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Assessing Practical Skills in Computer Science: Exploring the Relationship between Coursework and Standardised Examinations in Zimbabwe

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Abstract
The study investigated the relationship between candidate performance in practical coursework and practical examinations in the Computer Science Ordinary level syllabus in Zimbabwe, focusing on three components namely; Data Base, Web Design and Programming. The study involved a sample of 743 candidates from 50 examination centers. The findings revealed weak positive correlations between practical coursework and practical examination scores for the Database and Programming components, but a negative correlation for Wed Design. The study also found that mean scores for coursework were significantly higher than those for practical examinations, which was attributed to factors such as the absence of scoring guides, undue assistance to students, and the unilateral assignment of marks by teachers. The research recommended capacity development workshops for teachers on item setting and marking, as well as the distribution of clear guidelines for coursework and practical examinations to all the Computer Science centers.

Keywords: Computer Science, Ordinary Level, Practical Coursework, Practical Examination, Database, Web Design, Programming, Teacher Factors.

1.0 Introduction

1.1 Background to the Study

Evidence from research studies generally converge to the conclusion that coursework assessment marks are greater than examination marks (Chansarkar and Raut-Roy 1987, Gibbs and Lucas 1997). This finding concurs with an observation made on coursework and examination marks for ordinary level Computer Science candidates who sat for the Zimbabwe School Examinations Council examinations in 2022. Coursework marks for Computer Science components namely, Data Base, Programming and Web Design were observed to be higher than the corresponding examination marks for the same components.

This study therefore, was conducted in order to investigate relationships, if any, between candidate performance in coursework and the corresponding practical examination in Computer Science in the November 2022 examinations. The two assessment formats tested the same concepts and skills. The knowledge and skills gained by learners as they do coursework are in turn reflected in candidate performance in the practical examination.

Murdan (2005) conducted a study to analyse coursework marks and the related examination marks. The study revealed that coursework marks were higher than examination marks, meaning candidates

performed better in coursework than the examination. Weak correlation coefficients were recorded between coursework and examination marks of specific candidates. This study, therefore, wanted to establish the relationship in candidate performance in Computer Science components identified above.

In normal circumstances, it is expected that coursework marks of individual learners are higher than examination marks. This is so because of availability of resources and practice effect. However, one would still expect a positive correlation between the two sets of scores as the same concepts and skills are tested by the two assessment formats. The objective of coursework is to enhance student learning and therefore learners should also do better in the examination, if the coursework has been implemented well. This study wanted to investigate teacher level factors that influenced student performance in coursework.

1.2 Purpose of the Study

The purpose of the study was to investigate the relationship between candidate performance in coursework and the corresponding practical examination in Computer Science. This was necessitated by the fact that a significant number of candidates achieved high coursework marks but scored low marks in the respective components in the 2022 examination session.

1.3 Research Questions

The study sought to answer the following research questions:

1. What is the relationship in candidate performance between coursework and the practical examination in the three Computer Science components?
2. What is the proportion of candidates who achieved higher marks in coursework than the practical examination and vice-versa?
3. What is the relationship between the scores on the Computer science practical coursework and the practical examination?
4. What factors contribute towards candidate performance in coursework and the standardised practical examination?

1.4 Significance of the Study

The study was of significance to the Zimbabwe School Examinations Council in particular and examination boards in general in that they would be aware of the limitations of coursework as an assessment model. Examination boards, as a result of the study would try to minimise the gap between coursework and examinations. Computer Science teachers would be aware of the threats caused by coursework, and be able to wear two jackets, that of an examiner and the other of a teacher.

2.0 Literature Review

2.1 Conceptual Framework

This study is grounded in the concepts of formative and summative assessment, as well as the role of coursework and examinations in evaluating practical skills in Computer Science. The assessment of practical skills in Computer Science is essential since it fosters the development of digital skills which are critical in this ever-changing social and economic environment.

Formative assessment, as embodied by coursework, is designed to monitor student learning and provide ongoing feedback to improve teaching and learning (Black & William, 1998; Yorke, 2003). Coursework allows teachers to track student progress and provides a more relaxed environment for students to demonstrate their practical skills (Taras, 2005). The assumption is that the formative nature of coursework should better prepare students for the summative assessment of practical examinations.

Summative assessment, such as standardised practical examinations, is intended to provide a standardised measure of student learning at the end of a learning period (Biggs, 1998; Madaus & O`Dwyer, 1999). Examinations are typically administered under controlled conditions and can be high stakes, which often cause anxiety and pressure for students (Struyven et al., 2005).

The theoretical framework posits that there should be a positive relationship between students' performance on practical coursework and their performance on the related practical examinations (Orsmond et al., 2000). This is because students who have developed the necessary practical skills and knowledge during the coursework phase should be able to demonstrate their competencies in the examination setting. However, factors such as the nature of the assessment tasks, the quality of teacher feedback, and the examination environment can also influence the relationship between these two forms of assessment (Gibbbs & Simpson, 2004; Harlen, 2005).

By exploring the relationship between practical coursework and practical examinations in Computer Science, this study aimed to provide insights into the effectiveness of these assessment approaches in measuring and developing students' practical skills, as well as identify areas for improvement in the assessment process.

2.2 Coursework and Examinations

Coursework has been used more often to assess learners at their place of learning. Coursework by design is teacher assisted and learners carry out the assessment tasks in a relaxed environment. In the past, examinations were the major forms of assessment used to assess candidate knowledge and skills in a discipline. Through research, coursework has become a popular mode of assessment because of its numerous advantages over examinations. Coursework is administered to play a formative function in the assessment of learners. Learners are monitored and supervised as they do coursework. Teachers track learner progress in the implementation of coursework in schools, thus learners learn much as they do coursework. Therefore, coursework is tailored to improve student learning, and has a ripple effect in candidate performance in the examinations.

Examinations are administered under controlled environments. If the examinations are standardised, then all the candidates sit for the examinations under the same or similar conditions. Therefore, the examinations put candidates under extreme pressure and anxiety. Generally, candidates who do better in coursework of a given domain should do better in the examinations for the same domain. The reason being that learners who have mastered the content and possess skills in a subject should as well show their competencies in the examination for the same subject.

Coursework has become a popular mode of assessment due to its numerous advantages over examinations (Brown & Glasner, 1999; Harlen, 2005). Coursework is designed to play a formative function in the assessment of learners, as it allows teachers to monitor and supervise students' progress, thus enhancing student learning (Taras, 2005; Yorke, 2003) The assumption is that learners who have mastered the content and possess the necessary skills in a subject during the coursework should also demonstrate their competencies in the examinations for the same domain (Madaus & O'Dwyer, 1999).

Examinations, on the other hand, are administered under controlled environments and can put candidates under extreme pressure and anxiety (Struyven et al., 2005). However, examinations are still considered an important form of assessment, as they provide a standardised measure of student learning (Biggs, 1998).

Coursework and examinations complement each other in terms of knowledge and skills for learners. Coursework can be a good predictor of learner performance in the examination. Candidates who have been well-prepared during the coursework tend to perform better in the examinations, while performance

in examinations can also reflect the effort put into the coursework during the teaching and learning process (Gibbs & Simpson, 2004).

2.3 The Computer Science Syllabus

The Computer Science syllabus is a four year course where learners write their final examinations in Form 4. The course offers a foundation for learners intending to pursue computer related fields at the advanced level.

The assessment objectives of the syllabus are divided into three areas namely, knowledge and understanding, problem solving and practical skills. The scheme of assessment is organised as shown in the table 1.

Table 1: Computer Science Scheme of Assessment

Paper	Type of Paper	Duration	Weighting
1	Multiple Choice	1 hour	10%
2	Structured-free response	2 hours	30%
3	Practical Examination	3 hours	40%
4	Practical Coursework	5 Terms	20%
TOTAL			100%

Source: Ministry of Primary and Secondary Education (2015), O level Computer Science syllabus.

Paper 1 and 2 are theory papers, while papers 3 and 4 test practical skills. This study was concerned about the performance of candidates in the practical coursework and practical examination. Three syllabus components are tested in papers 3 and 4; namely data base, programming, and web design. Candidates are expected to do coursework in each of the three components in 5 terms and then sit for the examination in Form 4. It is important to note that, the same content and skills are assessed in paper 3 and 4.

2.4 Related Studies

Recent studies have explored the relationship between coursework and standardised examinations in assessing practical skills, particularly in the field of Computer Science.

A study by Moghaddam and Araghi (2013) investigated the correlation between students' performance on practical programming assignments and their scores on a summative programming examination. The researchers found a significant positive relationship, indicating that students who performed well on the practical coursework also tended to excel on the final examination. This supports the idea that formative assessment through coursework can effectively prepare students for summative evaluation.

Similarly, a study by Chetty and Ramalingam (2016) examined the alignment between practical programming tasks completed as part of a course and the practical examination. They found that students who demonstrated proficiency in the coursework components were more likely to perform well on the practical examination, suggesting that the coursework authentically assessed the skills required for the final assessment.

Research has it that candidate performance in coursework is generally higher than performance in related examinations. This was confirmed by Richardson (2015) in a study involving six subjects. The results showed that in English and History, coursework performances were slightly higher, while in Biology, Business Studies, Computer Studies and Law; coursework performances were much higher than examination performances. It was the intention of the study to check the situation for Computer Science with regards to performances in practical coursework and the related examination.

In a related study, Murdan (2005) investigated relationships between examination and coursework performances of Pharmacy students. The results revealed a weak correlation between coursework and

examination marks of individual students. In the study, coursework marks were consistently high, while a number of students failed the examinations. It is logical that candidates with high coursework marks also obtain high examination marks, given that the same concepts and skills would be tested. The assumption here is that high examination marks reflect learning, provided for during coursework. In Murdan's study, it was surprising that coursework marks were constantly high, yet a number of candidates failed the examinations.

Other studies, however, have highlighted potential disconnects between coursework and examinations. Funke and Geldreich (2018) investigated the relationship between students' performance on programming assignments and their scores on a practical Computer Science examination. While they found a positive correlation, the strength of the relationship was moderate, indicating that factors beyond the coursework may influence examination results.

Researchers have also explored the role of teacher feedback and assessment environment in mediating the relationships between coursework and examinations. Fachikov and Boud (1989) found that the quality and timeliness of feedback provided to students during the coursework phase can significantly impact on their performance in the final examination.

These studies underscore the complex nature of assessing practical skills in Computer Science and the need to understand the interplay between formative and summative assessment approaches. Examining the relationship between coursework and standardised examinations can provide valuable insights into the effectiveness of these assessment practices and inform strategies for enhancing the assessment of practical competencies.

The main objective of coursework is to enhance learning as students receive feedback on their assessed work. It was the intention of this study to establish whether the coursework in Computer Science helped candidates to learn and improve their performance in the practical examination.

3.0 Research Methodology

The study employed a mixed methods approach, utilising both qualitative and quantitative research methods. The concurrent triangulation design was chosen as an appropriate design, as it allowed the researchers to use qualitative data to complement quantitative data. This design enabled the researchers to describe factors that influenced learners' performance in coursework and practical examinations, as well as to test the hypotheses using quantitative data. The design also enabled the study to explore teacher-level factors that influenced learner performance in either the coursework or the related practical examination.

The population for the study included all Computer Science examination centres and candidates who registered and sat for the subject in 2022. A sample of 50 schools was randomly selected from the 280 Computer Science centres, and at each selected school, all the candidates who registered for Computer Science and had all the marks for the three coursework components (data base, programming and web design) were included, resulting in a candidate sample size of 743.

Computer Science teachers at the selected schools completed self-administered questionnaires, and teacher documents such as coursework assignments, tests and marking guides were analysed. Coursework marks for the three components were then compared with the respective practical examination marks.

The data was captured in the Statistical Package for Social Sciences (SPSS) spread sheet, analysed, and presented in tables and graphs. Descriptive statistics, t-tests and correlations were used to compare candidate performance in coursework and practical standardised examinations.

4.0 Presentation and Discussion of Results

4.1 Presentation of Results

Results on candidate performance in the three components are presented starting with quantitative data and followed by qualitative data.

4.1.1 Data Base

Table 2: Data Base: Descriptive Statistics

	Mean	Std Deviation	N
Coursework	23.68	6.864	743
Practical Examination	20.19	7.421	743

The table shows the descriptive statistics for data base marks. The mean for coursework marks (23.68) was higher than that for examination marks (20.19). In addition, coursework marks were bunched together while examination marks were more spread. Considering the mean, candidates did better in coursework than in the practical examination.

A T-test was run to establish whether the difference between the two means was significant. The results are shown in table 3.

Table 3: Data base: T-Test Analysis

	Test Value = 0					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Coursework	94.058	742	.000	23.684	23.19	24.18
Practical Exam	74.155	742	.000	20.188	19.65	20.72

The T-test results indicate that the difference between the two means was significant at the 5% level. This meant that the better performance of candidates in coursework than the practical examination was not due to chance but other factors that influenced learners to score high marks in coursework.

Table 4: Correlation Analysis for Data Base Marks

		Coursework	Practical Exam
Coursework	Pearson Correlation	1	.356**
	Sig. (2-tailed)	-	.000
	N	743	743
Practical Exam	Pearson Correlation	.356**	1
	Sig. (2-tailed)	.000	-
	N	743	743

** Correlation is significant at the 0.01 level (2-tailed)

A correlation analysis for Data Base coursework and examination marks was done to establish the relationship between the two sets of scores. The correlation coefficient was 0.356 indicative of a weak correlation between coursework and examination marks. The correlation was significant at the 1% level. Therefore there was a weak relationship between the two sets of scores, meaning that candidates who did well in coursework portrayed a weak performance in the examination.

4.1.2 Programming

Table 5: Programming: Descriptive Statistics

	Mean	Std Deviation	N
Coursework	29.31	15.774	743
Practical Examination	18.17	7.691	743

Descriptive statistics for Programming marks were computed and are reflected in table 5. The mean for coursework (29.31) was far much higher than that for practical examination. The marks for coursework were more spread as compared to practical examination scores. Considering the mean, candidates did better in coursework than in the practical examination.

A T-test was run to test for the significance difference between the two means. The T-test results are shown in table 6.

Table 6: Programming T-test Analysis

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Coursework	50.656	742	.000	29.314	28.18	30.45
Practical Exam	64.419	742	.000	18.175	17.62	18.73

T-test results show that the two means were significantly different at the 5% level. Therefore, the coursework mean was significantly higher than the practical examination mean. Candidates truly performed better in coursework than in the practical examination. The issue that candidates' marks in coursework were higher than those for practical examination was not a result of chance factors but this was heavily influenced by other factors such as teacher or school level factors.

Programming marks were further subjected to correlation analysis to establish the relationship between the two sets of scores. Correlation statistics are shown in the table below.

Table 7: Correlation Analysis of Programming Marks

		Coursework	Practical Exam
Coursework	Pearson Correlation	1	.361**
	Sig. (2-tailed)	-	.000
	N	743	743
Practical Exam	Pearson Correlation	.361**	1
	Sig. (2-tailed)	.000	-
	N	743	743

** Correlation is significant at the 0.01 level (2-tailed)

Pearson correlation revealed a weak relationship between the two sets of scores. The correlation coefficient of 0.361 was significant at the 1% level. The weak correlation indicates that as one set of marks goes up, the other set slightly goes up and vice versa. Coursework marks were partially related to the practical examination marks. Candidates who were better in coursework obtained weak passes in the practical examination.

Further analysis of programming scores was done by computing the proportion of students who achieved higher marks in coursework than the practical examination. The proportion of candidates who scored higher marks in coursework was 0.845, meaning that 84.5% of the candidates achieved higher marks in coursework than the practical examination.

4.1.3 Web design

Table 8: Web Design: Descriptive Statistics

	Mean	**Std Deviation**	**N**
Coursework	13.33	3.206	743
Practical Examination	12.59	2.874	743

The table shows the means for web design coursework and practical examination. The coursework mean of 13.33 was higher than the practical examination mean of 12.59. This reflects that candidates did better in coursework than the related examination.

Table 9: Web Design T-test Analysis

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Coursework	113.344	742	.000	13.331	13.10	13.56
Practical Exam	119.370	742	.000	12.593	12.39	12.80

The T-test results revealed that the difference between the two means was significant at the 5% level. This meant that candidates truly performed better in coursework than the practical examination, and such performance was not a result of chance factors but other factors related to teaching and learning of web design aspects.

Table 10: Correlation Analysis of Web Design Marks

		Coursework	Practical Exam
Coursework	Pearson Correlation	1	-.079*
	Sig. (2-tailed)	-	.032
	N	743	743
Practical Exam	Pearson Correlation	-.079*	1
	Sig. (2-tailed)	.032	-
	N	743	743

* Correlation is significant at the 0.05 level (2-tailed)

Pearson correlation for web design marks was done to establish if the two sets of scores were related. The correlation coefficient was -0.079, indicating a weak negative relationship between the two sets of scores. The Pearson correlation was significant at the 5% level indicating that the weak negative correlation was not a result of chance factors but true differences between coursework and practical examination marks.

Further statistical analysis of coursework and practical examination marks revealed a high proportion of learners who achieved higher marks in coursework than the examination. About 72.4% of the candidates

achieved higher marks in coursework than the examination. This meant that candidates did extremely well in coursework than the practical examination.

4.2 Results from Teacher Questionnaires and Documents

An analysis of teacher assessment tasks (assignments and tests) revealed variability in the setting and administration of the tasks. Assessment tasks in some schools were well set with marks clearly allocated while in other schools, the tasks were not clear and more marks were allocated to simple practical test items. Marking schemes were available in some of the teachers' files while some teachers marked students' work without scoring guides. This compromised the quality of marking and led to unilateral dishing out of marks, resulting in coursework marks being higher than examination marks.

In the majority of schools, coursework tasks were well spread according to teaching and learning school terms and also as provided for in the syllabus. The syllabus recommends that each of the coursework component tasks should be spread throughout the 5 terms. It was surprising to note that some teachers administered all the coursework tasks in Form 4. These could be those teachers who did not follow circulars on the administration of practical coursework in Computer Science.

The syllabuses and recommended textbooks were available in the majority of schools. However quite a number of schools did not have the policy circular that guides the administration of coursework and the practical examination. These could be some of the factors that contributed to candidates achieving high coursework marks and getting low marks in the examination.

4.3 Discussion of Results

The study revealed a discrepancy between coursework and examination marks as evidenced by the proportion of candidates who scored higher marks in coursework than the practical examination. Teachers in their responses thought that the differences between coursework and examination marks was due to the fact that examinations are difficult, stressful, time-limited and require a lot of knowledge for one to pass. Computer Science teachers claimed that there is limited time for candidates to prepare for the examinations, especially, when there is so much coursework to be done. In Computer Science, students begin their coursework in Form 3 and are expected to finish their coursework in Form 4 during second term. It could be that students who were pressurised with coursework did not start it on time as stipulated in the circulars.

Teachers in their responses to questionnaires gave various reasons that contributed to high coursework marks and low examination marks. The reasons were cited as follows:

- Learners sometimes work together in groups. This means that weak students would gain from those who are knowledgeable and get high marks in the coursework, but when the examination comes, the weak students will not get assistance.
- Students pass coursework because they have more time to do their practical work. The examination has time constraints hence the candidates fail.
- Sometimes students get assistance in coursework or they can easily copy.
- Students use a lot of reference material as they do coursework. When the students write examinations, they are not allowed to bring any materials in the examination room.

Teachers agreed that some students got assistance as they did their coursework and such assistance might have had an impact on the performance of students in coursework. It is known that sometimes students cheat in order to get high marks and on the other hand teachers themselves cheat so that their students pass.

The study revealed a weak correlation between examination and coursework marks in the three components that were considered. Since the coursework and examination tested the same knowledge and skills, the great difference between examination and coursework marks of candidates who failed the examination but did well in coursework shows that these students "did" the coursework, but did not learn from it. One teacher pointed out that "the students did the coursework from Form 3 to 4 but then forgot whatever they learnt. By the time the students had to sit for the examinations, they had to start to learn the concepts again". Even though the coursework was used to promote student learning, many students did not learn from the coursework. The students could have used other means, to get high marks from coursework, other than learning from the coursework.

Students could have viewed the coursework not as a learning strategy but as a way to simply get marks by whatever means (Ramsden, 1984). The study also confirms the work of Miller, Imrie and Cox (1998) who stated that coursework tasks are seen by students as assessments that can be negotiated with the teachers as opposed to assessments that serve as a learning opportunity. In the case of Computer Science, the coursework marks come from several assessment tasks that are spread over 5 terms in each of the three components under consideration. Therefore, instead of students doing the assessment tasks as prescribed, they chose to bunch their work to be done in very few terms, which meant that specified deadlines were not adhered to. The students thus focussed on marks obtained by whatever means for the coursework, rather than on learning in order to achieve higher marks in the examination.

5.0 Conclusions and Recommendations

5.1 Conclusions

The study revealed the relationship between coursework and examination marks in three components of the Computer Science syllabus. From the results of the study, there was a weak correlation between coursework and examination marks. Candidates did better in coursework than the practical examination. A high proportion of students got higher marks in coursework than the practical examination. Students' performance in coursework had a weak relationship to their performance in examinations.

The research revealed a gap between coursework and examination performance, especially for the weak learners, as it showed that the conduct of coursework did not necessarily lead to learning. The situation that high performance in coursework did not always reflect high performance in the practical examination, is a reflection that learning did not always take place during the implementation of coursework. For the majority of candidates, the focus was thus on marks and not on continued learning from coursework, as coursework results did not impact positively on examination performance.

The study also revealed that the nature and quality of coursework tasks varied from one school to another. The way how Computer Science teachers marked students' work varied from school to school, with some teachers marking candidates' work without marking schemes.

5.2 Recommendations

On the basis of these conclusions, the study recommends that teachers should work towards diverting the student focus from accumulating marks toward learning and helping the weakest students to perform better in examinations. Teachers should emphasise to students the importance of learning from coursework in order to succeed in examinations.The study also recommends capacity development workshops for teachers in item setting and marking for practical tasks in Computer Science. Teachers should be psychologically trained to wear two jackets; that of an examiner and that of a teacher in order to minimise variability in the assessment of coursework and practical examination. Coursework and practical

examination guidelines should be distributed to all Computer Science centers. Finally, further research should be conducted to trace the performance of candidates in coursework and practical examination for the coming cohort.

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