

# The Effectiveness of Information and Communication Technology Curriculum: A Case of Private Senior Secondary Schools in Botswana

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## Abstract

This formative evaluation seeks to measure the effectiveness of Botswana ICT curriculum (Code 0417) by evaluating the content taught and the instructional strategies used to deliver the course contents. It also seeks to assess whether both academics and students felt that the course content and instructional strategies were important. This study employed both quantitative and qualitative research designs as surveys, focus groups, one-on-one interviews, classroom observations and student test annual examination grades were used to collect data. Sixty students enrolled in the course and twelve course instructors were selected randomly from a sample of three private senior secondary schools in Botswana. Descriptive statistical analyses were used to analyse the data collected. Students rated all ICT course topics, except computer networks, as less useful than did their instructors. Both students and teachers offered a number of suggestions on how this course might be improved.

**Keywords:** Computer Literacy, Formative Evaluation, Effectiveness of ICT Curriculum, Teaching Strategies, Botswana.

## INTRODUCTION

Educational evaluation as defined by Brown (1995) is the systematic collection and analysis of all relevant information necessary to promote the improvement of a curriculum and assess the effectiveness and efficiency, as well as participants' attitudes within the context of the particular institutions involved (p. 227). Similarly, Finch and Crunkilton (1999) see educational evaluation as determining the value of curriculum, predicated on collecting data to be analyzed in a systematic manner. The two purposes of evaluation that it is thus possible to identify are the assessment of effectiveness and the promotion of improvement. Evaluation is therefore the process of gathering information that facilitates improving a program (formative) or that helps in determining its value (summative). Many experts have analyzed the difference between formative and summative evaluation. For Markle (1989),

summative evaluation is an evaluation to prove while formative evaluation is an evaluation to improve. According to Baker and Alkin (1973), summative evaluation is evaluation for validation, while formative evaluation is evaluation for revision and improvement.

Curriculum evaluation as defined by Finch and Crunkilton (1999) involves deciding on the value of a curriculum or part of a curriculum based on data that was collected with the intent of improving the curriculum, program or curriculum materials. According to McNeil (1996), curriculum evaluation is more general in that involves ethically and empirically responding to the questions: "what should we do?" and "what can we do?" For McNeil, evaluation is a "collection of guidelines to make essential decisions" about what to teach and how to teach, which will benefit all involved in the particular curriculum. White (1988) adds that evaluation of this type is not concerned with assessing an individual's achievement, but with making broader judgments about the value of the curriculum. In education, a high quality curriculum is vital as the outcome of an excellent curriculum is excellent students. Thus as McNeil (1999) emphasizes evaluation should be done so as to develop a curriculum without deficiencies or, in other words, to identify its weaknesses and proactively avoid any major problems it may cause.

There are many different types of curriculum evaluation, depending on the objects being evaluated and the purpose of the evaluation, and they are generally distinguished based on method (for example, questionnaire method or interview method). For Brown (1995), evaluation can be formative or summative, process or product-oriented, and quantitative or qualitative. Stake (1986) offers an interesting description of the first two. For him, "when the cook tastes the soup, that's formative; when the guest tastes the soup, that's summative". Formative evaluation is based on information gathered during the learning process. Summative evaluation, on the other hand, is based on information gathered at the end of the learning process.

The term "formative evaluation" was coined by Scriven (1967) and is the process of collecting qualitative or quantitative data during the developmental stage of the instructional design process (Seels & Glasgow, 1990). The data collected is used to provide immediate feedback and helps to make revisions or modifications to the program before the final product is developed. In the process of instructional development, the instructional designer evaluates the instructional materials to determine weaknesses so that the material can be modified (Smith & Ragan, 1999). Formative evaluation can be done by an internal or external evaluator or, preferably, a combination of the two.

As acknowledged by Bachman (1991), there are four important considerations when planning a formative evaluation. The first is whether the program is suited to such evaluation. The second is ensuring that the design of the evaluation is effective. Thirdly, the data gathered must be relevant to the research question being studied. Finally, this type of evaluation is generally not suited to large samples as these samples in this type of evaluation consume considerable time and effort.

In this study, a formative evaluation approach is used to improve the curriculum design of a computer literacy program, rather than a summative approach that might have demonstrated the overall effectiveness of the curriculum. This formative evaluation was aimed at helping instructors to identify whether or not students achieved sufficient mastery of the skills in the curriculum or if further instruction was needed in specific areas. It was also aimed at determining if instructors and students agreed on the importance of course content and instructional strategies.

### **Formative Evaluation in Information and Communication Technology**

Computer literacy encompasses "an understanding of computer characteristics, capabilities, and applications, as well as an ability to implement this knowledge in the skilful, productive use of computer applications suitable to individual roles in society" (Simonson, Mauere, Montag-Toradi, & Whitaker, 1987, p. 233). Gupta (2006) defines it quite simply as the individual's ability to operate a computer system. This includes having a basic understanding of file management processes as well as how to open, save, copy, delete and print documents. It also involves using computer applications or software to perform personal or job-related tasks, using web browsers and search engines online, and being able to email.

Information and Communication Technology (ICT) is a fundamental part of contemporary secondary school curriculum. Computer literacy is not only required in ICT courses, but in most other courses and disciplines students will pursue. Previous studies have confirmed that computer competency is essential to both academic and career achievement (Davis, 1999). Consequently, several studies have focused on the contents of ICT courses and their instructional strategies in terms of learning effectiveness. Gupta (2006) found that basic parts and functions of information systems, system software, security and privacy issues, the use of application software (word processor, spread sheets, presentation), and accessing remote computers should be among the course objectives of a basic

computer literacy course. While the above may appear to be broad-reaching, it does not encompass all basic-level skills as an "all-purpose Information and Communication Technology" class that expects everything to be taught in one semester is considered unrealistic (Beard, 1993).

According to Lankshear and Knobel (2003), new computer literacy skills often pertain to electronic gaming, synchronous and asynchronous communication, weblogs, webpages, and multimedia text productions. In Andrews (2004) new computer technologies literacy research, the focus is on the environment in which students learn how to read and write which now includes multiple modalities: graphics, animations, video, audio, hyperlinks, and print. Wambach (2006) observes that computer proficiency now means that students are able to collaborate on classroom projects and work on annual inquiry projects with and through the Internet. Wambach concluded that whatever type of computer system is used (desktops, laptops, or tablets) and wherever the computer is used (in a lab, on a wireless cart, or on a bedroom desk) students desire one-to-one access (rather than a shared computer) and consider computers as learning tools, as essential as pencils or calculators.

With the changes in technology, the elements of computer literacy are likewise bound to change constantly, making it important for educators to regularly revise course contents to include the latest advancements. Currently, computer and web-based instruction with interactive practice activities have been found to be effective methods for teaching computer literacy (Martin, Klein & Sullivan, 2004, 2006). At the same time, the rapid pace of technological change has led businesses to reorganize and to demand a highly computer-literate workforce (Porter & Miller, 1985). They thus seek computer skills in almost everyone they hire (Ndahi & Gupta, 2000; Hedberg, J. (2002). So as to meet these demands and needs it is important to determine what constitutes the desired computer competency skills and how they should be taught. Formative evaluations such as this are thus important in primary, secondary and post-secondary schools so that course goals align with student needs, technological advancements, and employer requirements.

### **The Information and Communication Technology Curriculum**

The course at the centre of this formative evaluation is a computer literacy course called Information and Communication Technology (Syllabus Code 0417) as administered by the International General Certificate of Secondary Education (IGCSE) Technology program worldwide. In Botswana this curriculum is only offered in private senior secondary schools, not in government schools. This curriculum provides students with a solid introduction to computers and the software applications they will use in both their personal and professional lives. The course is conducted in a learner-centred classroom and requires active student participation. Instruction features illustrated lectures, in-class group work, on-line research and discussion, student-generated information and demonstrations, and hands-on lab activities. The course has two areas of concentration: theoretical knowledge about computers and practical knowledge on how to use computers for productivity, problem solving, and data analysis.

Information and Communication Technology (ICT) falls into Group V (Creative, Technical and Vocational) of the International Certificate of Education (ICE) subjects. Information and Communication Technology is an applied subject and all candidates require frequent access to computer and Internet facilities to develop and demonstrate their skills. The syllabus is structured around the flexibility needed to cope with a wide variety of resources and ever-changing technologies. Curriculum content is divided into eight interrelated sections which should be read as an integrated whole and not as a progression. These are:

1. Types and Components of Computer Systems
2. Input and Output Devices
3. Storage Devices and Media
4. Computer Networks
5. Data Types
6. The Effects of Using ICT
7. The Ways in Which ICT is Used
8. Systems Analysis and Design

### **Purpose of the Evaluation**

Evaluation is conducted to improve a curriculum by identifying its strengths and weaknesses (White, 1988). The purpose of this evaluation was to measure the effectiveness of the course by evaluating the content taught and the instructional strategies used to deliver course content. This evaluation also sought to identify if academics and the

students agreed on the importance of the course content and instructional strategies. The effectiveness of the course was arrived at by measuring student and instructor perception of usefulness of different topics and the helpfulness of teaching strategies used. A summative assessment of student performance data (monthly tests and annual exams) was also conducted to enhance information gained about student learning in the formative evaluation.

### **Research Questions**

This student and academic portions of this study were structured around the following questions:

- Do academics and students agree on the optimal content of the computer literacy course?
- Do academics and students agree on the optimal instructional strategies used to teach the content of the computer literacy course?

The beneficiaries of this evaluation include learners, teachers, college administrators, and education policymakers. In its National Development Plan, the Government of Botswana outlines the strategies that it hopes will produce the knowledgeable, skilled, enterprising and independent individuals demanded by today's technologically advanced environment (Republic of Botswana, 2003). In its Revised National Policy on Education, it acknowledges that society must be computer literate and that the workforce has to be prepared to make the best use of ICT (Republic of Botswana, 1994). The Government of Botswana has indicated its intention to provide resources for the expansion of educational facilities, including the provision of computer and Internet access in all schools by 2016 (Republic of Botswana, 1997). This study aims to make available, to the Government of Botswana, an ICT curriculum evaluation that could help to shape and perhaps expedite its intention to provide these resources.

### **Limitations**

This study recognizes that locally dependent factors related to culture, history, norms and values constitute a background which may influence the results of the study. Empirical study results can thus only be generalised to other populations with similar cultural and societal conditions. The curriculum under evaluation is only offered by private senior secondary schools in Botswana and the study was therefore limited to these schools.

## **METHODOLOGY**

### **Participants**

Participants in this study included students and course instructors in the Information and Communication Technology course offered at private senior secondary schools in Botswana. Sixty students enrolled in the course and twelve course instructors were randomly selected from a sample of three private senior secondary schools. Twenty students and four instructors were selected from each of the sampled schools. The coordinator of the course was also interviewed so as to obtain additional relevant information. Based on the different data sources, different evaluation procedures were used, as explained in the next section.

### **Data Sources**

A variety of quantitative and qualitative data sources were investigated and recommendations were made based on the results of the data analyzed. The primary data sources included surveys and interviews with students and instructors as well as classroom observations. The secondary data accessed included grades on student tests and annual examinations. Student and instructor opinions on course content as well as instructional strategies were noted. A descriptive statistical analysis was adopted and percentages and means were calculated.

### **Survey**

Sixty students and twelve instructors were surveyed. The survey questionnaire was administered by the researcher with the help of course instructors. The survey consisted of two categories of questions, feelings toward topics covered (usefulness of content) and feelings toward teaching strategies used (helpful strategies). The same survey questions were asked of both students and instructors. Respondents were asked to rate the questions on a four-point

Likert-type scale adjusted to reflect the two categories of questions. For the usefulness of content category, the Likert scale was Very Useful = 3, Useful = 2, Less Useful = 1 and Not Useful = 0. For the helpful strategies category, the Likert scale was Very Helpful = 3, Helpful = 2, Less Helpful = 1 and Not Helpful = 0. The validity of the instrument was verified by asking two ICT instructors to review and consider the instrument and then incorporating their suggestions and alterations into the final survey.

To comply with ethical requirements, a letter from the University of Botswana was obtained. The letter was given to the principal of the school being studied and after his or her permission had been obtained, the study commenced.

### Test and Examination Scores

Student performance on tests and annual examinations was analysed. Four tests were administered to all students. These four tests covered the major topics of the course. The content covered during the study year (three terms) was tested by an annual exam.

### Classroom Observations

Observations were made in the class so as to collect data on instructional strategies and the content taught in the class. Most classes involved lectures and in-class activities. In-class activities and hands-on projects helped instructors to evaluate the skills learned by the students. Observations were made by the researcher and three lessons were randomly selected for observation.

## RESULTS

The results of the study are presented based round the study's research questions: A. What to teach? and B. How to teach?

### A. What to teach: do academics and students agree on the optimal content of the ICT course?

#### Survey results

Both student and instructor opinions of the content taught in this Information and Communication Technology course were collected through the survey. The weighted mean of the responses obtained were tabulated and are depicted in the graphs below. The eight main topics taught in the course (type and components of computer systems, input and output devices, storage devices and media, computer networks, data types, the effects of using ICT, the ways in which ICT is used, and systems analysis and design) were listed on the survey. Students and instructors rated these topics on a four point Likert-Type scale on the basis of their usefulness (Very Useful=3, Useful=2, Less Useful=1 and Not Useful=0). The results of student and instructor survey mean scores on the usefulness of course content are shown in Table 1.

Table 1: Student and Instructor Survey Mean Scores on the Usefulness of Content

Contents taught	Students	Instructors	Total
A1. Types and Components of Computer Systems	1.88	2.11	2.00
A2. Input and Output Devices	1.56	2.36	1.96
A3. Storage Devices and Media	2.56	2.88	2.72
A4. Computer Networks	2.60	2.90	2.75
A5. Data Types	1.72	2.49	2.11
A6. The Effects of Using ICT	1.08	2.04	1.56
A7. The ways in which ICT is used	2.20	2.79	2.50
A8. Systems Analysis and Design	2.06	2.50	2.28
<b>Mean Total</b>	<b>2.00</b>	<b>2.51</b>	<b>2.25</b>

The mean score of student ratings was 2.00 as compared with 2.51 for instructors suggesting that instructors deemed the content to be slightly more useful than students. Computer networks was rated as the most useful by students ( $M = 2.60$ ) followed by storage devices and media ( $M = 2.56$ ). Computer network was also rated as the most useful by instructors ( $M = 2.90$ ) followed by storage devices and media ( $M = 2.88$ ). According to the students, the least useful content was the effects of using ICT ( $M = 1.08$ ) while the instructors rated type and components of computer systems ( $M = 2.11$ ) to be the least useful. Students rated all topics less useful than the instructors, except computer networks. The top two topics rated both by the students and instructors were computer networks, storage devices and media and the way in which ICT is used. The analysis of ratings can be seen in the graph in Figure 1.

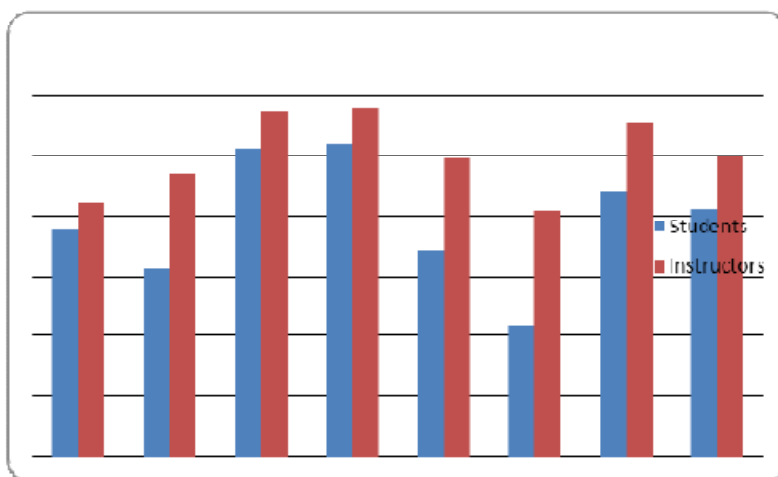


Figure 1: Analysis of students' and instructors' perception toward contents covered

#### Student Performance on Tests and Annual Examinations

Student performance on the different tests offered an assessment of student understanding of the different contents taught. These four tests covered the major topics of the course. A maximum of 100 points could be scored on each test and on the annual exam. The content covered during the study year was tested in the annual exam.

Student test and exam marks are presented in Table 2. Students seem have learnt the contents quite well as they scored more than 70% on all four tests and the exam. However, the performance of students from all sections was comparatively better (81.4%) on test four (ways in which ICT is used, and systems analysis and design) and test two (storage devices and media and computer networks. Test one (types and components of computer systems and input and output devices) and test three (data types and the effects of using ICT) had relatively lower results. Test one had a mean of 72.08%, test two had a mean of 76.64%, test three had a mean of 72.80%, and test four had a mean of 81.40%. On the annual exam, the mean score was 70.56%.

Table 2: Mean Analysis of the Tests and Annual Scores

Tests	Test 1	Test 2	Test 3	Test 4	Annual
Mean%	72.08	76.64	72.80	81.40	70.56

Student performance on test one was the lowest (72.08%). The poor performance on this test can be explained, in part, by the fact that students rated the topics covered in this test (types and components of computer systems and input and output devices) as not very useful and therefore may not have been interested in these topics. They scored highest marks (81.40%) on test four, which included the ways in which ICT is used and systems analysis and design. Interestingly, students rated this content as the third most useful for them. The lowest scores were

given on the annual exam, likely because the exam covered all the content in the course and required much greater preparation and knowledge.

B. How to teach: do academics and students agree on the optimal instructional strategies for teaching the content?

### Survey Results

Eight instructional strategies that were used in the course: PowerPoint presentation for teaching, reading from textbooks, hands-on practicals, in-class activities to develop practical skills, group work, printed hand outs, Internet-based research, and monthly tests and exams. All were listed on the survey questionnaire. Students and instructors rated these strategies on a four-point Likert scale based on their level of helpfulness (Very Helpful=3, Helpful=2, Less Helpful=1 and Not Helpful=0) (see Table 3). Students ( $M = 2.60$ ) and instructors ( $M = 2.84$ ) agreed that in-class activities to develop practical skills were the most helpful for learning course content. Students and instructors also agreed that the least helpful teaching strategies were tests and exams (students = 0.56, instructors = 1.30) followed by readings from textbooks (students = 1.12, instructors = 1.52). PowerPoint presentations were rated the second most useful instructional strategy by instructors ( $M = 2.78$ ) but students rated this as one of the least useful instructional strategy ( $M = 1.92$ ). Given the literature review and general usefulness of PowerPoint as a teaching tool, it is worth further investigation to determine why students didn't find this to be a helpful strategy. Perhaps, in the way they are used in this setting, students find them to be too teacher-centred and do not allow students to be part of the learning process. On an average, instructors rated all the instructional strategies higher ( $M = 2.08$ ) than did students ( $M = 1.84$ ). Graphical representation of the responses of students and instructors on the helpfulness of the teaching strategies is shown in Figure 2.

Table 3: Analysis of Student and Instructor Perception towards Teaching Strategies

Strategies Used	Students	Instructors	Total
B1. PowerPoint presentation for teaching	1.92	2.78	2.35
B2. Reading from textbooks	1.12	1.52	1.32
B3. Hands- on practicals	2.24	2.56	2.40
B4. In class activities to develop practical skill	2.60	2.84	2.72
B5. Group work	2.36	1.90	2.13
B6. Printed handouts on different activities	2.00	1.70	1.85
B7. Internet excess based research	1.88	2.25	2.09
B8. Monthly tests and annual exams	0.56	1.30	0.93
<b>Mean Total</b>	<b>1.84</b>	<b>2.08</b>	<b>1.96</b>

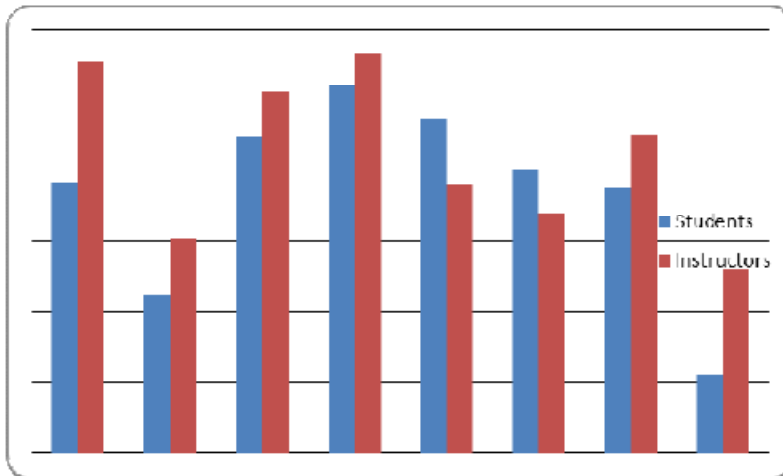


Figure 2: Analysis of students' and instructors' perception of helpfulness of teaching strategies used

### Classroom Observations

Classroom observations revealed that students seemed to dislike the long PowerPoint presentations that instructors tended to use to deliver lectures. Here again, students seemed to prefer in-class activities and hands-on projects. While students did not like the written tests and exams, instructors felt that this was an important strategy for measuring student learning. Students seemed inclined towards the hands-on finals that tested their skills. Overall, there was much interaction between the instructor and the students, and students were helped individually when they encountered difficulties. It was, however, difficult for one instructor to pay individual attention to all students because of the large number of students in the class.

### Open-ended Question Analysis

The survey contained an open-ended question that focused on areas of potential improvement in the course (Part C). The most common suggestions offered by students were: (1) No changes required; satisfied with the content taught; (2) More than one instructor needed for a class size of 15-20 students as it is difficult to get individual assistance when working on projects; (3) The text book assigned was not helpful and activities were preferred in place of readings; (4) Pace of class needs to be slower, especially when working on difficult topics; (5) Lessons should be paired (two lessons at a time) so as to finish all intended content; (6) The frequency of tests should be reduced; and (7) Involvement of students while using PowerPoint should be increased.

### DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Formative evaluation was used in this study to evaluate the content and teaching strategies of an ICT course taught in Botswana private schools. Data from different sources was collected and analysed. The data collected from student and instructor surveys provided their assessment of the usefulness of topics and skills taught, and the helpfulness of the teaching strategies used.

The student and instructor surveys both indicated that the content of the course was useful as the mean score was 2.25. Computer networks, storage devices and media and the ways in which ICT is used were the top scoring topics for both students and teachers. For students, the least useful topic was the effects of using ICT, while the instructors rated type and components of computer systems as the least useful. With the exception of computer networks, students rated all the topics to be less useful than did instructors. Microsoft skills are required for many jobs today and have become a part of everyday life. These skills thus assist students in their other classes and so were rated as quite useful. Likewise, while students and faculty realized the importance of learning concepts related to the Internet and the World Wide Web, they did not find it as important to know what was inside a computer. Data types and input and output devices received a low rating by students, but a high rating by



instructors. More practical activities designed to teach the importance of these devices and skills were recommended by the instructors.

Students and instructors indicated that in-class activities designed to develop practical skills were the most helpful instructional strategy. According to students and instructors, the least helpful teaching strategies were monthly tests and exams followed by readings from textbooks. PowerPoint presentations were rated the second most useful instructional strategy by the instructors but were rated as one of the least useful instructional strategies by students. This paper recommends that instructors seek new ways to make PowerPoint lectures more interactive as student dislike of this otherwise useful tool may be related to their feeling that this tool is instructor-centred and fails to provide students with meaningful involvement.

Overall the following conclusions can be drawn from this study:

- Group work, hands-on projects and in-class activities were the most helpful strategies according to both instructors and students.
- Long lectures and monthly tests and exams were disliked by both students and instructors.
- The teaching of Excel and web design could be enhanced with more demonstrations and directions.
- It was difficult for instructors, based on the classroom observations, to help each of the thirty students in the class when they encountered difficulties. Having an assistant to the instructor in larger classes is advisable.
- Clear directions and handouts are needed for projects and in-class activities.
- A greater number of collaborative activities would allow students to learn from each other.
- Analysis of the course materials showed that the text book was inappropriate for the class.
- The discussion forum must be redesigned with clearer directions and more time assigned in class to work on it.

The findings of this evaluation have implications for the Information and Communication Technology curriculum for all schools in which this computer literacy course is offered. Some of these implications are not surprising. For examples, hands-on projects are more effective than lectures and textbooks when teaching practical skills. One unexpected implication is such that instructors need to more find creative methods to impress upon students the importance of file management systems.

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