjusted for (e.g. student background characteristics) and (3) malleable conditions (e.g. educational processes and practices) that may account for the variation between institutions, faculties, departments, cohorts or individual students. To measure 'VA' progress made, baseline measures at the time of entry and outcome measures at the completion of a programme or course are necessary. Necessary baseline measures required at the point of entry include entry qualification, student background information (e.g. gender, age) SES (the language is spoken).

In theory, VAMs relatively offer a much richer analyses of students' test scores given that it measures the learning trajectories of students as they progress through a course or programme, and are more defensible in examining how much students have learned from teachers between the time they start and end a course or programme (Beardsley, 2008).

Although the methodology has been used by many researchers (Nkrumah, 2018; Rogers, 2007; Thomas, 2001), literature shows that there are relatively very few studies employing VA methodology in HE worldwide and Ghana in particular. The methodology has, indeed, been mostly used at the basic and secondary school levels. Besides, most studies at the HE level have only looked at correlation, for example, between entry qualifications and degree success and not individual courses (Hopkins et al., 1997; Peers & Johnston, 1994). Also, although some studies have compared student achievement in schools, departments, etc, most of these have been conducted across different schools at the pre-tertiary level, not within a HE single institution. As such, a literature gap, in terms of the number of studies that use VA methodology within a single HE institution, is very conspicuous. It is in this sense that this study is unique.

The study also took advantage of methodological advancement in the School Effectiveness Research, that is, multilevel modelling which aids the exploration of issues such as how effective institutions have been in raising the achievement level of students in different outcomes and the stability of students' performance over time (Teddlie & Reynolds, 2000; Mortimore, 2000; Hopkins & Harris, 2000).

The multilevel statistical technique presents several advantages when used in VAMs. For example, it allows: (1) the variation in student achievement to be partitioned into individual-level and group-level components (because of hierarchical nature of the data) and (2) intra-class correlations (the proportion of total variance in an outcome attributable to a group level e.g. department) to be calculated. The technique also allows explanatory variables to be placed at their correct levels in the data hierarchy and be looked at

simultaneously instead of aggregating or disaggregating them to a single level of analysis (Heck 2007; Bryk & Raudenbush, 1992). It further facilitated the examination of mean relationships between student's outcomes and the explanatory variables (from the fixed part of the model) and the proportion of total variance attributable to departments (from random part).

Research Questions

The study addressed these three research questions:

1. What is the best approach to and model for estimating student 'VA' progress in the context a single HE institution?

2. To what extent do students' 'raw' and 'VA' mean achievements in CL2 vary between and within departments after controlling for prior attainment and cohort?
3. What are the implications of the study findings for institutional practices and policies and further research?

METHODOLOGY

A case study approach was used. The strengths of case studies include its ability to test theory and generate theory (Gersick, 1988). Hence, there is an increased likelihood of adding new knowledge from the Ghanaian HE context to existing literature. The risk, however, maybe that the theory generated may be idiosyncratic and may not be generalizable to other contexts beyond the study's context.

The study participants were 6,234 students from all four faculties and departments of the institution. All students belonging to the 2007, 2008 and 2009 cohorts were included in the study except a few, whose prior attainment measures in the English Language (simply called English) were missing. The input-process–output-context framework (2004) was used in selecting appropriate variables for the study. Accordingly, the following data were collected: student registration number, examinations scores in CL2, prior attainment in English and cohort. These variables were put into the following three main categories: clustering, outcome and student-level explanatory variables. The details are:

Clustering Variable

Department

All sixteen departments of the institution were involved in the study. Each student of a cohort was matched exclusively to one of these departments.

Outcome/Dependent Variable (CL2)

The outcome/dependent variable for the analysis was students' examinations scores in CL2 for the period 2007-2009. The examinations were conducted and marked under the supervision of the National Board for Professional and Technician Examinations (NABPTEX).

Student-level Explanatory Variables

Prior attainment in English, from the West African Secondary School Certificate Examinations (WASSCE), was used. Since the actual 'raw' scores could not be obtained, class-mid-point equivalents were entered directly for each student. The grades used and their numerical class-mid-point equivalents are presented in Table 1.

Table 1: WASSCE Grades and Their Numerical Equivalents

Grade	Numerical Representation / %	Class Mid-points / %
A	70 and above	70 and above
B	65 – 69	67
C	60 – 64	62
D	55 – 59	57
E	50 – 54	52
F	49 and below	49

Cohort

Students' age was calculated in years based on each student's date of birth. These were entered directly without coding for each student. The cohort was treated as a dummy variable. See Table 2.

Table 2: Quantitative Variables Summary

Variable	Type of Variable
Clustering:	
Department Identity (ID)	Multilevel hierarchical level (1 … 16)
Student identity ID	Multilevel hierarchical level (1 … 6,234)
Outcome: CL2	In percentages out of 100%
Prior Attainment: English Language	In percentages out of 100%
Student-Level Explanatory:	
Cohort	Dummy variable: 2007 = 0, 2008 = 1, 2009 = 2

Statistical Models for the Estimations

MLwiN 2.24 was used in generating the different statistical models simply referred to as Models 1-3. The two-level models used had a department at level 2 and students at level 1. In all, the following three statistical models were developed and tested:

1. the variation between and within departments in terms of 'raw' scores (Model 1);
2. VA progress made after taking into account students' prior attainment in English (Model2**)**; and
3. VA after controlling for student cohort (Model 3).

Model 1: Raw Students' Performance

Model 1 (with no explanatory variables) is also called the *null model*. The Model was used to estimate the extent to which average department 'raw' achievement in CL2 varies across departments. Like all the other models, Model 1 had two components - the fixed effects component and the random/variance component and included only an intercept term as expressed below:

Fixed Effects

Level 1 model: $Y_{ij} = \beta_{0j} + r_{ij}, r_{ij} \sim N(0, \sigma 2)$.

Level 2 model: $\beta_{0j} = \gamma_{00} + \mu_{0j}, \mu_{0j} \sim N(0, \tau 00)$.

Combined model: $Y_{ij} = \gamma_{00} + \mu_{0j} + r_i$

Where: Y_{ij} = the achievement of student *i (*in CL2) in department *j*

β_{0j} = the average achievement of a department in CL2

r_{ij} = student-level error term

γ_{00} = the grand mean of all the departments in CL2

μ_{0j} = department level error term

Random Components

The model also provided estimates of the student-level (σ^2) and department-level (τ_{00}) variance components. The summation of these two variances provides the total variance estimated by the model. The extent of variation in average department achievement can be estimated by using the parameter estimates of the null model to calculate a 95% confidence interval, referred to as a range of plausible values, under the assumption that the department-level variance is normally distributed (Raudenbush & Bryk, 2002).

Range of plausible values is given by, $\hat{\gamma}_{00} \pm 1.96\ (\hat{\tau}_{00})^{1/2}$

Where: $\hat{\gamma}_{00}$ = the estimated grand mean for CL2 (intercept)

$\hat{\tau}_{00}$ = department-level variance

Model 2: Differences in 'VA' Progress Made

As earlier mentioned, measuring 'VA' progress made requires an adjustment of an initial level of achievement so that the contribution of departments to students' progress could be estimated from the residual differences in the students' pre-and-post-test scores (Thomas et al., 2007; Thum, 2003). Hence, Model 2 added to Model 1 (or statistically controlled for) students' prior attainment in English in order to estimate 'VA' progress made. Willms (1992) describes the estimates of Model 2 as Type 'A' effects, that is, how well we expect a student with an average entry qualification and background to perform in a

department relative to the performance of a student with a similar qualification in another department. The statistical model is expressed as:

Level 1 model: $Y_{tij} = \pi_{0ij} + \pi_{1ij}\, a_{tij} + e_{tij}$, $e_{tij} \sim N(0, \sigma 2)$,

Where: π_{0ij} and π_{1ij} = prior attainment (when time = 0) and rate of change for student *i* in department *j;*

a_{tij} = a measure of time;

e_{tij} = random error term;

Level 2 model:

$\pi_{0ij} = \beta_{00j} + r_{0ij}$, $r_{0ij} \sim N(0, \tau_{\pi 00})$

$\pi_{1ij} = \beta_{10j} + r_{1ij}$, $r_{1ij} \sim N(0, \tau_{\pi 11})$.

Combined model:

$Y_{ij} = \beta_{00j} + \beta_{10j} + r_{0ij} + e_{tij}$

The intercept (β_{00j}) is interpreted as an estimation of students' average achievement in English upon entry. The slope (β_{10j}) represents achievement gains during a semester for the course. The variances were partitioned into within and between department variance components as done for Model 1 and were used to calculate the proportion of the total variance explained by Model 2:

Proportion of total variance explained = $\dfrac{[\hat{\tau}_{00}(\text{Model 1}) - \hat{\tau}_{00}(\text{Model 2})]}{\hat{\tau}_{00}(\text{Model 1})}(100\%)$

Model 3

Model 3 is similar to Model 2 except that it additionally adjusted for student cohort. The model was used to estimate the 'value added' by departments to students after adding a cohort as explanatory variables. For the summary of the models used and how they were used to address the research questions, see Table 3.

Validity, Reliability and Ethical Issues Related to The Study

To ensure validity, actual student data and other relevant variables necessary for VAMs (e.g. students' entry characteristics) were collected and used. Also, the research findings are discussed according to the research questions to ensure that conclusions are drawn and recommendations made correspond to the data collected. In terms of reliability, the study involved all students whose relevant information where available. Also, at least, two repeated measures (WASSCE grades and end-of-semester examinations scores were used. Additionally, data entry checks were made to identify wrongfully inputted and missing data. Reliability of the entire quantitative dataset was checked using slit-half reliability (Cronbach's alpha).

Table 3: Summary of Research Design

Research question	Participants	Data Collection Technique	Data Analysis Multilevel Model Type)
Research question 1 What is the best approach to, and model for estimating student 'VA' progress in the context a single HE institution?		Literature review	
Research question 2 To what extent do students' 'raw' and 'VA' mean achievements in CL2 vary between and within departments after controlling for prior attainment and cohort?	Students (2007-2009 cohorts) from 16 departments	Secondary data	***'raw' Achievement (Model 1)*** Department is placed at level 2 and students at the level. A random intercept model with no explanatory variable except cons) is used. ***'VA' Progress made (Model 2) - department*** English (centered on the mean) is added to the null model. ***Model 3*** Statistically, and cohort is added to Model 2.

With respect to ethical issues, an application letter for permission to access the data was sent to the Rector of the institution. Upon approval, a personal follow up was made to have a verbal agreement on how the data

should be collected and used. Obtaining permission from individual students was considered ideal but problematic due to financial and time constraints and the potential loss of data due to non-response (for example, some students had completed school at the time of the data collection). Codes were further used to hide the real identity of individual students so that others could not identify them. These were done to avoid potential harm e.g. defamation of individual students.

RESULTS

The presentation of the study results starts with the descriptive statistics and the correlation between the selected variables. The main discussion, however, focused on the three models (Models 1-3) and how they highlight the strengths of 'VA' methodology.

Descriptive Statistics

The study involved a total of 6,234 students from three student cohorts i.e. 2007 (2,011), 2008 (2,011), and 2009 (2,112). The majority of the students were from the Faculty of Business and Management Studies (3,238), and they constituted 52% of the total student population used for the study. The Faculty of Applied Science had the least number of students (522) which constituted 8% of the total population. The average student age was 22 years and the average department size was 260 students.

Correlations

The value of the Pearson's correlation (r) for CL2 and English was 0.087 ($p = 0.000$) and was statistically significant indicating that there a positive relationship between CL2 and English was poor. The percentage r^2 suggests that only about 17% of the total variance in CL2 is related to students' entry qualification in English.

The Model Estimates

The estimates of the multilevel Models 1, 2 and 3 were used to answer research questions 2 after controlling for English and cohort.

'Raw' Student Performance

Model 1 was used to estimate the extent of variation in 'raw' average department achievement in CL2. The estimated mean achievement in CL2 across all 16 departments was 62.21 (measured in percentage points out of 100%). The total variance estimated by Model 1 was 145.01 (42.20 at the department level plus 102.59 at the student level). Thus, 29% (42.20/145.01 × 100%) of the variance in CL2 achievement can be attributed to differences between departments. The range of plausible values under the assumption that the department-level variance is normally distributed is between 43.36 and 82.06{62.21 (mean attainment across departments) $\pm$ 1.96 $[102.59]^{1/2}$ (variance at the department level) }. These range of values show that average CL2 achievement varies, to a large extent, among departments (Table 4).

'VA' Progress Made

Perhaps, these observed variations were due to differences in entry characteristics, hence Model 2 statistically adjusted for English. Model 2 was the same as Model 1 except for the addition of English to the model as a prior attainment measure. The mean score across departments after controlling for English was 65.82 percentage points and was statistically significant. Arguably, the students progressed in CL2 by 3.61 percentage units after English had been adjusted for.

A comparison of Models 1 to 2 showed that the addition of English as prior attainment reduced the variance at both the department and student levels. For example, the between-department variance was halved from 42.42 to 20.77, and the within-student variance was reduced from 102.59 to 93.71. The decreases in variances were expected because prior attainment has been known as the single most important explanatory variable that explains student academic achievement. The comparison of the models in terms of the total variance further showed that English as a prior attainment measure accounted for 21% of the total variance in CL2.

'VA' Estimates After Controlling For Student Cohort

Model 3 was used to estimate the 'VA' to students by departments after adding a cohort as explanatory variables. The intercept for CL2 achievement across departments after controlling for the cohort was 68.32 percentage units and was statistically significant (representing the mean for 2007 given that this category was the reference group coded zero). Interestingly, the mean achievement for the 2007 was higher than that of the two other cohorts (2008 and 2009). For instance, the 2008 cohort performed 5.42 percentage units less than the 2007 cohort whereas the 2009 cohort performed 3.74 percentage units less than the 2007 cohort (the estimates for 2008 and 2009 were not significant).

After controlling the cohort, the student level variance decreased from 93.71 to 92.70 whereas the department level 2 variance increased slightly from 20.77 to 21.12. The total variance, however, reduced from 114.48 to 113.82. Thus, the model estimates showed that cohort, an explanatory variable, accounted for only 22% of the total variance in CL2.

A comparison of the 3 models, however, showed that Model 3 is the best model because it relatively explained (22%) more of the total variations between the departments.

Table 4: Comparison of Models 1 - 3 for CL2

	Model 1 'raw' achievement	Model 2 Progress made	Model 3 VA (Age)
CL2 **Fixed part (coefficients)**			
Mean achievement across departments/ Cons/intercept	62.21 [0.96]	65.82 [0.69]	68.32 [1.58]
English	N/A	+ 0.36 [0.03]	+ 0.31 [0.03]
(2008)			- 5.42 [2.20]
(2009)			- 3.74 [2.27]
Random part (Variances)			
Between Departments	42.42 [9.07]	20.77 [4.59]	21.12 [4.65]
Within Students	102.59 [1.85]	93.71 [1.69]	92.70 [1.67]
Total	145.01	114.48	113.82
% Variance explained			
Departments	N/A	51%	50%
Students	N/A	9%	10%
Total		21%	22%
% variance attributable to Department level	29%	18%	19%

Note: Standard errors are in parenthesis

DISCUSSION

The limitations of current methodologies mostly used in assessing quality in HE has already been discussed (see pages 2 and 3). Nevertheless, it is important to mention that current methodologies are also limited in additional ways. For example, despite the fact that quality education is affected by a wide variety of factors including those within the control of institutions (e.g. institutional management, ethos, facilities and resources, pedagogic features) and those outside its control (e.g. student entry characteristics), the latter has mostly been neglected (Thrupp, 2010; Schereens, Glas & Thomas, 2003; Rutter & Maughan, 2002). This makes inferences and decisons subsequently made arguably unfair and deceptive, given that they fail to portray the full picture of the state of quality in an institution.

As evidenced by the findings of this study, VAMs are more informative and useful in addressing case by case situations. For example, this study has shown that significant differences exist between departments within the same institution in terms of CL2 'raw' student achievement, 'VA progress made' and VA attainment after controlling for English and cohort. The intra-class correlations have further shown that, to a certain extent, some departments were more effective in promoting both the "raw" and 'value added' performances of the students. The decreases in the intra-class correlations further suggest that the variables

examined by the study are important factors to consider when examining issues of department effectiveness. This information would have been lost had other approaches to measuring quality been taken.

Thus, comparatively, VA methodology provides much more detailed information about quality in HE as it takes into account factors both within and outside the control of institutions. By so doing, it provides institutions and teachers alike objective information on how much they have added to students' learning, scores or other academic gains from time to time. Such measures are more defensible in examining how effective institutions and teachers have been in promoting students' the academic gains. VAM further provides valuable insights into factors affecting students' performance (Opdenakker & Damme, 2001). Measuring 'value added' performance instead of 'raw' performance is, therefore, critical and is recommended as an alternative approach to quality measurement.

CONCLUSIONS AND RECOMMENDATION

This study, by way of employing both "'raw' and 'value, added'" approaches in examining the quality of students' performance in a single HE institution, has demonstrated that the 'VA' methodology generally provides useful insights into tertiary students' performances. Indeed, the study presents the 'VA' approach as an alternative approach to looking at tertiary students' performances more generally across all outcomes (core and subject specific).

The use of VA methodology in self-evaluation is, therefore, recommended for a start as it may help institutions to (a) reflect on their own peculiar interests and concerns and (b) acquire feedback that could be useful in remedying problems and building on strengths. However, because self-assessment using 'VA' methodology may not be able to cover as much information and provide opportunities for benchmarking as a comparison between institutions will do, the latter approach (across institutions) is appropriately recommended in addition to the former.

REFERENCES

i. *Astin, A. W. (1993). What matters in college? Four critical years revisited. San Francisco, CA: Jossey-Bass.*
ii. *Ballou, D., Sanders, W., & Wright, P. (2004). Controlling for student background in value-added assessment of teachers. Journal of Educational and Behavioral Statistics, 29(1), 37-65.*
iii. *Beardsley, A. A. (2008). Methodological Concerns about the Education Value-Added Assessment System Educational Researcher, Vol. 37, (2), pp. 65–75.*
iv. *Bradshaw, R. H. (1992). Individual attributes as predictors of social status in small groups of laying hens. Applied Animal Behaviour Science, 34(4), 359-363.*
v. *Breen, R., & Jonsson, J. O. (2005). Inequality of opportunity in comparative perspective: Recent research on educational attainment and social mobility. Annual review of sociology, 223-243.*
vi. *Bryk, A., & Raudenbush, S. (1992). Hierarchical linear models in social and behavioral research: Applications and data analysis methods. Newbury Park, CA: Sage.*
vii. *Chetty, D. (1992) School efficiency and effectiveness: Pointers for educational transformation in South Africa, paper presented to the Economics of Education Conference, University of Cape Town.Chisholm and Vally, 1996*
viii. *Chisholm, L., & Vally, S. (1996). The culture of learning and teaching in Gauteng schools. Johannesburg: University of Witwatersrand Education Policy Unit.*
ix. *Christie, P., & Potterton, M. (1997). School development in South Africa: A research project to investigate strategic interventions for quality improvement in South African schools. Final Report. Johannesburg, South Africa: University of Witwatersrand.*
x. *Coates, H. (2006). Student engagement in campus-based and online education: University connections. Taylor & Francis.*
xi. *Creswell, J. (2009). Research design. Qualitative, Quantitative and Mixed Methods Approaches. 3rd. Edition. Sage: London.*
xii. *Gersick, C. (1988). Time and transition in work teams: Toward a new model of group development. Academy of Management Journal, Vol. 31, pp. 9-41.*
xiii. *Harvey, L., & Knight, P. T. (1996). Transforming higher education. Buckingham: Society for Research in Higher Education and Open University Press.*

xiv. *Heck, R. H. (2007). Examining the Relationship between Teacher Quality as an Organizational Property of Schools and Students' Achievement and Growth Rates Educational Administration Quarterly Vol. 43, No. 4 pp. 399-432.*

xv. *Hopkins, D. & Harris, A. (2000) Differentia l strategies for school development; in: D. Van Veen & C. Day (Eds) Professional Development and School Improvement: strategies for growth (Mahwah, NJ, Erlbaum).*

xvi. *Hopkins, D., West, M., Ainscow, M., Harris, A. & Beresford, J. (1997) Creating the Conditions for Classroom Improvement (London, David Fulton).*

xvii. *Hulpia, H., & Valcke, M. (2004). The use of performance indicators in a school improvement policy: The theoretical and empirical context. Evaluation & Research in Education, 18(1-2), 102-119.*

xviii. *Johnes, J. (2006). Measuring efficiency: a comparison of multilevel modelling and data envelopment analysis in the context of higher education. Bulletin of Economic research, 58(2), 75-104.*

xix. *Johnes, J., & Taylor, J. (1990). Performance indicators in higher education: UK universities. Open University Press and the Society for Research into Higher Education.*

xx. *Kothari, C. R. (2006). Reseach methodology methods and techniques 2nd edition. New Age International Publishers Limited Delhi.*

xxi. *Marginson, S., (1993). Arts, Science and Work: Work-related skills and the generalist courses in higher education (Canberra, AGPS).*

xxii. *Motala, S. (2001). Quality and indicators of quality in South African education: a critical appraisal. International Journal of Educational Development, 21(1), 61-78.*

xxiii. *Mortimore, P. (2000). The Road to School Improvement: Rotterdam, Swets & Zetlinger.*

xxiv. *Nkrumah, M. A. (2018). The relevance of teacher factors in understanding tertiary students' performances. Quality assurance in education, 26 (4), 476-488.*

xxv. *Opdenakker, M. C., & Damme, J. (2001). Relationship between school composition and characteristics of school process and their effect on mathematics achievement. British Educational Research Journal, 27(4), 407-432.*

xxvi. *Peers, I. S. & Johnston, M. (1994). Influence of learning context on the relationship between A-level attainment and final degree performance: a meta-analytic review, British Journal of Educational Psychology, 64, pp. 1-18.*

xxvii. *Raudenbush, S. W., & Bryk, A. S. (2002). Hierarchical linear models: Applications and data analysis methods (2nd ed.). Thousand Oaks, CA: Sage.*

xxviii. *Rodgers, Timothy (2007). 'Measuring Value Added in Higher Education: A Proposed Methodology for Developing a Performance Indicator Based on the Economic Value Added to Graduates', Education Economics, 15: 1, pp. 55 — 74*

xxix. *Rutter, M., & Maughan, B. (2002). School effectiveness findings 1979–2002. Journal of school psychology, 40(6), 451-475.*

xxx. *Scheerens, J., Glas, C., & Thomas, S. (2003). Educational Evaluation, Assessment and Monitoring. Lisse: Swets & Zeitlinger.*

xxxi. *Smith, J. and Naylor, R. (2001a). 'Determinants of degree performance in UK universities: a statistical analysis of the 1993 student cohort', Oxford Bulletin of Economics and Statistics, 63, pp. 29–60.*

xxxii. *Smith, J. P. and Naylor, R. A. (2001b). "Dropping out of university: a statistical analysis of the probability of withdrawal for UK university students," Journal of the Royal Statistical Society, Series A, (Statistics in Society), Volume 164(2), p. 389-405.*

xxxiii. *Tam, M. (2001). 'Measuring Quality and Performance in Higher Education', Quality in Higher Education, 7: 1, 47 — 54.*

xxxiv. *Teddlie, C. & Reynolds, D. (2000). The international handbook of school effectiveness research (London & New York, Falmer Press).*

xxxv. *Thomas, S., Peng, W. J., & Gray, J. (2007). Modelling patterns of improvement over time: value added trends in English secondary school performance across ten cohorts. Oxford Review of Education, 33(3), 261-295.*

xxxvi. *Thomas, S. (2001). 'Dimensions of Secondary School Effectiveness: Comparative Analyses Across Regions', School Effectiveness and School Improvement, 12: 3, pp. 285-322.*

xxxvii. *Thrupp, M. (2010). Emerging school-level education policy under National 2008–9. New Zealand Annual Review of Education, 19, 30-51.*

xxxviii. *Thum, Y. M. (2003). Measuring progress toward a goal estimating teacher productivity using a multivariate multilevel model for value-added analysis. Sociological Methods & Research, 32(2), 153-207.*

xxxix. *Willms, J. D. (1992). Monitoring school performance: A guide for educators. London: Falmer.*