

**EXPLORING THE EFFECTS OF A MULTIMEDIA CASE-
BASED LEARNING ENVIRONMENT IN PRE-SERVICE
SCIENCE TEACHER EDUCATION IN JAMAICA**

Melody Williams

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PROEFSCHRIFT

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door

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te Kingston, Jamaica

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*Dedicated to my parents
Ivy and Joseph Williams*

PREFACE

To everything, there is a season, a time for every purpose under Heaven. There is a time to reflect, and a time to give thanks. As I look back on my journey through the years at the University of Twente (UT), I can say unreservedly that I had support from colleagues, friends and family to help with the fulfilment of my mission in the Netherlands. For this, I am truly grateful.

My academic journey at UT began in 2000 having been impelled by the desire to seek out innovative ways to enhance science teacher education in Jamaica. The journey was made possible by funding from the TO fellowship, awarded by the Faculty of Educational Science and Technology (now Behavioural Sciences). My thanks go to Jules Pieters, who was the dean at the time and the members of the TO fellowship selection committee, particularly Jan van den Akker and Ellen van den Berg for their confidence in me, their vision in my PhD research; and the award of the fellowship.

Throughout the four-year sojourn at UT, a number of persons in the Netherlands and Jamaica helped me to realise the completion of my research. In the Netherlands, there was the 'critical friends group', which consisted of Ellen van den Berg, Peter Blijleven and Leanne Jansen. The group provided constructive criticism and technical assistance during the development of the multimedia case and displayed keen interest in my work. Their unhesitating collegial collaboration will always be remembered.

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yearning for home grew less intense as the welcome by the department and the faculty grew warmer with each passing year. "Dank je wel, collega's!"

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In addition, I am grateful to the International Education Office, particularly Jan Nelissen and Dionysia Loman for taking care of business. Jan and Dio always made sure that documents pertaining to my stay in the Netherlands and finances were in order and as such I was able to focus wholeheartedly on my studies.

The opportunity to undertake this research would never have occurred if it had not been for the co-operation I received from various groups of the education sector in Jamaica. The video teacher, Mr. Michael Lewis and the grade 7 students of Excelsior High School were most willing to contribute to the enhancement of teacher learning by sharing the video recording of their science lesson with pre-service teachers. Their readiness to be involved in this research is deeply appreciated.

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I consider myself blessed to have been placed under the tutelage of sterling supervisors: Jan van den Akker and Ellen van den Berg. Being under their guidance provided me with opportunities to develop as a student, a researcher and a teacher educator. Jan and Ellen worked as a team, discussing and commenting on my work in a prudent, purposeful and professional manner. I am deeply appreciative of their constructive comments for they have served to enhance me as a person. To Ellen, I say a special note of thanks for entertaining with patience and grace my occasional puzzled expressions during our regular consultations over the four-year period. Our meetings were always fruitful, and often spurred me on to revisit and reflect on aspects of my research. I regard Ellen as one of the Dutch pioneers in the field of learning with multimedia cases in teacher education and her enthusiasm for the field has made a positive impact on my vision for the advancement of teacher education in Jamaica.

Heartfelt thanks to my family, relatives and friends who have kept me in their thoughts and prayers. I am thankful to God especially for my parents who have played a quintessential role in life. They laid a biblical foundation in the home, and it is this sure foundation that prepared me for the four-year programme of study and enabled me to finish this course. I am deeply grateful for their teaching and humbly dedicate this book to them.

Finally, I give God thanks for reminding me that with Jesus Christ strengthening me, I can do all things. To Him be all the glory and the praise.

Enschede, March 2004

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CHAPTER 1

Background to the study

This book explores the use of a multimedia case-based learning environment in the Jamaican science teacher education programme. It reports on: (a) the design and formative evaluation of a multimedia case-based learning environment and (b) the effects of the multimedia case on pre-service teachers. The first chapter introduces the study, which has been coined: MASTER-Jam, the acronym for Multimedia and Science Teacher Education Research in Jamaica. The chapter is organised into six sections. The first two sections provide a background to the study, which includes a description of the pre-service teacher education programme in Jamaica and the problems encountered. The third section gives an overview of the intervention that is explored in the study to address the problems. This intervention is a multimedia case-based learning environment. In section 1.4, the aim and research questions are described, followed by a description of the research approach in section 1.5. The final section gives an overview of the chapters in this book.

1.1 THE ROSE PROJECT: A CHALLENGING INNOVATION

Over the past decade, Jamaican science teacher educators have been engaged in continuous discourse on how to improve the delivery of pre-service teacher education. One of the events that sparked this discourse was the advent of the national curriculum reform project called ROSE, the acronym for Reform of Secondary Education. The plan for reforming the Jamaican secondary education system was prompted by the results of a 1982 study by United Nations Educational, Scientific and Cultural Organisation (UNESCO), who were commissioned by the Ministry of Education and Culture (MOEC) to conduct this study. In 1983, UNESCO published the results of the study in the report, "Jamaica: Development of Secondary Education", which highlighted among other things, the absence of a common curriculum and unpreparedness of graduates for the world of work. Subsequently, the Ministry of Education and Culture started to develop plans aimed at rationalising the secondary education system. These plans focused

on (a) introduction of a common curriculum for grades 7-9, (b) provision of textbooks and educational support materials, (c) revision of existing teacher education programmes at the pre-service and in-service levels to address the methodologies in the ROSE curriculum, (d) improvements in, and limited new construction of, physical infrastructure for schools adopting the common curriculum, and (e) studies and pilot programs for improving upper secondary education.

The rationale for the ROSE project is to provide "for the development of a common curriculum for students in grades 7-9, thereby affording educators a unique opportunity to design a programme which specifically targets the special needs of young people at this critical stage of transition from childhood to adulthood" (MOEC, 1993a, p. 1). The objectives of the ROSE project are to improve the quality of learning, to achieve greater equity and enhance individual productivity in school, home and society through the provision of a common curriculum. The common curriculum initially addressed five subject areas: Mathematics, Language Arts, Resource and Technology, Science, and Social Studies; Career Education is to be infused in each subject area. In the ensuing years, other subjects were added to the curriculum including Physical Education, Dance and Music. The ROSE programme, which was developed with technical and financial assistance from World Bank, was introduced into schools on a phased basis. In 1991 and 1992, the draft common curriculum was field tested in a total of 11 schools and with each successive year more secondary schools adopted the ROSE curriculum. By 1998, all schools were introduced to the ROSE curriculum.

In addition to developing the common curriculum for grades 7-9, the methods courses that were offered at the teachers' colleges were also revised. The revised syllabi, which were used for both professional development (in-service) workshops and pre-service teacher education programme, addressed the rationale and philosophy of ROSE as well as teaching methodologies. These methodologies included co-operative learning, inquiry approaches, concept teaching models and technology integration techniques (see MOEC, 1993b). The professional development programme was held for five years, 1993-1998 and was conducted by ROSE teacher trainers¹. The programme consisted of (a) two-week workshop in August and (b) on-going school visits, which were aimed at orienting teachers in the content and methodology of the common curriculum. After 1998, the annual two-week workshops were no longer held; teachers who were ROSE trained were

¹ The researcher worked as a ROSE science teacher trainer between 1994 and 1996.

encouraged to train those teachers were not familiar with ROSE programme. Today, teacher trainers still make visits to schools, albeit less frequently per school than in former years due to the large number of schools that are now using the new curriculum. Furthermore, teachers leaving education institutions such as the University of the West Indies, and Teachers' Colleges are exposed to the methodologies of the grade 7-9 (ROSE) curriculum, so the need for frequent visits is not as great as in former years. This book focuses on how to enhance the enactment of the ROSE methodologies by pre-service teachers at the Teachers' College.

The next section gives a background on the pre-service teacher education programme at the Teachers' College and the learning experiences that were organised to prepare the student teachers to deliver the new curriculum, a curriculum that they had not experienced as a student in their secondary schooling (at the time of the study).

1.2 PRE-SERVICE SCIENCE TEACHER EDUCATION IN JAMAICA

The Teachers' Colleges in Jamaica are the institutions that are primarily responsible for delivering the pre-service teacher education programme, which sees graduates being awarded the Diploma in Teaching at the end of three years. The infrastructure is in place to support the education programme, as all colleges are equipped, *inter alia*, with lecture halls, a library, technical vocational centres, science laboratories, and computer rooms. This study is concerned with the prospective teachers pursuing the Diploma in Science Teaching at the secondary level, a programme that was in effect at four colleges at the start of the study in 2000.

1.2.1 Enrolment into the Diploma programme

The Diploma in Science Teaching is primarily for persons with no degree in science and little or no teaching experience. Prospective teachers wishing to be enrolled in this pre-service programme at the Teachers' Colleges must satisfy the entry requirements of four passes in the Caribbean Secondary Examination Certificate (CSEC) examination. The CSEC examination is taken at the end of five years of secondary schooling. Once enrolled into the diploma programme, the prospective science teachers can follow one of two tracks: Single Option Science or Double Option Science. Teachers following the Single Option Science track specialise in General Science and one other subject such as English, Computer Science, Mathematics, Physical Education, Geography, History or Social Studies. They need to have a science subject as one of the four CSEC subjects. The single option

teachers are prepared to teach science at Grades 7-9, which is the lower secondary level. Prospective teachers pursuing the Double Option Science track are prepared to teach science at the upper secondary level. They should have at least two science subjects in the area they intend to specialise. Double Option students do strictly science subjects, for example Chemistry and Biology. Pre-service teachers from both tracks participated in the study.

1.2.2 Science teacher education programme

Presently, the pre-service teacher education programme for secondary science teaching exposes the prospective teachers to general education courses in their first and second years; the science methods course is delivered in the second year. Content courses are done during the three years. Exposure to real life classroom settings comes through classroom observations for one week in the first year, three weeks of teaching practice in the second year and twelve weeks of teaching in the final year (see Table 1.1). The habit of reflection is encouraged during classroom observations and practice.

Table 1.1: Structure of the pre-service science teacher education programme

Courses		
<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>
General education	General education	General education
	Science methods (Grades 7-9)	Science methods (Grades 10-11) ^a
Content	Content	Content
1-week classroom observation	3-week teaching practice	12-week teaching practice

Note: ^a Only the Double Option students do this course.

As stated earlier, the science methods course (Science Education I) was revised to reflect the rationale for, and teaching methodologies required for the delivery of the Grade 7-9 ROSE science curriculum. There are six units covered in the 90 hour methods course:

- a. Why teach science?
- b. Learning science
- c. Methods of teaching science
- d. Unit and lesson planning
- e. Laboratory and classroom management
- f. Assessment and evaluation.

The science methods course, which is delivered across two semesters: September – December, and January – May, introduces each unit for the first 6-8 weeks of semester 1, in order to prepare the pre-service teachers for the three-week teaching

practice in November. Prospective teachers are exposed to the philosophy and rationale for the ROSE curriculum, methods of teaching science, lesson planning, and assessment techniques.

1.2.3 Teaching strategies for the science methods course

In order to facilitate a better understanding of the ROSE methodologies--co-operative learning, concept teaching, laboratory investigation--science teacher educators have been encouraged to model the methods in ways that can be emulated by pre-service teachers (Evans, 1997). There is no documentation as to whether all the science teacher educators at the colleges modelled the desired methods. At the college where this researcher worked (Salem), the strategies employed to deliver the science methods course included modelling the methods, engaging the students in micro-teaching exercises, discussion and organising occasional visits to nearby Grade 7-9 classrooms, in order to prepare them for practice. In addition to these strategies, pre-service teachers were provided with methodology modules² containing information on three ROSE methods (concept mapping, co-operative learning, and laboratory investigation) and procedural specifications or detailed lesson plans for these methods. The modules, which were originally developed for the ROSE in-service teacher training programme to facilitate a better understanding of the methods, were subsequently used in the pre-service teacher education programme. In the late 1990s, few videos of real exemplary classroom events on VHS cassette were also produced to help both in-service and pre-service teachers with the delivery of the ROSE methods.

1.2.4 Teaching practice and emergent problems

During the three-week teaching practice, the student teachers were expected to implement the ROSE teaching methods that they met in the methods course and reflect on their teaching experience. At Salem College, for the period 1997-1999, teacher educators who supervised the student teachers on second-year teaching practice expressed that student teachers displayed a limited understanding of the ROSE methods and engaged in shallow reflection on their lessons. On third-year teaching practice, the pre-service teachers' performance did not improve greatly at Salem. Discussions with teacher educators for the methods course at other colleges revealed a similar trend of poor transfer of theory to practice.

² Before being used in the ROSE teacher training programme, a formative evaluation of the modules was conducted, in partial fulfilment of the requirements for a Master's degree. The results of the evaluation can be found in the thesis (Williams, 1997) at the University of Twente. The findings from the study revealed that the modules helped to clarify problematic aspects of the methodology.

For Salem's prospective teachers it was observed that they do try to implement the ROSE methods, such as co-operative learning and concept teaching, when on teaching practice. However, when they organised co-operative learning experiences for their students, for example, they implemented one feature of co-operative learning and did not appear to be convinced of the rationale for, or benefits of, using the approach in science teaching. Co-operative learning, one of the teaching methods recommended by the ROSE curriculum is "the instructional use of small groups so that students work together to make best use of their own and each other's learning" (Johnson & Johnson, 1999, p. 5). For Johnson and Johnson, five features are crucial for the success of co-operative learning: positive interdependence, face-to-face interaction, individual accountability, interpersonal skills, and group processing. Implementing these features posed challenges for the pre-service teachers on teaching practice. Furthermore, the pre-service teachers appeared to have been overwhelmed by the large class size (30-40) and tended to place students in large groups in attempt to have smaller numbers of groups to monitor. This way of dealing with the large class size only exacerbated behaviour problems. Co-operative learning was not the only problematic methodology; concept teaching was also challenging for the pre-service teachers.

Chief External Examiner for the third-year teaching practice (Practicum), Marceline Collins-Figueroa, reported that very few pre-service teachers "seem to understand what conceptual development involves..." and stated that questioning strategies were still problematic (Collins-Figueroa, 1999, p. 2). Teacher educators also expressed that the pre-service teachers' reflection on their practice was superficial, and lacked careful thought on their actions. These observations were confirmed in the 1999 Collins-Figueroa report, which stated:

Evaluation continues to be weak. Students often just report that objectives were met or not met. While we expect this, we also want to see (a) diagnosis of why objectives were or were not achieved; (b) *qualitative reflective comments* which may not relate to original objectives or which may not be measurable but which affected the teaching and learning processes; c) an evaluation of matters that arose in the teaching that were not anticipated; d) *self-evaluation* of their competencies... (p. 3)

The problems of limited transfer of theory to practice (as evidenced by limited understanding of methodology on practice) and weak reflection on practice were discussed with teacher educators. Interestingly, the in-service (ROSE) teacher educators observed that the professional teachers were also having difficulty in implementing the ROSE methods (Beaumont-Walters, 2000). This suggested that

pre-service teachers' field experiences were lacking in "observation by apprenticeship" opportunities. The observations made by the teacher educators called for a review of the current delivery methods, and a study of contemporary literature on teacher education in order to find a possible solution to the problems mentioned earlier. What intervention could therefore be developed to facilitate practice in reflection and help pre-service teachers understand better the complexities of classroom teaching? This question is addressed in the next section.

1.3 THE INTERVENTION: A MULTIMEDIA CASE-BASED LEARNING ENVIRONMENT

In order to reduce the theory-practice gap and encourage the practice of reflection, the use of digital video of a real classroom was explored. The power of computer technology was harnessed to embed the video in a computer-based learning environment, and store the video on compact disc (CD). Using a CD would afford pre-service teachers the opportunity to work individually or in small groups in the college's computer room. They could re-visit scenes as often as possible and work at their pace. In addition, a CD allows the possibility to incorporate other media formats such as text (guiding questions to foster the practice of reflection on the video scenes, and lesson materials), audio (invited comments from teacher educators on the questions), and graphics (pictures of relevant material to help with the interpretation of the video). Presenting these different components – video, questions to foster reflection, comments, lesson materials – linked in meaningful ways on the CD was seen as an example of a multimedia case-based learning environment.

A multimedia case-based learning environment has at its heart a real-life situation, in this case, a video lesson, and incorporates sufficient context information aimed at promoting analysis and reflection by users. Although several studies (Abell, Bryan and Anderson, 1998; Goldman & Barron, 1990) affirm the pedagogical promise of multimedia cases as a unique medium for catalysing reflection, not all studies are conclusive about the reflective power of multimedia cases (Kenny, Andrews, Vignola, Schilz & Covert, 1999). Still, it might be interesting for the MASTER-Jam study to explore the potential of using a multimedia case-based learning environment to help alleviate the problems alluded to earlier. The expectation is that multimedia case use in the science methods course can provide teachers with the opportunity to practise reflection; facilitate learning of the essential features of ROSE methods such as co-operative learning, and in so doing help to form a bridge between theory and practice.

1.4 AIM AND RESEARCH QUESTIONS

The MASTER-Jam study aimed to develop a multimedia case-based learning environment and investigate the potential of this medium to facilitate learning and reflection for pre-service science teachers in Jamaica. Two main research questions guided the study. The first question, which was addressed primarily through a theoretical exploration, was:

"What are the essential principles for designing a multimedia case-based learning environment?"

The second question, which focused on how pre-service teachers benefited from using the multimedia case, was:

"What are the effects of multimedia case use on pre-service teachers?"

Three research sub-questions were formulated to guide the effects study:

1. What do pre-service teachers learn from the case-based learning environment?
2. How does the multimedia case function in facilitating reflection?
3. How does the multimedia case affect classroom practice?

The next section describes the research approach that was employed to conduct the study.

1.5 DESIGN AND RESEARCH APPROACH

The MASTER-Jam study followed a development research approach and included three main stages: (1) preliminary investigation, (2) development of the case with its iterative cycles of deliberative design, evaluation and revision; and (3) empirical testing of its effects. The following paragraphs in this section describe briefly the approaches that were used within the development research framework to develop and subsequently explore the effects of multimedia case use with pre-service teachers. Figure 1.1 summarises the main activities of the research approach.

1.5.1 Preliminary investigation

The preliminary investigation included (a) reviewing literature on case-based learning, teacher learning and designing multimedia based environments; (b) analysing the context in which the multimedia software was to be used; and (c) analysing inspiring examples of multimedia cases. These activities were punctuated

by deliberations and confrontations with critical friends³ and resulted in the formulation of design guidelines to inform the development of the multimedia case. The collegial confrontation was crucial as it facilitated the creation of a platform of ideas, which in turn helped the developer to refine the problems alluded to in section 1.2. It was important that the problems were clarified in order to have some congruence between the context in which the case was to be used and the design decisions taken. The platform of ideas served as a theoretical and logical basis for design decisions and helped to give the development process more coherence and identity (Van den Akker, 1999, 2002a; Van den Berg, 1999; Walker, 1990).

The preliminary investigation yielded seven principles for designing the multimedia case. The second chapter describes these guidelines in more detail. After the principles were articulated, the next step was to use the principles to guide the selection of components and arrangement of these components in the case-based learning environment. The next paragraph describes the strategies that were employed during the development process to ensure that the principles were followed in the design of the learning environment.

1.5.2 Development process

The approach to developing the multimedia case is comparable to Walker's (1990) deliberative approach to curriculum development, which is characterised by:

- deliberation - formulating a platform of ideas;
- prototyping - using the ideas to generate prototypes ;
- formative evaluation - evaluating the prototypes to obtain suggestions for improvement;
- revision - revising each successive version until it cannot be improved further or some constraint forces a halt.

Figure 1.1 highlights the development process.

³ The term 'critical friends' is taken from a professional development programme called 'Critical Friends Groups' (CFGs), which comprises coaches trained to create a collegial culture within their groups, and encourage careful reflection on practice and student work, with a constant focus on improving student learning (Dunne, Nave & Lewis, 2000).

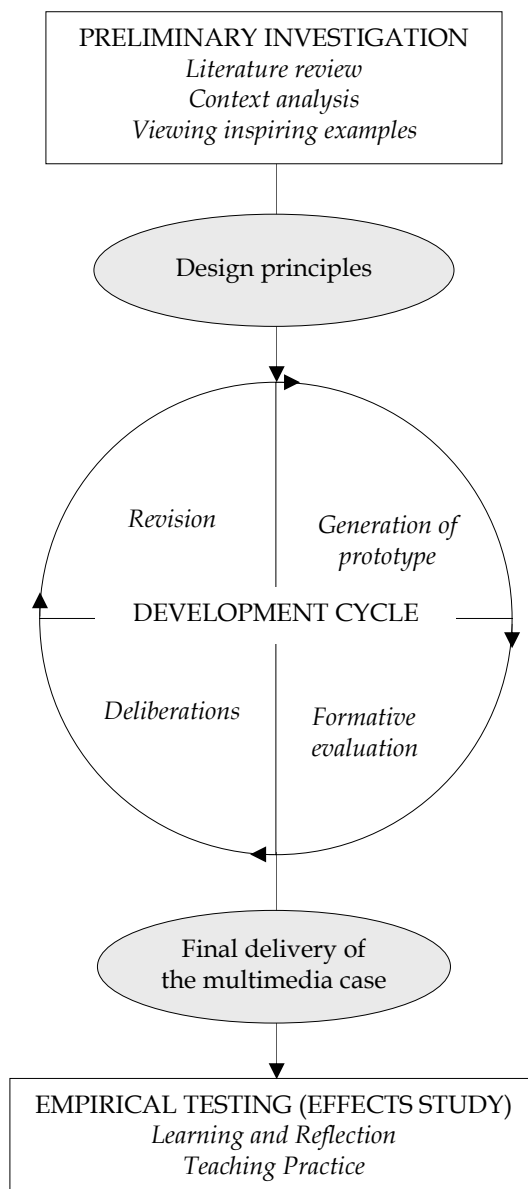


Figure 1.1: Outline of the development research approach

For the MASTER-Jam study, the deliberations were not for consensus seeking among members of a team (cf. Walker), as the responsibility for the design of the multimedia case rested with one person, the developer. The deliberative approach to the development of the multimedia case served to confront design decisions with critical friends in order to refine the selection and organisation of the components of the case.

The development process yielded three prototype versions of the multimedia case, which passed through iterative cycles of formative evaluation, deliberations and revision. See Chapter 3 for a detailed description of the development process. The outcome of the development process was the final version of the multimedia case, which underwent empirically testing.

1.5.3 Empirical testing

One of the main activities of the development research approach is empirical testing, which for MASTER-Jam involved an investigation of the effects of the multimedia case on pre-service teachers. Two investigative studies were conducted. The first study explored the effects of the case on pre-service teachers' learning and reflection and as such was coined Learning and Reflecting with a Case, or the LRC Study. The second study, which was referred to as the Teaching Practice Study, examined the effects of the case on pre-service teachers' practice.

1.6 OVERVIEW OF THE FOLLOWING CHAPTERS

The activities and outcomes of the MASTER-JAM study are described in more detail in the subsequent five chapters. Chapter 2 first gives a brief history of the case methods in legal education. This is followed by a discussion of the rationale for cases in teacher education. The chapter then explores the use of case-based instruction in teacher education and highlights the emergence of multimedia cases as a maturing innovation. Literature on designing a multimedia case-based learning environment is presented, before conclusions are made on design principles for multimedia cases. Chapter 3 describes the design and formative evaluation processes of the multimedia programme. Here, the procedures, sample, instruments and results of the development process are described for three prototypes that were generated. A description of the final delivery of the multimedia case-based learning environment is presented. The chapter ends with conclusions from the development process.

Having incorporated the suggestions for improving the multimedia case, two effects studies were conducted. Chapter 4 documents the first part of the study, which explored what teachers learnt from the multimedia case and the extent to which the pre-service teachers engaged in reflection. The second part of the effects study is presented in Chapter 5, which discusses how four pairs of pre-service teachers implemented co-operative learning after using the multimedia case. This chapter also includes their evaluations of the lesson as well as their views of the case-based learning environment.

The final chapter, Chapter 6, presents and discusses findings from the development process and the effects studies. It explores issues that arose from using a development research approach for the MASTER-Jam study. The chapter ends with conclusions and recommendations for further study.

CHAPTER 2

Multimedia cases and teacher education

In recent years, there has been a renewed and growing interest in case-based learning for teacher education. This surging interest can be attributed to the inherent potential of cases, by virtue of their construction, to expose the complexities of teaching and allow for subsequent reflective analysis by teachers. The following theoretical exploration is documented in the six sections of this chapter. The first section looks at the historical roots of cases in education fields such as law. This is followed by a discussion in section 2.2 on the rationale for cases in teacher education. The use of narrative cases in teacher education is the focus of the third section, which also discusses the purposes, benefits, and limitations of such cases. The fourth and subsequent sections of this chapter are dedicated to a discussion and review of research on multimedia cases. Section 2.4 defines multimedia case, highlights theories that could be used to explain why multimedia cases are thought to be effective in enhancing teacher learning, and examines various research studies that have explored the use of multimedia cases in pre-service teacher education. The fifth section deliberates about the design of a computer-based learning environment, and section 2.6 concludes with design principles for multimedia cases.

2.1 HISTORICAL ROOTS OF CASES

Educational literature records the use of cases in several fields of professional education. Historically, Harvard University figures prominently in the literature. In the 1870s, case methods were used first in the professional education of law students, and then in 1900s these methods emerged in the schools of business, medicine and education (Doyle, 1990; Merseth, 1996; Sykes & Bird, 1992). The next paragraph briefly examines the use of the case method in legal education, in an attempt to better appreciate its vitality for the 21st century.

The introduction of the case method in legal education was not a slow and emergent process in the history of legal pedagogy. Rather, it was principally due to the

"academic fiat of a single man: Christopher Columbus Langdell, Dean of Harvard Law School, in the early 1870s" (Garner, 2000, p.1). The rise of the case method was partly due to an acknowledgment of the ineffectiveness of the lecture and textbook methods. Langdell believed that the principles of law were best learned by inductive study of the actual court opinions and legal situations rather than by reading legal texts. The case method is deemed effective because it allows law students to do, with promptings from an instructor, what they would be required to do without promptings, as a lawyer. In a typical learning session, the legal educator employs the 'Socratic method', asking students to respond to a series of questions about a real case. This probing proceeds over time to expose the essential legal principles embedded in the case. Students are asked to reflect on the decisions made by the persons in the case under study, and to immerse their proposed strategies and actions into the case. Through professorial questioning, the students are expected both to analyse the case for its content and complexities and to set out the law and the facts in the case. The case method therefore can be seen as a way of personalising legal education as it places the onus on each law student to create her mental framework for conceptualising the law and consequently helps students to take ownership of their knowledge of the law (Garner, 2000). The case method in legal education also recognises the complexities and ambiguities of law and as such is seen to provide a more realistic view of law than textbook or lecture methods.

Although the case method in legal education has received many accolades, it has experienced severe criticisms from legal educators. One group of critics harp on the objectives and the scope of the case method, while the other set of criticisms attack the manner in which professors employ the case method. The first category of criticisms raises concerns about a method that is inadequate for the study of, for example, legislation – the process of making laws. Garner rebuts this criticism with the assertion that the primary objective of the case method in legal education is not substance-oriented, that is, imparting to students large amounts of substantive legal principles. Rather, the objective of the case method is process-oriented, that is, teaching students to think like lawyers by providing opportunities for them to master legal reasoning skills. Garner suggests that the use of the case method be confined to situations in which the method's basic objectives coincide with the objectives of the course, and alternative strategies be employed to match the course objectives. The second criticism centres on the legal educator's pedagogical tactics, which involve a sole dependence on the case method and consequently overlooking relevant information from other disciplines, information that could help to elucidate grey areas of the issue under study. Garner recommends that professors supplement casebooks with appropriate material that would facilitate

understanding and analysis of the case. In short, the success of the case method (in fact, any pedagogical method) rests primarily upon the educator who employs it.

The case method in legal education has survived pedagogical controversies over the past century and continues to be the principal method of education in American law schools, (Garner, 2000). The vitality of the case method in the twenty-first century is not only seen in law school pedagogy, but in Harvard Business School, the case method is seen as the foundation of learning. It is viewed as a method that challenges business students by bringing them as close as possible to the business situations of the real world. It would be both useful and interesting to further study the use of cases in the legal, business and other professional fields, so as to draw parallels to teacher education. However, such an exploration is not the focus of this study; rather this literature review is primarily concerned with cases in teacher education. Therefore, the rest of this chapter explores the use of cases in teacher education. The next section explains the reasons for the adoption of cases in teacher education.

2.2 MAKING A CASE FOR CASES IN TEACHER EDUCATION

In recent years, there has been a surging interest in educational literature on how to organise enriching learning experiences for pre-service teachers, (Darling-Hammond, 1998; Korthagen & Kessels, 1999; Loughran, 2002; Putnam & Borko, 2000; Russell, 2001). For example, Korthagen and Kessels (1999) and Loughran (2002) stress the importance of engaging pre-service teachers in purposeful and structured reflective practices on their experiences as it is through these experiences that the theory-practice gap may be reduced. Darling-Hammond (1998) advocates that yearlong supervised internships, intensive mentoring and purposeful reflection are avenues to enhance teacher learning. For Russell (2001) placing pre-service teachers for an extended period in real life classroom settings before they receive any formal training is the way forward. He reported that most of the teacher candidates, who followed this 'practice-before-theory' approach, and who had been well supported as they learned from experience, were positive about the program structure. These teacher-learning experiences support the idea of immersion in, and reflection on, real-life classroom experiences.

The approach involving the placement of pre-service teachers in real classrooms and allowing them to experience the complexity and ambiguity of teaching is rooted in the notion of teacher learning as being situated. Situated learning perspectives came to prominence in educational literature in the late 1980s (e.g.,

Brown, Collins, & Duguid, 1989; Lave, 1988). The theory captured educators' attention with its roots in the apprenticeship system, and its emphasis on learning within the context of real-world situations. Brown, Collins and Duguid note that newcomers who are directly participating in a particular activity experience great gains in learning. Newcomers need to "observe how practitioners at various levels behave and talk to get a sense of how expertise is manifest in conversation and other activities" (Brown et al., 1989, p.39). This approach to learning is seen a form of apprenticeship, and brings to the fore the inherently context-dependent and situated nature of learning. Therefore, from a situated perspective, pre-service teachers are seen as a part of a community of practice --the school environment-- in which they are involved as apprentices in an authentic activity, testing their ability to undertake the role and duties in that environment.

Looking back at the Jamaican Teacher Education System, part of the learning experiences that are organised for the pre-service methods course incorporate one-week structured classroom observations and fifteen weeks of teaching practice over a two-year period. However, it would seem as if the opportunities for immersion in real-life classroom practice are too brief, as teachers still do not articulate the theory well in their practice. How then can teacher educators allow their students to continue to explore the richness and complexity of authentic pedagogical problems outside of a real-life classroom? Putnam and Borko (2000) offer an alternative. They agree that knowledge is situated in particular and social contexts, but at the same time, they admit that it is difficult to situate pre-service teachers' learning in real classroom contexts for the duration of their preparation. They suggest therefore, that rather than putting teachers in particular classroom settings, cases can be used to provide vicarious experiences with the classroom situations, as these situations show the embedded complexities and the irregular events normally associated with that setting.

Cases can serve to bring authentic classroom activities to the 'college-room' in a compact way, to be examined critically and meaningfully, with the aim of developing desirable knowledge, skills and attitudes employed by professional teachers. However, Putnam and Borko have a different view of 'authentic activity' from Brown et al. (1989). They prefer to consider authentic activities as those that "foster the kinds of thinking and problem-solving skills that are important in out-of-school settings, whether or not the activities themselves mirror what practitioners do" (Putnam & Borko, 2000, p. 2). This book adopts a position similar to Putnam and Borko and therefore views the use of cases as an authentic activity in which a teacher can learn "the kinds of thinking and problem-solving skills"

employed by professional teachers. The next section is dedicated to a discussion on cases in teacher education.

2.3 CASES IN TEACHER EDUCATION

Doyle (1990) documents that case use in teacher education had its beginnings in 1864, when E. A. Sheldon reported the use of cases to show how the project method worked in classrooms. Merseeth (1996) records the use of cases in teacher education from as early as 1925, probably influenced by the apparent successes of the case method at the neighbouring schools of business and law. Merseeth notes that in 1925, the New Jersey State Teacher's College was engaged in the systematic collection and study of cases. In spite of this historical evidence of case use since the turn of the century, cases have played a comparatively minor role in teacher preparation due in part to the absence of a "consensus of the learned" about the concepts and modes of inquiry in teacher education (Broudy, 1990). Broudy bemoaned the fact that teacher education had not developed 'paradigm cases' as have most of the learned professions such as law, medicine and business. Lawyers and doctors, regardless of the university are likely to employ similar classifications and terminologies to discuss problems of their professions; the same cannot be easily said about teachers or teacher educators. Consequently, in the early 1990s, teacher educators, such as Katherine Merseeth, Lee Shulman, Judith Shulman, Gary Sykes and Tom Bird have been examining case use in teacher education and lobbying for some consensus on case-based learning in teacher education. A review of literature written by these and other educators sheds light on case use in education over the past decade. This section describes case use in teacher education and focuses on the definition, purposes and uses of cases, and ends with their benefits and limitations.

2.3.1 Cases: Definition, purposes and uses

Merseeth (1996) views a case as:

... a descriptive research document based on a real-life situation or event. It attempts to convey a balanced, multidimensional representation of the context, participants, and the reality of the situation. It is created explicitly for discussion and seeks to include sufficient detail and information to elicit active analysis and interpretation by users. (p. 726)

This definition encapsulates the description of a narrative case, which is presented in written or text form and is the focus of this section. Merseeth (1996) emphasises

that cases are *real*; they depend on *meticulous research and study*; and they provide information for *careful deliberation and discussion*. Sykes and Bird (1992) assert that the instructional value of cases rests on their lifelikeness. Wallace (2001) concurs with Merseeth's idea of a case, when he states that a case is based on a 'real-life' situation or event, which even though concentrates on the fine points of that situation, at the same time embraces a holistic view. Based on its authentic and situated nature, a case can therefore provide potential learning opportunities for the user of the case. He further adds that a case is "specific, unique and bounded" (Wallace, 2001, p. 185).

Cases can be viewed as carefully crafted constructions that can serve varied purposes. Merseeth (1996) draws on the work of Doyle (1990), L. Shulman (1992) and Sykes and Bird (1992) to place the purposes of cases into three categories. Firstly, she identifies cases as *exemplars*. Cases can be exemplars of particular principles, or instructional techniques and generally emphasise "the theoretical, the prescriptive, the model" (Merseeth, 1996, p. 728). Such cases are used as a more direct method of instruction or exemplification rather than involving the participant in the construction of the case. An exemplar-focused case provides an image of a highly skilled reform-oriented teacher and comprises commentaries or materials to guide the analysis of the principles or pedagogical reasoning of the teacher (Barnett-Clarke, 2001). An exemplar-focused case serves to make a "clear and explicit connection between accomplished practice and an underlying theory" (Barnett-Clarke, 2001, p. 310). The purpose of the subsequent discussion of the case primarily functions to analyse how principles and knowledge are applied in the case setting, rather than critiquing the teacher in the case.

Cases, according to Merseeth (1996) can also serve as *opportunities to practise analysis, assimilate different perspectives and contemplate action*. Such cases focus on dilemmas faced by an accomplished or not so accomplished teacher, rather than exemplary practices. Dilemma-focused cases are often used as a springboard for discussion and exploration, thus encouraging open debate (Wallace, 2001). The aim of the discussion is to understand the dilemmas and their roots, generate alternative ideas, and use pedagogical reasoning to critically analyse the alternatives suggested (Barnett-Clarke, 2001). With dilemma-based cases, teachers are compelled to work out, for example, why students in the case made inaccurate inferences, what activity would work better, how to rephrase the teacher's question, or why a certain concept was ambiguous in the students' mind. Dilemma-focused cases therefore allow pre-service teachers to practise analysis, decision-making and problem solving which in turn can help them "think like a teacher" (L.

Shulman, 1992). For Kleinfeld, to 'think like a teacher' is to "learn how to formulate educational problems, design strategies that fit specific children, and reflect on the ethical and policy issues as well on the pedagogical issues embedded in everyday instructional decisions" (Kleinfeld, 1992, p. 34). L. Shulman (1992) strengthens Kleinfeld's assertion by adding that asking student teachers to respond to problems in cases as if they were 'mature members of the profession' could be seen as helping them to practise thinking like a professional.

A third purpose of cases, as proposed by Merseth (1996, 1999) is to *stimulate personal reflection*. Reflection can be encouraged by any of two ways: case discussion of an individual's teaching and case writing. Kleinfeld (1992) advocates that case discussion stimulates the habit of reflective inquiry. The other way that cases can stimulate reflection is by having users construct a case of their experiences, with intense coaching from researchers and editors. J. Shulman (1992) argues that it is this internal process of writing cases, rather than the external process of discussing them that induces reflection. The process of case writing can be seen as a form of catharsis, which deepens the writer's understanding of the phenomena described. Merseth (1999) concludes that researchers who report on the ability of cases to foster reflection assert that cases enhance learning from experience, whether it is from personal experience or the experience of others. Section 2.4.2 elaborates on how cases are used to promote reflection.

Wallace (2001) notes that the purposes served by cases might not be easy to demarcate but can intersect. For example, cases can be created by a group of teachers to extract meaning from experience, and then used to generate discussion and exploration with a different group of teachers. Cases as exemplars can serve as precedents to show not only an instructional technique, but can also be used to expose the intricacies associated with that technique. Doyle notes that such precedents provide opportunities for student-teachers to practise analysis and problem-solving and develop the theoretical rationale underpinning the 'master' teacher's action. An example of a dual-purpose case is documented in the Van den Berg and Visscher-Voerman (2000) study, which developed a case to demonstrate exemplary teaching in the complexity of classroom teaching and to stimulate reflection on pedagogical content issues. The case's purposes were achieved as prospective teachers had the opportunity to visualise the ideal, and engage in reflective thought and communication, which was facilitated by the provision of assignments (see also Van den Berg, 2001). The case used in the MASTER-Jam study also served three purposes: (a) to show pre-service teachers one way to implement co-operative learning, (b) to facilitate understanding of the rationale for

the features of co-operative learning and (c) to provide an opportunity for pre-service teachers to develop the habit of reflection.

An examination of case-based literature in teacher education reveals that cases have benefits as well as limitations. The next paragraph explores some of the benefits and limitations associated with developing and using cases.

2.3.2 Cases: Exploring the benefits and limitations

There is growing evidence to suggest that cases have the potential to contribute to pre-service teachers' discoveries of knowledge about the intricacies of teaching (Kleinfeld, 1992; Lundeberg, 1999; Merseth, 1999). The use of cases provides opportunities for pre-service teachers to:

- apply theoretical knowledge to real school contexts;
- reason critically about complex situations and recommend courses of action;
- develop self-knowledge and recognise own assumptions;
- clarify personal beliefs about teaching;
- compare and evaluate their own and others' perspectives;
- develop the practice of reflection.

Barnett-Clarke (2001) concurs with the above benefits when she mentions that cases, particularly dilemma-focused cases, naturally draw users into an inquiry mode by exposing some of the inherent drawbacks and ambiguities in teaching and learning mathematics and science concepts. L. Shulman (1992) affirms that it is the verisimilitude of the case, its specificity and contextual nature that enables it to be such powerful educational tool.

Although the potentials for case are encouraging, there are some limitations to be considered by educators contemplating case-based learning (Barnett-Clarke, 2001; L. Shulman, 1992). Cases are costly and time-consuming to produce and the subsequent formative evaluations are often demanding. They are difficult to teach well as they require teacher educators who possess skills in Socratic questioning and discussion moderation. Much time is needed to prepare questions for case discussion. Cases can be viewed as being inefficient, as very little content is covered in these lengthy case discussions, and they are often criticised for their episodic, discontinuous and fragmentary nature. Cases may be prone to overgeneralisation. A single case, for example, may be so compelling that the learner transforms its apparent message into a strict aphorism. Barnett-Clarke adds another limitation, mainly for the discussion accompanying dilemma-focused cases. Her concern is that the student teacher might get discouraged that there is not a 'right way' to teach and subsequently feel a sense of hopelessness because

every suggested alternative course of action has disadvantages. In spite of these limitations associated with case use, cases and case methods warrant the attention of teacher educators and students alike. If teacher educators organise case-based learning experiences to counter the limitations, then there is a great possibility that the potentials associated with case use will be realised. Cases motivate by stimulating interest in the problems they represent; they allow for the critical analysis of complex situations and facilitate the practice of reflective, ethical decision-making (Lundeberg, 1999). Reflective thinking and being analytical are just two of the many essential attributes of an effective teacher. If cases are seen as vehicles through which such attributes can be developed, then cases are worth the teacher educator's time and effort.

Much of the literature on case use in teacher education concentrates on narrative cases, but in the 1990s, there has been a gradual increase in research on the use of video cases (Richardson & Kile, 1999; Rowley & Hart, 1996). A video case can be viewed as a presentation of moving pictures of classroom interactions and analyses (usually on videocassette), and may be supplemented by written or videotaped interpretations of the classroom actions by the teachers, students, principals, parents, and others such as experts in the field; and other materials such as the teacher's lesson plans (Richardson & Kile, 1999). Research on video case use is promising, however, the medium—videocassette—has limitations such as poor video quality, and deterioration of quality with use. In addition, like narrative cases, the information presented on videocassette is linearly sequenced. To overcome these limitations, educators have looked to the power of computer technology to present classroom practices, perspectives on such practices and other relevant information in a way that is non-linear, multifaceted and preserves authenticity.

The next section examines how one such innovation—multimedia case—has emerged as a way of embedding video cases in a hypermedia environment.

2.4 MULTIMEDIA CASES: A MATURING INNOVATION

2.4.1 Multimedia case described

In the previous section, two formats for delivering cases were described: text (narrative) and videocassette, which both present information in a linear way. This information can be said to have a beginning, middle and end. In recent years, educational researchers have capitalised on the use of hypertext (which literally means 'more than text') to design cases. Hypertext is a representation of multiple

and flexible links between distinct pieces of data, allowing users to move along multiple paths, in a non-linear fashion, through a network of units of information and to build and store their own links (Lampert & Ball, 1990). When the data to be linked comprise a variety of communication media such as video, audio, graphic and text-based information, the representation is called hypermedia or multimedia. A case that comprises multimedia (e.g., video, audio, text, and graphics) in order to capture a slice of the real-life event, and is often supplemented by relevant information to maintain the authenticity of the situation, can be referred to as a multimedia case. This carefully crafted computer-generated construction is usually created for discussion and includes adequate details to encourage users to engage in active analysis, interpretation and reflection.

Multimedia cases can be perceived to be an extension of narrative cases and so share the advantages described for narrative cases (section 2.3.2). In addition to these advantages, a multimedia case possesses the following benefits:

- an array of data can be incorporated into the learning environment and stored on one medium, for example a compact disc (CD);
- there is the possibility to arrange these data sources in a non-linear fashion (McKnight, Dillon & Richardson, 1996).

These benefits, coupled with the power of computer technology, allow users to cross-reference various sources of information making up the multimedia case (e.g. video lesson, audio recording of comments on the lesson, links to websites and video lesson plan), at their own pace, at any time of their choosing. Embedding the video in the hypermedia environment allows both teacher educator and student teachers to revisit and re-examine classroom scenes in order to make sense of them, and access information that is difficult to describe in written accounts (e.g., teacher's non-verbal cues). This cross-referencing of information paves the way for pre-service teachers to develop a broader perspective of teaching issues and consequently facilitate and stimulate an active learning attitude in the learner-controlled environment (Van den Berg & Visscher-Voerman, 2000).

The use of multimedia cases also has limitations similar to those associated with narrative cases, but to a greater extent for the limitations. Compared to narrative cases, multimedia cases are more costly and time-consuming to produce, and can result in greater overgeneralisations, because video is more appealing than written text. To counter the possibility of overgeneralisation, particularly with exemplary cases, Barnett-Clarke (2001) cautions that student teachers should be encouraged to discuss the tensions that come with teaching or they may run the risk of resorting to

easier methods when these tensions occur in their practice. Van den Berg and Visscher-Voerman add that working with multimedia cases might overpower the student teachers with rich details; they may not see the wood for the trees. But because multimedia cases come much closer than written cases "to mirroring the complexity of the problem space in which teachers work" (Putnam & Borko, 2000, p. 7), this study regards multimedia case-based learning as a promising means for providing potential learning opportunities for pre-service teachers.

2.4.2 Enhancing teacher learning through cases

This section looks at the conditions that are deemed effective in enhancing learning and the role multimedia cases can play in facilitating learning. A review of literature on theoretical frameworks for effective teacher learning suggests that learning is enhanced if (a) it is situated, (b) there are multiple representations to convey a phenomenon, and (c) reflection is incorporated into the learning environment (Brown, Collins & Duguid, 1989; Korthagen & Kessels, 1999; Schön, 1987; Spiro, Feltovich, Jacobsen & Coulson, 1992). The next paragraph describes the tenets of each of three theoretical frameworks about learning: (a) situated learning, (b) cognitive flexibility theory and (c) reflective practice, and discusses how cases can be constructed to reflect these conditions for learning.

Research on *situated learning* suggests that if pre-service teachers learn about teaching in a manner similar to where they will use the knowledge and skills gained, they are more likely to transfer the knowledge into practice (Baker, 2000). Situated learning, which was described briefly in section 2.2, stresses the importance of field experiences in enhancing teacher learning. While immersion in real classrooms is ideal, it is difficult to keep teachers in the field for the duration of their preparation. Educational researchers have proposed an alternative way to situate teachers' learning, this being case-based learning. Cases are seen as means to situate learning because of their specificity and localism and have emerged as effective means to preserve the complexities of classroom teaching. The Cognition and Technology Group at Vanderbilt (CTGV) affirm that multimedia cases do situate learning when they note that technology and case-based instruction are useful in problem-solving and preparing students to know and act at the same time (Risko, 1995). They propose that learning and teaching activities should be designed around an *anchor*, which should be some sort of dilemma-based case study that is of interest to the learner.

Cognitive Flexibility Theory focuses on learning in complex and ill-structured domains. Spiro, et al. (1992) state that an ill-structured domain is one that satisfies

two criteria: (a) each case involves the simultaneous interactive involvement of multiple, wide-application conceptual structures, each of which is complex; and (b) the pattern of conceptual occurrence varies considerably across cases technically of the same type. Classroom situations are often described as being intricate, irregular and ill-structured fields, because teachers are called upon to make quick decisions based on changing sources of information. Consequently, many novice teachers have difficulty in applying knowledge gained in the pre-service programmes to the real-life classroom practice. Spiro and his colleagues suggest:

... the remedy for learning deficiencies related to domain complexity and irregularity requires the inculcation of learning processes that afford greater cognitive flexibility: this includes the ability to represent knowledge from different conceptual and case perspectives and then, when the knowledge must later be used, the ability to construct from those different- conceptual and case representations a knowledge ensemble tailored to the needs of the understanding or problem-solving situation-at-hand. (p. 24)

A multimedia case-based learning environment could be designed in such a way to convey several instances of the ill-structured nature of teaching, and promote the features of cognitive flexibility. Spiro and his colleagues view the computer as an ideal medium to foster this cognitive flexibility, by virtue of its capability to produce multi-dimensional and non-linear learning environments (cf. section 2.4.1).

The third theoretical framework that is thought to promote teacher learning is *reflection*. Reflection can be viewed as the "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it," and the further consequences to which they lead (Dewey, 1910, p. 6). For Dewey, a consideration of further consequences implies that an individual has found himself in a state of perplexity, hesitation, doubt; and is now concerned with a search directed toward bringing to light further facts that serve to substantiate or to annul the suggested belief. Research shows that reflection on practical experiences is a crucial factor to successful learning about teaching (Korthagen & Kessels, 1999; Loughran, 2002; Yost, Sentner & Forlenza-Bailey, 2000). In order to facilitate effective reflective practice, there needs to be deliberate efforts to help pre-service teachers develop appropriate reflective skills. Dewey's early conception of reflection has provided a foundation for organising learning experiences for pre-service teachers aimed at promoting reflective practice (Jay & Johnson, 2002; Loughran, 2002; Posner, 1996; Yost, et al. 2000). For example, Posner proposes journaling to help pre-service teachers reflect on their field experiences.

He offers a fieldwork log format, which asks teachers to carry out three main tasks.

- a. *Sequence* the events in the lesson, that is, make a brief listing of what happened.
- b. *Elaborate* on one or two significant episodes, an episode being an event or sequence of events complete in itself but forming part of a larger one, that bothers, excites or causes the teacher to rethink his initial ideas.
- c. *Analyse* the episode(s), including an interpretation of what feelings and thoughts may have caused the episodes to happen, experiences or readings to help with the analysis, and plan for future action.

Learning experiences of this kind focus on teachers' personal practical experiences (see also Korthagen, 1999), but pre-service teachers do not spend all of their preparatory years in a real classroom. What lessons then can be learnt from the preceding literature about organising learning experiences that will help pre-service teachers develop reflective skills outside of the real classroom? Yost, et al. (2000) believe that teacher education programmes must interweave reflection throughout the teacher education curriculum. Case-based learning is one avenue through which this intertwining can take place and can function as a means to actively engage pre-service teachers in linking theory to practice, so that they will develop a rationale for their teaching practice and use this rationale as a basis for their reflections.

Cases can be used to improve the development of appropriate reflection practices. Schön (1987), in his discussion on case use in business education, asserted that case teaching deserves to be called a reflective practicum because of the questions a student is asked to consider and the thinking processes in which he is engaged, such as: framing and reframing problems, generating alternatives. Case use in teacher education also requires pre-service teachers to engage in similar thinking processes. Cases can be designed so that pre-service teachers are allowed to view authentic problem situations, propose alternative courses of action for such problems as if they were the teacher, and think about merits and challenges of such actions in light of their experiences and existing educational theories. Schön further adds that when cases call on students to make links to other theories, these students tend to think differently about the educational theories they learnt, especially "when they realise that they hold comparable tacit theories of their own" (1987, p. 324). Such mental activities are powerful as they facilitate the framing and reframing of interpretations of a phenomenon. Cases are therefore thought to enhance teacher learning because they can be used to situate the content by highlighting situations from actual classroom settings, promote cognitive flexibility by exposing pre-service teachers to the ill-structured nature of the case, and finally, they encourage reflection. The next section discusses what recent research has to say about the possibilities of multimedia case-based learning.

2.4.3 Research on possibilities of multimedia cases

Research studies that have explored the use of cases in teacher education are promising in their findings. Like narrative cases, multimedia cases have the potential to:

- stimulate reflection (Rowley & Hart, 1996; Van den Berg, 2001);
- broaden teachers' content knowledge and pedagogical content knowledge of science (Daehler & Shinohara, 2001);
- foster habits of *praxis*, that is, critical, reflective practice that enables prospective teachers to adapt to the many varied contexts they may meet in the field (Bencze, Hewitt & Pedretti, 2001).

For example, Van den Berg (2001) explored the potential of a multimedia case on 'Liquids in test tubes' to stimulate reflection by pre-service teachers for primary education. This multimedia case consisted of an interactive video, with focal questions added to the different episodes of the video. The video had hyperlinks to six other components: (a) comments on the video by teacher educators and prospective teachers, (b) context (c) curriculum, (d) video lesson plan, (e) subject matter and (f) justification. Assignments supplemented the case and were designed to focus student reflections and stimulate discussion. Concerning the inclusion of the assignments, Van den Berg (2001) concluded that directed assignments were useful in stimulating discussion on the multimedia case.

Bencze, Hewitt and Pedretti (2001) explored the use of case methods as a means of fostering habits of *praxis* – that is, critical, reflective practice – to enable prospective teachers to adapt to the many varied contexts they may meet in the field. The case focused on a Year 8 science Optics lesson. Before viewing the case, the pre-service teachers were introduced to Lock's framework for analysing teaching and learning scenarios. The rationale for this framework was to provide some scaffolding and practice in assessing scenarios before applying it the 'real' Optics case. An analysis of the data collected led them to assert that case methods have strong pedagogical virtues. Bencze and colleagues noted:

Case methods may help to students begin to develop a habit of *praxis*; that is to question their assumptions and theoretical understandings, link theory to practice, critically reflect on their own practice, engage in pedagogical reasoning, and share multiple viewpoints and interpretations. (p. 200)

Although the findings tentatively showed emerging habits of *praxis*, Bencze et al. (2001) cautioned designers of case-based curricula to: "ensure case authenticity, ...and use multimedia case methods in conjunction with other approaches to promote habits of *praxis*" (p. 191).

Rowley and Hart (1996) developed video case studies for the 'Becoming a Star Urban Teacher' programme. The study was designed to promote reflective dialogue and made use of questions to stimulate reflection. The video cases presented realistic classroom situations and comprised built-in reflection points and interviews with star teachers. Each Star Urban Teacher programme consisted of an 8-10 scene video case designed to stimulate discussion and analysis of one of the functions of the star teacher. Rowley and Hart (1996) affirm that these realistic classroom situations give pre-service, novice, and experienced teachers an opportunity to share experiences and engage in collaborative reflection on exemplary practice. In addition to promoting reflective dialogue, the authors report that the reflection points built into the video cases situate participants at the heart of challenging professional dilemmas to which there is rarely a unique, correct, calculated answer. They ascribe prominence to these decision points as it is at such a crossroad that the teachers find themselves "engaged in a virtual world where they are free to experiment with their ideas and vicariously experience the challenges of professional decision making" (Rowley & Hart, 1996, p. 29). According to L. Shulman (1992), asking students to respond to embedded questions on certain events in a case provides them with opportunities to practice "thinking like" a professional.

The next section examines the design guidelines for computer based learning environments and is followed in the final section with the set of principles that informed the design of the multimedia case-based learning environment.

2.5 DESIGNING A COMPUTER-BASED LEARNING ENVIRONMENT: A CONSTRUCTIVIST APPROACH

Two approaches to designing learning environments have prevailed in educational literature over the past decade: objectivism and constructivism (Honebein, 1996; Jonassen, 1991, 1994; Oliver, 2000; Wilson, 1996). Objectivists believe that knowledge about the world is reliable because the key features of objects are relatively unchanging. Their conceptions of learning assume that knowledge can be transferred from teachers or transmitted by technologies and acquired by learners. In contrast, learning from a constructivist viewpoint is an active process in which knowledge is individually constructed and socially co-constructed by learners based on interactions between (a) prior knowledge and beliefs; (b) the ideas and events with which they come into contact; and (c) their interpretations of experiences in the real world, (Jonassen, 1991; Richardson, 1997). Since knowledge cannot be

transmitted, learning environments should consist of experiences that facilitate knowledge construction and engage learners in meaning making. Furthermore, constructivism embraces the theoretical frameworks--situated learning, cognitive flexibility and reflection--described in section 2.4.2. Using constructivist guidelines to inform the design of the multimedia case will help to create an environment that focuses on events in the real world, with all its intricacies, which require persistent and deliberate ways to solve them. This study therefore regards a constructivist orientation as being better suited for creating a learning environment that will reflect the context, culture and complexities of the real-world and as such will be adopted for the design of the case-based learning environment.

To facilitate the design of a constructivist learning environment, instructional designers have proposed guiding principles or foundational tenets (Jonassen, 1994; Honebein, 1996). Jonassen (1994) suggests that a constructivist learning environment should seek to:

- support the construction of knowledge through internal negotiation (which involves reflection), social negotiation and the exploration of real-world environments;
- provide a meaningful, authentic context for learning; and
- provide collaboration among learners and with the teacher, who is more of a coach and not a transmitter of knowledge.

He further adds that learning environments should allow learners to use the knowledge they construct, which should be "supported by case-based problems which have been derived from and situated in the real world with all of its uncertainty and complexity and based on authentic tasks (those likely to be encountered in real-life practice)" (Jonassen, 1994, p. 37).

There is support for the heuristics proposed by Jonassen (1994) in Honebein (1996), who states that constructivist designers live by seven pedagogical goals. These goals are listed below:

- provide experience with the knowledge construction process;
- provide experience in and appreciation for multiple perspectives;
- embed learning in realistic and relevant contexts;
- encourage ownership and voice in the learning process;
- embed learning in social experience;
- encourage the use of multiple modes of representation;
- encourage self-awareness of the knowledge construction process.

These guidelines, when incorporated in the development of multimedia case-based learning environments, can help to preserve the complexity of this problem space in which teachers work and in so doing realise the potential of multimedia cases to enhance teacher learning. Two research studies support the benefit of adopting a constructivist-orientation when designing multimedia cases. These studies are presented in the next paragraphs.

Van den Berg & Visscher-Voerman (2000) applied Honebein's heuristics to the design of their multimedia case entitled 'Liquids in test tubes'. For example, they used a non-scripted video of an elementary science lesson as a means of embedding learning in a realistic and relevant context. Multiple modes of representation were depicted by (a) audio and video commentaries, (b) different formats of the video lesson plan, (c) background information on the school, the teacher and the pupils, (d) information about the science content of the lesson and (e) information about how the lesson fits into the elementary science curriculum. Van den Berg and Visscher-Voerman viewed the multimedia case as having features that reflected a constructivist vision on teaching and learning, but cautioned that the full potential of the case will be dependent of the way in which teacher educators implement the case into their programmes.

Herrington and Oliver (1997) report that they drew on situated perspectives (Brown et al., 1989) to generate nine critical characteristics of a situated learning model to guide the design of an interactive multimedia program. The learning environment used in their study needed to reflect the following nine characteristics:

- provide an authentic context that reflects the way the knowledge will be used in real-life;
- provide authentic activities;
- provide access to expert performances and the modelling of processes;
- provide multiple roles and perspectives;
- support collaborative construction of knowledge;
- promote reflection to enable abstractions to be formed;
- promote articulation to enable tacit knowledge to be made explicit;
- provide coaching and scaffolding at critical times;
- provide for integrated assessment of learning within the tasks.

The characteristics of this situated learning model are similar to those proposed by Jonassen and Honebein above, and as such are viewed as being constructivist-oriented. Herrington and Oliver (1997) concluded that the use of their model was successful in providing guidelines for the development of an interactive multimedia

programme which (a) provided enjoyment for students, (b) enabled students to reflect on their learning and (c) was easy and intuitive to navigate.

The research studies on designing multimedia cases using constructivist guidelines are promising in their outlook. The next section presents the critical design principles that this study adopted to inform the design the multimedia case.

2.6 DESIGN PRINCIPLES FOR THE MULTIMEDIA CASE

The previous section presented constructivist design guidelines that have been used by researchers to inform the design of a computer-based learning environment. The MASTER-Jam study benefited from an examination of such guidelines and formulated the following principles to guide the design of the multimedia case-based learning environment.

1. *Embed learning within relevant and authentic contexts*

This involves having users participate actively in problem situations that mirror the kind of experiences naturally encountered in the field. Honebein (1996) encourages educators to preserve the reality of the context by grounding problems within the noise and complexity that surround them. He further adds that students must be given opportunities to impose order on the complexity and noise as well as solve the main problem. This way of organising learning experiences increases the ability of the students to transfer what they learn in the 'college room' to the real-life classroom.

2. *Provide access to multiple perspectives*

Problems in the real world seldom have one correct solution, but can be addressed in a variety of ways. In order to support the consideration of alternative solutions, additional resources could be incorporated to enable sustained exploration from a number of different perspectives (cf. Van den Berg, 2001). L. Shulman (1992) supports the inclusion of multiple perspectives or commentaries, arguing that they layer cases by providing additional lenses through which to view the events of the case. Commentaries are not answer keys or resolutions to the complexities of a dilemma; rather a commentary is "an opportunity to take a particular case—whether apparently straightforward or undeniably perplexing—and to provide alternative lenses for viewing it" (L. Shulman, 1992, p. 12).

3. *Create opportunities for meaningful reflection*

Reflection can be viewed as a process in which an individual (a) expresses his thoughts on an issue, or his mental model, (b) considers other opinions on the issue

(e.g., from experts, their peers or educational literature), (c) reviews his original conceptions in light of alternative perspectives, and (d) establishes a renewed perspective having considered the implications of the issue. One way to enhance reflection is to provide opportunities for pre-service teachers to understand "how their beliefs measure against the philosophy of their teacher education programs, so that cognitive change can occur" (Yost, et al. 2000, p. 42). Teacher education philosophy can be conveyed through commentaries from experts and educational literature. Including focus questions to encourage constructing on the concepts of peers and experts could also help to stimulate reflection. Such questions can facilitate a deeper consideration of the issues presented, and consequently improve understanding (see Copeland & Decker, 1996; Jay & Johnson, 2002; Korthagen, 1999; Van den Berg, 2001).

4. *Encourage collaborative construction of knowledge*

This feature can be realised through internet-based discussion groups or having users work through a case together face-to-face, and discussing the issues that arise (see Copeland & Decker, 1996).

5. *Accommodate a scaffolding role*

Scaffolding techniques provide the skills, strategies and links that the students are initially unable to use in order to complete a task. Scaffolding can be in the form of commentaries, which provide alternative ideas about the real life case events (Van den Berg and Visscher-Voerman, 2000) or a reflection model or framework (Korthagen, 1999; Posner, 1996).

6. *Provide authentic assessment activities*

Authentic activities should have real-world relevance and have practical applications (see Honebein, 1996). For example, the activities could be in the form of assignments that encourage pre-service teachers to link their experiences in the classroom to the educational theory they learn outside of the classroom. The activities should also bear relevance to the teacher's interests and should complement the teacher education curriculum as much as possible.

7. *Allow for the free exploration of the case by imposing a non-linear design*

A non-linear design adapts to different levels of prior knowledge; allows students to see a subtask as part of a whole task, and allows students to adapt materials to their own learning style. A non-linear design preserves the complexity of the real-life setting.

In summary, the multimedia case-based learning environment should be an authentic context that reflects the way knowledge will be used in real life. This involves having users participate actively in problem situations that mirror the kind of experiences naturally encountered in the field. The design principles guided the development of the multimedia case-based learning environment; a description of the development process is presented in the next chapter.

CHAPTER 3

Development of the multimedia case

The purpose of this chapter is to report on the development of the multimedia case. The first section of this chapter gives an overview of the development process, and is followed by a description of the components of multimedia case-based learning environment. Section 3.3 is dedicated to a discussion of the deliberations about the co-operative learning content and the production of the first prototype version: version 1.0. Formative evaluation was crucial to the prototyping process as it generated suggestions for improving version 1.0. Section 3.4 reports on the formative evaluation of this version and decisions taken. Two more prototype versions of the case – version 1.1 and version 2.0 – were generated as a result of successive formative evaluations before the final delivery was reached. Sections 3.5 through 3.7 document the formative evaluations conducted, and subsequent revisions made. The final delivery is described in section 3.8. The chapter ends with conclusions.

3.1 OVERVIEW OF THE DEVELOPMENT PROCESS

As stated in Chapter one, the approach to developing the multimedia case mirrored elements of Walker's (1990) deliberative approach to curriculum development, and included:

- deliberations about the components and co-operative learning content of the case-based learning environment;
- prototyping;
- formative evaluation of the prototypes to obtain suggestions for improvement; and
- revision of each successive version.

The seven constructivist design principles guided the process of selecting the components of the case. The selection and organisation of the components was facilitated by frequent, rapid deliberations with critical friends about what should go in to the multimedia case and how these components could be organised. The collegial confrontations were not so much about consensus-seeking (cf. Walker's deliberative approach); rather it functioned as a medium in which the critical

friends generated constructive criticisms and ideas for improvement. Having input from critical friends (see section 1.5.1) provided a forum in which the developer's ideas were confronted, and clarified.

When the learning environment had reached a stage in its development in which for the most part components were identifiable, though not fully operational, the resulting learning environment was called a prototype. The fundamental idea of adopting prototyping for this study was to build a working model of the case-based learning environment that could then be used to gather more detailed information on improving the components of the environment through formative evaluation.

Formative evaluation held a prominent place in the development process as it allowed for a judgement to be made on strengths and weaknesses of each version of the multimedia case-based learning environment in its developing stages, followed by the generation of suggestions for improving the weak points (Tessmer, 1993; Van den Akker, 2002a). Revising aspects of the intervention can serve to improve its appeal and ease of use by the pre-service teachers, and finally achieve product quality (Nieveen, 1999; Smith, 1991). After successive rounds of formative evaluation, three distinct working models or prototypes (version 1.0, version 1.1, version 2.0) and the final version of the multimedia case were produced (Figure 3.1).

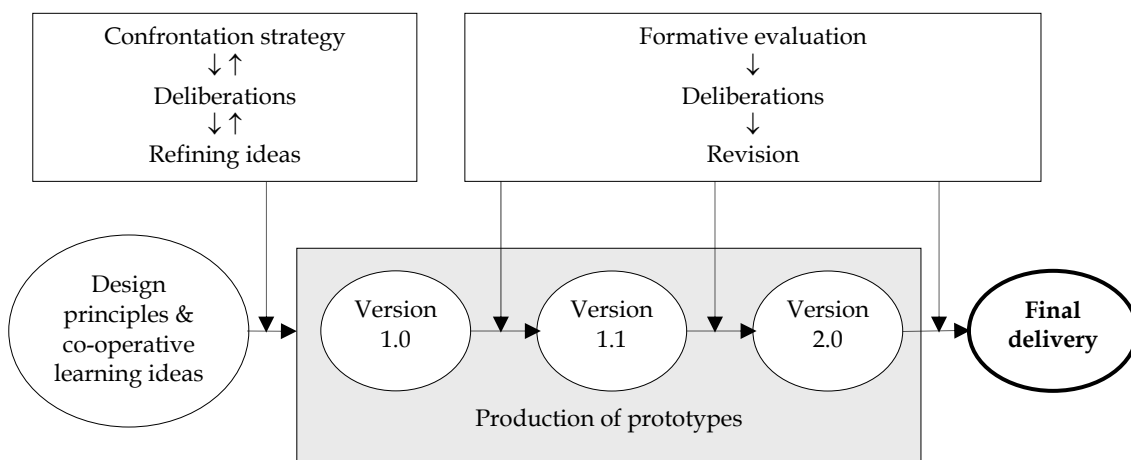


Figure 3.1: Model of the development process

Although, the first two prototypes (versions 1.0 and 1.1) did not have all the functions that a penultimate prototype had, they provided the developer with early insights into the possible potentials and pitfalls that the final version could have. An awareness of these insights allowed for relevant adjustments to be made before undertaking a full detailed design of the case-based learning environment. These strategies served to elucidate the sometimes, arguable suggestions for improving the learning environment.

The type of each evaluation changed with each prototype. The formative evaluation of the three versions underwent expert appraisals. In addition, a member of the user group evaluated version 1.1, and version 2.0 underwent small group evaluation. The expert appraisal focused on matters such as internal coherence of the components, and appropriateness of the content. The users were asked to comment on aspects such as ease of use, relevance and appeal. The formative evaluations allowed informed decisions to be made regarding the improvement of the subsequent prototypes. After the formative evaluation of the third prototype and subsequent revisions, the final version of the multimedia case emerged.

The next section explains the development process in more detail and starts with a description of how the design principles were operationalised into the learning environment.

3.2 COMPONENTS OF THE LEARNING ENVIRONMENT

The development of the multimedia case began with designing the case-based learning environment in such a way that the constructivist design principles were reflected in the layout of the environment. The application programme Microsoft PowerPoint was used to design the environment as it allowed for the incorporation of graphics, sound and more importantly hyperlinks. The preliminary design process involved collegial confrontations with three 'critical friends', who had expertise in courseware development for science teacher education programmes. The collegial confrontations involved bringing the developer's ideas about the components, face to face with the critical friends. The confrontation strategy proved effective, as feedback forced the developer to defend and elaborate the inclusion of particular features. The confrontation strategy encouraged the constant review of the context for which the case-based learning environment was being developed and helped to ensure internal consistency between the principles and components (cf. Van den Berg, 1999). Table 3.1 summarises the design principles and the corresponding components.

Table 3.1: Components of the multimedia case-based learning environment

Design principles	Component of the case
1. Create an authentic context	Non-scripted <i>video</i> lesson, with background information on teacher, students and school
2. Provide access to multiple perspectives	<ol style="list-style-type: none"> a. <i>Commentaries</i> from teacher educators and video teacher on video lesson b. Short <i>notes on co-operative learning</i> c. Hyperlinks to co-operative learning <i>websites</i>
3. Create opportunities for meaningful reflection	<ol style="list-style-type: none"> a. <i>Reflection questions</i> accompanying video segments b. <i>Learning task</i> for teachers to write a reflection report on their classroom practice
4. Encourage collaborative knowledge construction	<ol style="list-style-type: none"> a. Peer discussion of responses to reflection questions b. Internet-based <i>discussion group</i> on teaching practice
5. Accommodate a coaching and scaffolding role	Formulation of reflection questions in two or three parts to help the learner to gradually see essential features of co-operative learning.
6. Provide authentic assessment activities	Learning tasks address the objectives in the Science Methods course and relate to teaching practice.
7. Allow for the free exploration of the case	Main menu appears at the top of every page thereby reflecting a non-linear design and allowing the learner to visit any page at any time

In Table 3.1, the main components of the case-based learning environment have been italicised, and are highlighted in Figure 3.2. The *video component* was seen as the core of the multimedia case and consisted of the video lesson plan and student lesson materials, background information on the context, reflection questions accompanying each video segment, hyperlinks to commentaries and notes on co-operative learning features.

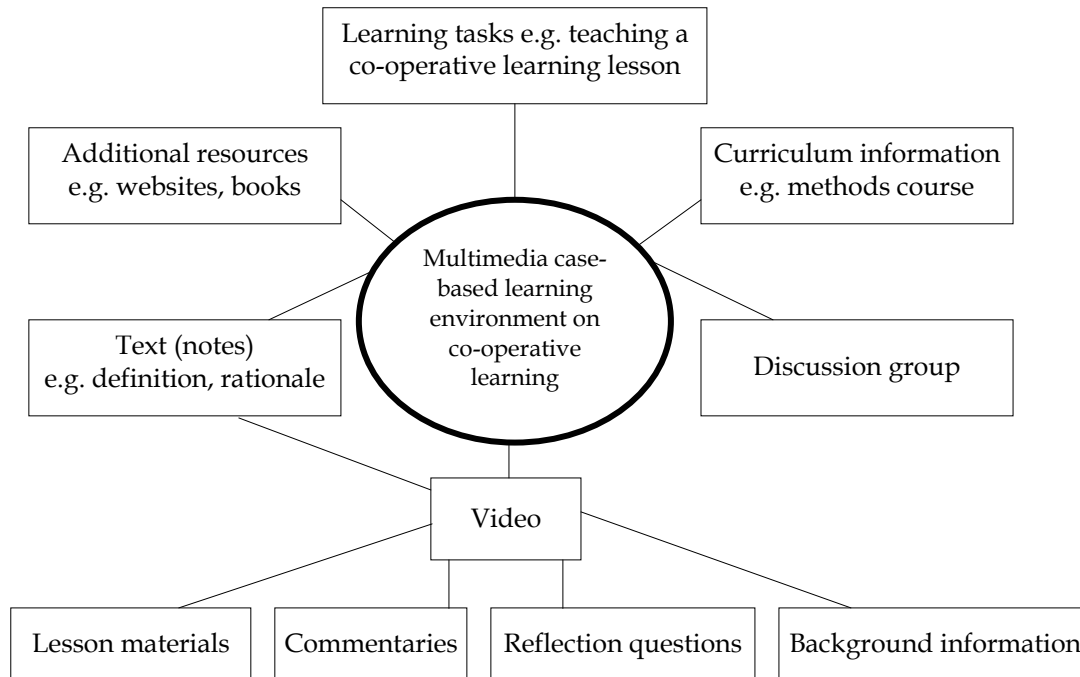


Figure 3.2: Main components of the multimedia case-based learning environment

When the main components were made partially operational in the PowerPoint version of the case, the version was referred to as version 1.0. Version 1.0 was not fully operational as core components--the video and notes on co-operative learning--were yet to be developed. The next stage focused on the developing of the co-operative learning content, a process that was marked by rounds of deliberations with the critical friends about the content choices for co-operative learning. The subject of the deliberations and decisions that were taken are described in the next section.

3.3 DELIBERATIONS ABOUT THE CO-OPERATIVE LEARNING CONTENT

Careful attention was paid to developing the co-operative learning content, as it was one of the ROSE methodologies that pre-service teachers found challenging to implement. Co-operative learning is a well-researched approach to organising teaching-learning experiences (see Johnson & Johnson, 1999; Kagan, 1994; Vermette, 1998). Literature presents different ways, which vary in complexity, to organise co-operative learning. Johnson and Johnson promote the use of a relatively complex five-feature model as a way of organising co-operative learning. This model encourages the structuring of: positive interdependence, individual accountability, group processing, interpersonal skills and face-to-face interaction

(see Appendix A1). Kagan offers several simple step-by-step 'structures' or strategies to help teachers to implement co-operative learning. Three of these structures are: Think-Pair-Share, Pairs Check and Jigsaw (see Appendix A2 for a description of these structures).

A prolonged consideration of these two approaches resulted in the first focus question for deliberation:

Which model(s) of co-operative learning should be presented – Kagan's simple structures or Johnson and Johnson's complex five-feature model?

With respect to this question, it was decided at the outset to treat the co-operative learning approach simply, using Kagan's structures: Think-Pair-Share, Jigsaw and Pairs Check. The idea for presenting the co-operative learning using simple structures rather than the complex five-feature model was to avoid the situation in which users might have to grapple with learning with a computer-based innovation as well as learning about the challenging five-feature model by Johnson and Johnson.

Another issue that came to the fore in the early stages of the development process was how to present co-operative learning to the user. The second focus question for the deliberation was therefore:

How should co-operative learning be presented to the user – as *one of many* approaches or as *one* approach of science teaching?

Arising from a review of the context, the decision was taken to present co-operative learning as *one of many approaches* to science teaching (Figure 3.3).

The user would have the opportunity to read a paragraph about other approaches to science teaching, such as discussion, field trip, and projects. Only co-operative learning would be elaborated in detail by including a definition, and examples of co-operative learning situations. The idea behind presenting co-operative learning as one of many approaches to science teaching was to help preserve the relevance of the learning environment to the science methods course. In the methods course, eight approaches are addressed.

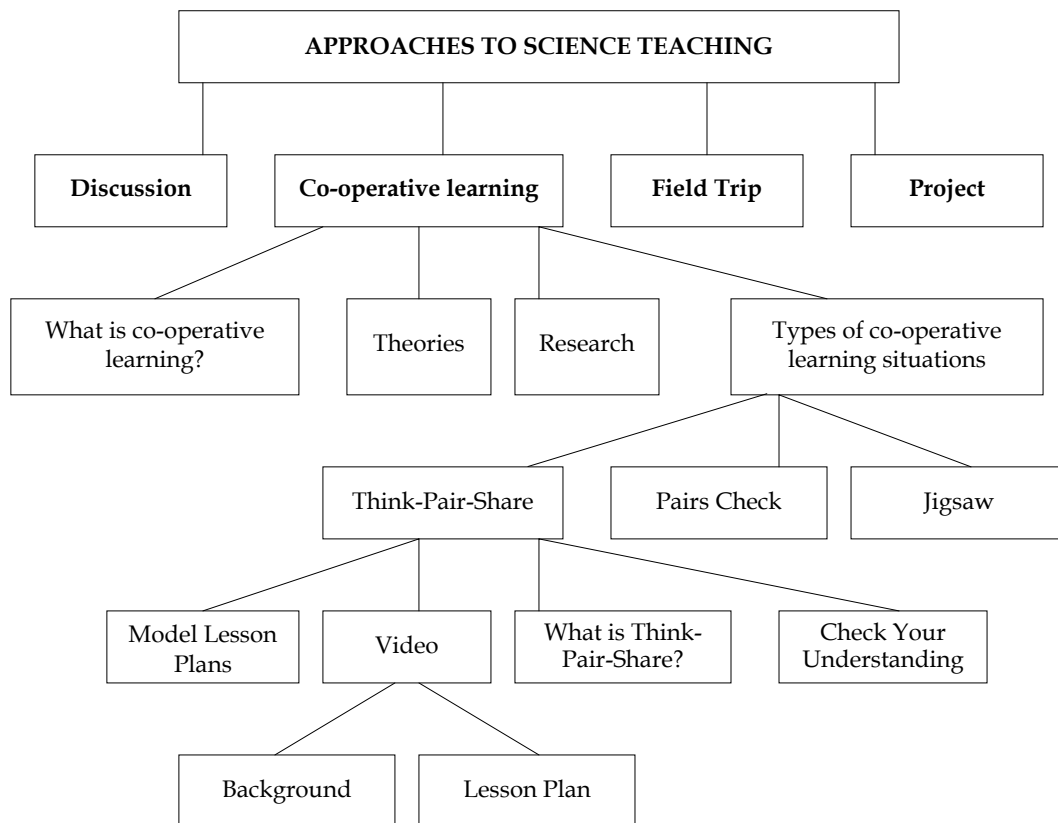


Figure 3.3: Content outline for Version 1.0

It was the intention to develop cases to address other methods in the future; co-operative learning would be seen as one in a series of cases on teaching methods. The content outline for version 1.0 was presented to the critical friends for formative evaluation. The next section describes the evaluation of the content outline.

3.4 FORMATIVE EVALUATION OF VERSION 1.0

3.4.1 Aim, evaluation concerns and procedure

The formative evaluation of the preliminary design or version 1.0 of the multimedia case-based learning environment took the form of collegial consultation, and deliberations. The three critical friends, who had experience in courseware development for science teacher education programmes, were asked to examine the content outline, provide comments and offer suggestions for improvement.

3.4.2 Results and revision decisions

Following deliberations about this approach to the content, the suggestions for improvement were as follows:

- Abandon the treatment of co-operative learning as 'one of four approaches' and present co-operative learning as the focus of the case.
- Develop the video lesson of only one of the simple strategies - the *Think-Pair-Share* strategy.

Presenting co-operative learning in this way would avoid content overload.

The suggestions from the evaluation were accepted and version 1.0 subsequently revised. The co-operative learning content for the improved version, version 1.1 now presented general information on co-operative learning and used Think-Pair-Share as an example of a simple way to organise co-operative learning. The next section describes version 1.1 in more detail.

3.4.3 Description of version 1.1

Version 1.1 comprised three main components on co-operative learning: Overview, Example, and Resources (Figure 3.4).

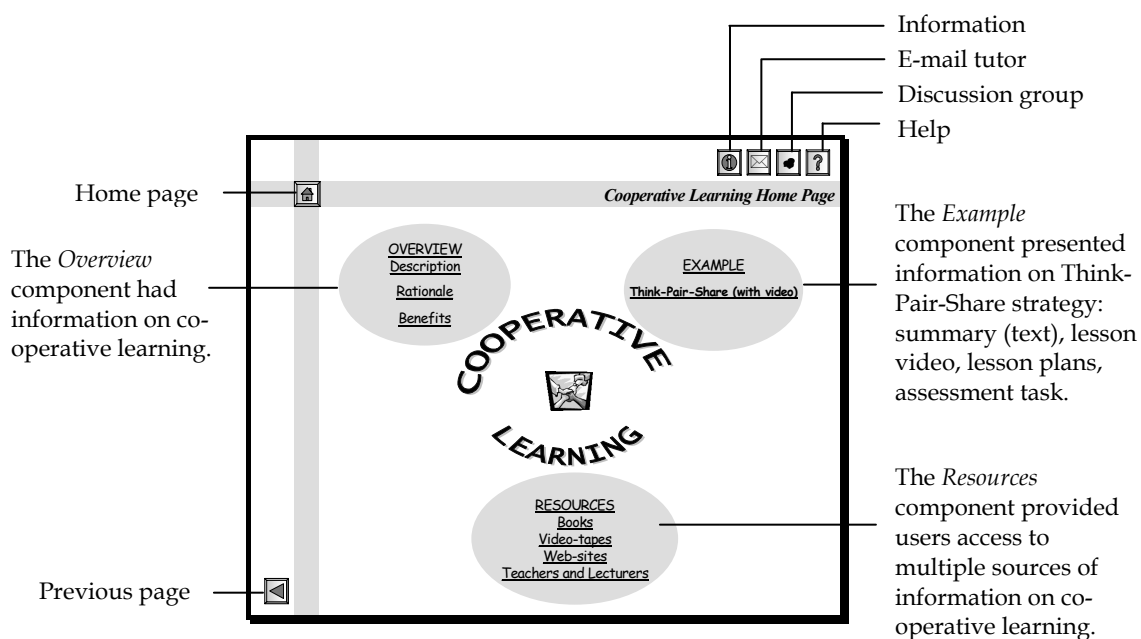


Figure 3.4: Annotated picture of Home Page for version 1.1

The information on the Think-Pair-Share strategy comprised (a) text-based summary of the strategy, (b) video of lesson, (c) lesson plans and (d) an assessment task entitled Check your understanding. For the Check your understanding

feature, users had the option to do two kinds of reflective learning tasks to check their understanding of Think-Pair-Share.

- The collaborative task invited them to view a video clip of a teacher using Think-Pair-Share, critically reflect on the video lesson and finally discuss your comments with your peers.
- The personal task encouraged them to try to use Think-Pair-Share in the classroom and reflect on how the strategy was implemented. Questions were formulated to help them in their reflection.

The Resources component was included to allow users access to varied resources on, and representations of co-operative learning. For example, users could visit websites on co-operative learning to get information on different co-operative learning strategies such Jigsaw, or Pairs Check (Appendix A2). The users would also have the information on how to procure videotapes on co-operative learning lessons.

Other features comprised the learning environment (Figure 3.4):

- Information – To provide users with the opportunity to know more about the science education syllabus, and the production of the learning environment;
- E-mail tutor – To allow the user to communicate with tutor or teacher trainer;
- Help – A click on this icon would direct the user to a screen that explained what the various icons meant and how they could navigate through the page.

The next stage in the development process involved the formative evaluation of version 1.1, which was seen as a partially specified working model of the multimedia case-based learning environment, because the video component, commentaries and reflection questions were yet to be included. The formative evaluation, which took place in the Jamaican context, is documented in the next section.

3.5 FORMATIVE EVALUATION OF VERSION 1.1

3.5.1 Aim and evaluation concerns

The aim of the formative evaluation was to get some early insights into the possible potentials and limitations of the learning environment. Two types of evaluations were done: an expert appraisal and a one-to-one (user) evaluation. The evaluation concerns revolved around the theoretical quality, technical quality, and practicality in terms of its usability in the Jamaican teacher education programme. The expert appraisal addressed the theoretical quality of the learning environment such as the

appropriateness of the components, and the degree of coherence between the components. The one-to-one evaluation involved a pre-service teacher, (intended user) reviewing the case-based learning environment with the developer present, and focused on the technical quality of the learning environment. Aspects of technical quality of concern included ease of navigation, appropriateness of the user interface.

3.5.2 Participants

The participants all came from Jamaica and were drawn from the University of the West Indies, the Teachers' Colleges, and the Ministry of Education and Culture. Four science teacher educators and one instructional design expert functioned as the expert evaluators, while one pre-service teacher was asked to evaluate the learning environment. A member of the target group was chosen to get an insight into possible drawbacks that could affect the technical quality of the learning environment and its acceptance by the pre-service teachers.

3.5.3 Procedure and data collection techniques

The five experts and the pre-service teacher were observed using the multimedia case-based learning environment on a one-to-one basis. The evaluators were asked to work through the prototype by clicking on all the hyperlinks, and think aloud while using version 1.1. The researcher made notes of halting actions and questions asked at various points in the programme while the experts and evaluators used the prototype.

3.5.4 Results and revision decisions

After the "walk-through" of the prototype and subsequent discussions, the evaluators offered the following suggestions for improving the theoretical and technical quality.

- Treat the concept of co-operative learning as a strategy comprising Johnson and Johnson's (1999) five features rather than dealing with *Think-Pair-Share* as an example of co-operative learning. These five features are: positive interdependence, individual accountability, group processing, interpersonal skills, and face-to-face interaction. Using the five-feature model, though complex, addresses co-operative learning in a more holistic way. If the *Think-Pair-Share* strategy is presented as an example of co-operative learning, there is the risk of oversimplifying a challenging strategy.
- Include more information on the features of co-operative learning rather than simply naming them.

- Include an additional page to introduce each of the major components such as *Overview, Resources*.
- Discuss difficulties faced by teachers and students involved in co-operative learning settings
- Some users might not be familiar with the various icons on the screen. Include a labelled picture of a typical screen in the Help page.
- Give guidance on how to exit the multimedia case.

All the respondents felt that the multimedia case-based learning environment was a practical innovation and would be accepted by the pre-service teachers, the target users. The suggestions for improvement were accepted and revisions made to version 1.1. The revision process resulted in an improved version, version 2.0, which is described in the next section.

3.5.5 Design and description of version 2.0

After incorporating the suggestions for improvement, attention turned to developing the video. Appendix B summarises the video production process, which involved the videotaping and editing of a co-operative learning lesson, and incorporating the video segments into the multimedia case-based learning environment.

As version 2.0 began to expand, the need arose for a more flexible tool to design and develop the multimedia case. Following a discussion with the critical friends, it was decided to use Microsoft FrontPage 2000 to design the learning environment. FrontPage was readily available and easy to learn to use. It facilitates the creation and management of a large number of pages and supported video files. The PowerPoint version served as a blueprint for the design process and allowed for a relatively smooth translation of the components from PowerPoint version to the FrontPage version, version 2.0. Using a different application tool required frequent meetings with the critical friends primarily to discuss technical issues such as layout and navigation, and theoretical issues such as internal coherence between the components. The critical friends generated the following ideas for improving the layout and the terms given to the components.

- A change in the name for each of the components *Overview, Video, Resources*, and *Check your understanding*, (see section 3.4.3), to *Read about it, Watch a video, Browse among resources* and *Review and reflect*, respectively. These terms denote more action-oriented responses from the user;
- A *Welcome page* instead of a home page to introduce users to the environment. The *Welcome page* is the first page the user sees upon entry to learning environment, and has music in the background on first entry to this page. The music was included as an attention-focusing and motivating device.

- Inserting the main menu on every page to maintain a non-linear design. This type of design not only allows the users to freely explore the learning environment and visit any page at any time, but also to adapt the various kinds of information presented to their learning style.

Other suggestions (adjusting of colour, missing hyperlinks, re-phrasing sentences, providing additional information, and so on) were given to improve version 2.0, as a result of the deliberations with the critical friends group. Although these comments have been very useful in 'debugging' the learning environment, they are too detailed to present here. Figure 3.5 shows a picture of the video component of the version 2.0, which was designed using FrontPage. An annotated picture of the Welcome Page for this version can be found in Appendix C.



Figure 3.5: Annotated picture of the video component of version 2.0

The main menu for version 2.0 consisted of eight components: (a) Watch a video, (b) Read about it, (c) Browse among resources, (d) Review and Reflect, (e) Journal, (f) Share your insights, and (g) About this CD, as shown in Figure 3.5. The Watch a video component presented the 30-minute edited video lesson in ten segments (see Appendix D for a description of the lesson video).

Questions followed each video segment in order to stimulate reflection on the events in the video, and help students understand the rationale for a particular action. An expert comment on the aspects of the reflection question was also provided. This comment was in the form of a video clip or it was text-based. The pre-service teachers were asked to discuss their responses to the reflection questions with each other before listening to the expert comment. The video lesson was seen as a means of providing a meaningful authentic context for learning. The *Watch a video* component also consisted of the video lesson materials, reflections on the lesson from the video teacher and a pre-service teacher, and background information on the video teacher the students and the school.

With the video lesson embedded into the learning environment, version 2.0 was almost functional and ready for another formative evaluation round. The formative evaluation took the form of an expert appraisal and field test (small group evaluation). For the expert appraisal, version 2.0 did not have the reflection questions well developed and as such, no expert commentaries on the questions were available. After the expert appraisal, suggestions for improving the reflection questions were obtained, and the videotaping of the expert comments was done. Version 2.0 for the field test now had expert comments; however, the reflections from the video teacher were not available for the formative evaluation of version 2.0.

The next section first describes the expert appraisal of the version 2.0 and is followed by a description of the field test with the target group – the pre-service teachers. The expert appraisal began in July 2001 and focused on the theoretical quality of the learning environment. The formative evaluation with the pre-service teachers began in October 2001 and focussed on assessing the practical quality of the learning environment.

3.6 EXPERT APPRAISAL OF VERSION 2.0

3.6.1 Aim and evaluation questions

The aim of the expert appraisal was to assess the theoretical quality of the learning environment and gather suggestions for improving the reflection questions and coherency between the components. The questions that guided the evaluation were:

- What are participants' perceptions of the theoretical quality of the learning environment?
- In what ways can the theoretical quality be improved?

In addition to these questions, the evaluation hoped to gather the participants' initial impressions about the usability of the case in the Jamaican context.

3.6.2 Participants

The participants came from Jamaica and the Netherlands. The Jamaican experts in the sample comprised the Science Education Officer at the Ministry of Education, two external examiners for the pre-service teachers' practicum, two pre-service science teacher educators from different Teachers' Colleges, and a ROSE science teacher trainer. These persons were chosen to evaluate the learning environment, which was delivered on a compact disc (CD), as they were involved with science teacher education in different ways. They would therefore look at the CD from different angles, and give a broad perspective on the theoretical quality of such a medium. The one participant from the Netherlands had experience in developing instructional materials for teacher education programmes.

3.6.3 Data collection techniques and procedure

The expert appraisal was conducted on a one-to-one basis. Techniques used to gather data from the participants were observation, work-aloud protocol, interview and discussion. Each participant was asked to examine all components of the learning environment and give suggestions on how to improve its theoretical quality. In particular, they were asked to comment on the quality of reflection questions and give suggestions for formulating suitable questions for each video clip. The improvement of the reflection questions was crucial as the revised questions were to be incorporated into the CD before the evaluation by the pre-service teachers.

Each participant was asked to think aloud while s/he used the CD. This helped the observer to identify unclear areas and detect any problems the experts were having navigating through the CD. Experts were asked why they lingered for an unusually long time on a page and reasons for their actions were noted. In general, all the comments from the experts were aired, discussed and suggestions for improvement recorded. Each participant took about one and half hours to evaluate the case-based learning environment.

3.6.4 Data analysis

The data sources for the evaluation included notes made while observing the participants using the CD and interview notes. An initial analysis of the responses from these data sources revealed that the participants focused on three main areas:

1. quality of reflection questions.
2. adequacy and relevance of content.
3. internal coherence of components.

The next section, which is organised according to these three areas, presents the comments made by the participants, the suggestions for improvement and the revision decisions taken.

3.6.5 Results and revision decisions

Quality of reflection questions

Table 3.2 presents the initial observations, and suggestions for improvement

Table 3.2: Expert comments on the reflection questions

Observation/Comment	Suggestion
The reflection questions:	Begin the questions with:
<ul style="list-style-type: none"> ▪ tell the user what is happening in the video; ▪ shift away from the constructivist philosophy underlying the design. 	<ul style="list-style-type: none"> ▪ What is happening...? ▪ Why do you think this happened...? ▪ How would you deal with...?
	Questions formulated in this way:
	<ul style="list-style-type: none"> ▪ might allow for varied perspectives on a particular event to emerge ▪ stimulate discussion on those perspectives ▪ promote more reflective thinking.

The suggestions for improvement were accepted and the questions rewritten and pitched at higher cognitive levels. The example in Box 3.1 shows the changes made to part of the reflection question for the *Introduction* video segment.

Box 3.1: Example of revision to reflection question for Introduction video clip

Before revision

The video teacher brought out the importance of measuring in the home, in the food industry and in the pharmaceutical industry. What do you think about the way in which the introduction was done?

After revision

What did the video teacher achieve in the introduction segment of the lesson?

The question was now open-ended and allowed for varied perspectives to be aired in a discussion forum.

Adequacy and relevance of content in each component

The science teacher educators made pertinent observations and suggestions about how to improve certain aspects of the content of the programme. These are listed in Table 3.3 below as well as the revision decisions taken.

Table 3.3: Expert comments on the theoretical quality

Comment	Suggestion
In <i>Browse among resources</i> , mention is made of videotapes of co-operative learning lessons.	Include excerpts from these videotaped lessons to stimulate and maintain interest in the CD.
Concept teaching models encourage the use of examples and non-examples of a concept.	Include written cases to illustrate exemplary and non-exemplary co-operative learning situations.
One view of co-operative learning (Johnson & Johnson, 1999), is addressed in <i>Read about it</i> .	Include at least two other perspectives.

The expert comments reflected the way in which science teacher educators are encouraged to organise learning experiences for pre-service teachers. For example, one expert suggested using examples and non-examples of a concept; another suggested the exposure to multiple viewpoints of a concept. The comments on how to improve the content were carefully deliberated with the critical friends in order to decide on what comments to accept. However, not all the suggestions were accepted. The first suggestion was rejected for two reasons:

- a. limited space on the CD;
- b. additional video clips might confuse the learner during the discussion of the events in the main lesson video.

The second suggestion about including written cases to illustrate exemplary and non-exemplary co-operative learning situations was also rejected. Having suitable reflection questions and subsequent discussions, the video lesson, which is not a perfect lesson, can be used to help the pre-service teachers understand what teacher and student behaviours exemplify or do not exemplify co-operative learning situations. Furthermore, using written cases might require a different methodology from what will be used for multimedia cases. The decision was therefore taken to adhere to the use of the multimedia case and focus on developing this medium and investigating its subsequent use in the teacher education programme.

The third suggestion in Table 3.3 was accepted. Two other views on co-operative learning were included: one from Kagan (1999) and the other from one of the experts.

Internal coherence

This section describes the experts' comments about the internal coherence of the multimedia case and the suggestions they gave for improving the learning environment. The multimedia case is deemed internally coherent if the diverse components such as *Read about it*, *Watch a video*, *Browse among resources* etc. are linked in meaningful ways. Table 3.4 summarises the comments pertaining to internal coherence.

Table 3.4: Expert comments on the internal coherence

Comment	Suggestion
More hyperlinks could be created between key content areas.	In the <i>Read about it</i> component, there is a list of benefits of co-operative learning. Link each benefit to a research abstract that supports this benefit.
The features of co-operative learning are not explicit in the video segments.	Insert hyperlinks in the video page to allow users to move to the relevant section in <i>Read about it</i> .

The expert comments on capitalising on the power of hypertext were accepted and implemented where possible. The first suggestion in Table 3.4 was accepted but was not implemented due to time constraints. The second suggestion was accepted and relevant changes made. For example, in the video segment that illustrates how positive interdependence could be structured, the hyperlink 'positive interdependence' was inserted on that video page to be linked to the page in the *Read about it* section that describes how to structure positive interdependence (see Figure 3.7). Increasing the hyperlinks provided pre-service teachers with more opportunities to gain access to a variety of information. This focus on the internal coherence helped to increase the access to multiple perspectives.

Usability

The science teacher educators deemed the multimedia case a 'relevant' medium for use in the science methods course. One science educator reported that the case addressed not just methodology but also allowed pre-service teachers to see how a teacher could teach the skill of measuring volume. Delivering the multimedia case on compact disc allowed the teacher to work at his or her pace, facilitated the revisiting of clips of special interest to the learner and was by no means time-consuming.

3.6.6 Discussion

The aim of the study was to design, develop and evaluate a multimedia case-based learning environment on co-operative learning. This learning environment already consisted of specific components created to reflect the design principles. Adherence to these principles was essential to the design of the learning environment. The evaluation of the CD by the experts yielded useful suggestions for improving the certain content areas. However, some of the comments made by the experts were rejected for pragmatic reasons, such as cost and time factors, others due to prior commitments, that is, the design principles. As a rule, if such suggestions were seen to be conflicting with the constructivist design principles, then these suggestions were rejected. Efforts were made to include additional information that would not overshadow the original intentions of the CD.

3.7 FIELD TEST OF VERSION 2.0

3.7.1 Aim and evaluation questions

The aim of the field test was to assess the practical quality of the multimedia case-based learning environment, which was delivered on a CD. Practical quality involved aspects such as usability in the Jamaican context, clarity and adequacy of the information, ease of navigation, and appeal. The evaluation questions were:

- How do pre-service teachers perceive the practical quality of the case-based learning environment?
- What do pre-service teachers think about the use of the case-based learning environment in the teachers' college?
- What do participants learn about co-operative learning from the multimedia case?

Responses to the third question might provide some insight into the potential of the multimedia case to facilitate a better understanding of co-operative learning. The next section describes the participants who were involved in the field test.

3.7.2 Participants

Fourteen pre-service teachers participated in the field test. The teachers came from the two Teachers' Colleges that offered the science methods course: Moriah Teachers' College and Carmel Teachers' College. At Moriah, eleven of the thirteen teachers who were present at the beginning of the evaluation completed the exercise, while at Carmel, three of the eight pre-service teachers who started the evaluation, completed the exercise. Those who did not complete the process were either novice computer users, worked slowly or had another meeting to attend.

3.7.3 Instruments

Two instruments were used to gather data: (a) questionnaire and (b) learner report. The *questionnaire* (Appendix E) was designed to gather data on the practical aspects of the learning environment (see Tessmer, 1993). The questions focused on:

- a. clarity of the programme;
- b. interest and acceptance;
- c. adequacy of the content;
- d. ease of navigation;
- e. perceptual features (user interface);
- f. revision suggestions;
- g. worth (what was new that they learned).

Evidence of the pre-service teachers' learning was obtained from the *learner report*, which required the teachers to respond to two questions on co-operative learning before and after using the CD:

- A. What do you understand by co-operative learning?
- B. According to research, what are the features of a co-operative classroom?

After using the CD, they were asked a more open question on the questionnaire:

- C. What was new that you learned?

These questions were asked to gain some insight into the potential of the multimedia case-based learning environment to enhance learning.

In addition to these two instruments, pre-service teachers at one college were asked to write their perceptions of case-based learning environment; at the other college the teachers were asked orally about their perceptions. The *interview* was recorded on audiotape.

3.7.4 Data collection techniques and procedure

The formative evaluation by the pre-service teachers was conducted in the computer laboratories of the teachers' colleges in Jamaica. At each college, the pre-service teachers were asked to write their idea of co-operative learning and the features of a co-operative classroom before they started to use the CD. After the pre-service teachers wrote their ideas of co-operative learning, they used the CD in pairs or in threes. They were asked to browse through the CD for about ten minutes and then focus on the video clips in the *Watch a video* section, because the *Watch a video* component was seen the core of the multimedia case-based learning environment. This instruction was given due to the limited time of two hours that the teachers had to evaluate the learning environment; therefore the pre-service

teachers were directed to this component as quickly as possible. At each college, the teachers were observed using the CD, and the work-aloud protocol was conducted for one group of students. Their discussions were recorded on audiotape. After the pre-service teachers completed using the CD, they were asked to write again their ideas on co-operative learning.

Following this task, the pre-service teachers were asked to complete the questionnaire (Appendix E) designed to gather data on the practical aspects of the learning environment. In addition to completing the questionnaire, the pre-service teachers at Carmel were asked to comment on the usefulness and relevance of other components such as: *Browse among resources*, *Review and Reflect*, *Journal*, *Help*, *About this CD* and the experts' commentaries. The pre-service teachers at Carmel were able to look at these features unlike those at Moriah. Time did not allow the Moriah students to evaluate the components. None of the pre-service teachers assessed the *Share your insights* feature due to time constraints

Interviews were conducted with a selection of pre-service teachers at Carmel to supplement and clarify their perceptions of the CD. At Moriah, the teachers wrote a summary of their overall perceptions of the multimedia software product. At both colleges, the data collection procedure lasted for approximately two hours.

3.7.5 Data Analysis

The questionnaire

Pre-service teachers' responses to the questions formulated on the questionnaire to assess practical quality, were analysed using the following criteria:

1. clear and relevant to students' learning needs;
2. interesting and challenging;
3. provides adequate information;
4. easy to navigate;
5. presents a clear user interface.

The number of teachers whose responses deemed the multimedia case practical in the particular area was reported.

The formative evaluation sought to gather suggestions for improving the learning environment. One question on the questionnaire asked: If you could change one thing, what would it be? The pre-service teachers' responses were examined carefully and two main categories of suggestions emerged. Their suggestions are organised according to these categories.

Learner report

The first two questions on the learner report asked pre-service teachers to respond to the questions before and after using the multimedia case:

A. What do you understand by co-operative learning?

B. According to research, what are the features of a co-operative classroom?

Their initial responses were analysed for common themes, and the number of responses with a recurring theme was reported. After working with the multimedia case, the responses to these questions were analysed to see if the teachers added new information or made any change to their original response.

For example, before using the case, nine of the eleven pre-service teachers indicated that co-operative learning meant 'working in groups'. After using the case, the two teachers who did not include this concept of co-operative learning initially, indicated that co-operative learning involves group work. The pre-service teachers could have acquired the new information from the *Read about it* component, where a detailed description of co-operative learning was provided: "Co-operative learning is the instructional use of small groups so that students work together to make best use of their own and each other's learning. Students are provided with opportunities to develop group skills and are accountable both as individuals and as a group" (Johnson & Johnson, 1999, p. 5). The pre-service teachers had the opportunity to read this description in *Read about it* or they could have learnt about co-operative learning from the *Watch a video* component or other components of the learning environment.

The analysis of the pre-service teachers' responses to Question B was guided by Johnson and Johnson's (1999) five features: positive interdependence, face-to-face interaction, individual accountability, interpersonal skills and group processing. The five features were addressed in the *Read about it* section of the multimedia case-based learning environment. Students' responses were analysed for evidence of these features before and after using the multimedia case. A pre-service teacher is deemed to have experienced gains in learning if after using the CD she or he adds a perspective to her or his response that is line with educational research on co-operative learning.

Perceptions

The pre-service teachers' perceptions of the multimedia case were analysed by looking for key words in their remarks that could help to formulate preliminary impressions about the quality of the multimedia case. Examples of these remarks were reported.

3.7.6 Results and revision decisions

This section organises the pre-service teachers' responses in three parts. The first discusses the practical quality, the second part presents their overall perceptions of the CD, and the third part focuses on the learning results.

Practical quality

The pre-service teachers were asked to respond to specific questions focusing on practical aspects of the CD. Table 3.5 presents the number of teachers whose responses indicate that the CD was practical and provides examples of such responses.

Table 3.5: Pre-service teachers' comments on the practical quality (N=14)

Criterion	No. of responses	Example of response
1. Clarity	13	"The programme is very clear."
2. Interest	11	"We found it quite interesting and were not at all bored... It enlightened our understanding of co-operative learning ..."
3. Adequacy of content	11	"Quite clear and the main idea of the lesson was quite obvious."
4. Ease of navigation	14	"Navigation was found to be quite easy, even for a person who isn't computer literate. It was quite user-friendly."
5. Perceptual features	13	Text and pictures on the screen were "quite clear to the naked eye". The pictures and font size were "appropriate for students at this level".

The pre-service teachers who did not supply a response that would deem the multimedia case a practical medium, offered suggestions for improvement. Suggestions for improvement were also obtained from one of the questions on the questionnaire: If you could change one thing, what would it be? The comments, when analysed, fell into two categories: (1) adequacy of content and (2) perceptual features. Table 3.6 summarises their actual comments, suggestions, and the revision decisions taken.

Table 3.6: Summary of pre-service teachers' suggestions for improvement

Comments/Suggestions for improvement	Revision decision
<u>Adequacy of content</u>	
"More video clips should have been included along with the text that was given. This would grab the user's attention faster."	It was not possible to include additional video clips in the <i>Read about it</i> section (predominantly text), due limited storage space. Instead, pictures of co-operative learning situations were added to the pages.
There needs to be more explanations on: <ul style="list-style-type: none"> ▪ student tasks in two of the video segments ▪ features of co-operative learning 	A booklet on co-operative learning was prepared consisting of the student worksheets, a summary of features of co-operative learning, and other relevant information on co-operative learning.
<u>Perceptual features</u>	
"The clips are a bit dark."	Although the observation of some of the clips being dark is accurate, it was beyond the scope of this study to change the video itself. In the future, steps will be taken to ensure that adequate lighting is present in the classroom.
Review the sound quality, as it is difficult to hear the discussions among students.	Text was included for the video segments where the volume was low.
Include text with the video clip featuring the expert comment. The volume of the sound is low.	The text of the expert's comments was included below the clip.

The pre-service teachers at Carmel Teachers' College were asked directly about the usefulness and relevance of the other components: *Browse among resources*, *Review and Reflect*, *Journal*, *About this CD*, *Help* and the expert views on the reflection questions. Time did not allow these questions to be asked of the Moriah teachers. In general, the Carmel teachers reported that all these components were useful. However, none of them had reason to use the *Help* feature; and the *Share your insights* feature was not evaluated due to time constraints. In hindsight, it would have been difficult to have the pre-service teachers use the *Share your insights* feature. To use this feature as intended, the pre-service teachers would need to return to the computer room at a pre-determined time and participate in the discussion forum involving teachers from the other college about implementing co-operative learning. They were already pressed for time viewing the other components in the two-hour period. Therefore, having teachers return to the computer room to evaluate the discussion group feature would have been extremely demanding. The decision was therefore taken to exclude the *Share your*

insights feature from the multimedia case-based learning environment. Since the teachers reported that navigation was easy, the *Help* feature was also removed. See Figure 3.7 for a picture of the revised and final version of the screen.

General perceptions of the CD

The pre-service teachers were asked to give their general perceptions of the CD. Table 3.7 shows the summary statements made in light of their perceptions of the CD.

Table 3.7: Summary of pre-service teachers' general perceptions of the CD

The CD-ROM was...	Actual comment
1. Useful	"The CD-ROM is useful. It is a better way of learning than in the classroom. One can pause, rewind etc. to clarify any points. The language is clear. The video was excellent."
2. Motivating	"I learnt from this CD-ROM and it was stimulating for me; it was a reinforcer for me. I feel as if I could enter a classroom and something on co-operative learning."
3. Relevant	"I think that this exercise is quite relevant to student teachers... It was very interesting and informative. This will help me in my teaching world in many different ways (co-operative learning)."
4. Practical	"The material was practical...giving guidelines for a successful class (by giving roles and explaining what each role entails, etc.) Generally it was an educational, interesting, detailed and sequenced material, and I would require every student teacher to obtain its contents."
5. Successful in bringing classroom situations to the pre-service teachers	"Having ... gone through, I realise that there are certain things in there that could be of help to me as a teacher in training and I did not know much about co-operative learning. Actually, I only knew it was actually a group of persons that help to foster, help to enhance each other's learning ability; but I did not actually know that it entailed so much and it would be so clear and well understood ... I've really learnt something."

Overall, the pre-service teachers' comments about the case-based learning environment on CD were positive. They found it appealing (as they wanted to use the CD) and relevant to their learning environment.

Learner report - Thoughts on co-operative learning

The pre-service teachers' responses to the question on their ideas about co-operative learning revealed common concepts: working in a group, achieving a common goal, heterogeneity, individual responsibility or duty, and developing skills. These are shown below in Table 3.8.

Table 3.8: Summary of pre-service teachers' concepts on co-operative learning (N = 13)

Teacher	Common concepts										Evidence of learning?	
	Working in a group		Common goal		Heterogeneity		Individual duty		Developing skills			
	Before	After	Before	After	Before	After	Before	After	Before	After		
1.	✓	✓		✓								Yes
2.	✓	✓										No
3.	✓	✓									✓	Yes
4.	✓	✓	✓	✓		✓		✓				Yes
5.	✓	✓	✓			✓			✓	✓		Yes
6.	✓											No
7.	✓	✓						✓				Yes
8.		✓		✓								Yes
9.		✓				✓						Yes
10.	✓	✓			✓	✓						No
11.	✓	✓										No
12.	✓	✓	✓	✓				✓				No
13.	✓	✓	✓	✓				✓				No

Note. The checkmark ✓ indicates that the concept is included in response. A blank cell means that the concept was excluded from the response.

Based on the results in Table 3.8, some degree of learning was achieved. No student provided the description of co-operative learning verbatim from the *Read about it* section; it would appear that those who expanded on original their ideas did so because of watching the video clips. If this were so, then steps would need to be taken to ensure that the *Watch a video* component has sufficient information on co-operative learning in the form of hyperlinks to relevant sections, text or audio to supplement the video clips.

Learner report - Identifying the features of a co-operative classroom

Pre-service teachers' responses were analysed for evidence of the co-operative learning features proposed by Johnson and Johnson (1999). Table 3.9 presents a summary of their responses.

Table 3.9: Summary of pre-service teachers' responses to the question: 'According to research, what are the features of a co-operative classroom?' before and after using the multimedia case (N =13)

Teacher	Co-operative learning feature										Evidence of learning?
	Positive inter. ^a		Face-to-face interaction		Individual acc. ^b		Group skills		Group processing		
	Before	After	Before	After	Before	After	Before	After	Before	After	
1.				✓			✓	✓			Yes
2.		✓					✓				Yes
3.											No
4.	✓	✓		✓			✓		✓	✓	Yes
5.		✓		✓			✓		✓	✓	Yes
6.		✓	✓				✓				Yes
7.		✓					✓				Yes
8.		✓		✓			✓		✓	✓	Yes
9.		✓		✓			✓		✓	✓	Yes
10.		✓		✓			✓		✓	✓	Yes
11.											No
12.	✓	✓					✓				Yes
13.	✓	✓					✓				Yes

Note. The checkmark ✓ indicates that the feature is included in response. A blank cell means that the feature was excluded from the response.

^aPositive interdependence

^bIndividual accountability

The pre-service teachers showed some amount of learning with respect to the features of a co-operative classroom. There were two kinds of responses. One set of responses reported the five features verbatim, as outlined in the *Read about it* section; others seemed to have gleaned one or two features from the video and these latter responses were reported in students' own words. Steps were therefore taken to improve the internal coherence between *Watch a video* and *Read about it* so that the teachers will be able to make the link between the feature they see in the video and an explanation for the rationale of this feature.

Learner report – New learning

Various responses were given to this open question; however, common themes emerged when responses were analysed. Table 3.10 summarises the results.

Table 3.10: Summary of pre-service teachers' responses to the question:
'What was new that you learned?' (N =14)

Category	Number of respondents
The concept of co-operative learning	2
One or more features of co-operative learning	9
When in the lesson co-operative learning can be used	1
Class management ideas	1
Format for writing a lesson plan	1

Based on Table 3.10, the pre-service teachers learned different things about co-operative learning. Nine of fourteen pre-service teachers said that they learned about one or more features of co-operative learning. The other five pre-service teachers' responses indicated that different aspects of co-operative learning appealed to them.

3.7.7 Discussion

When courseware developers design a multimedia case-based learning environment, there is usually specific information that they hope the learners will acquire. Sometimes learners learn what the developers intended; other times they learn something different. In this formative evaluation, the learners (pre-service teachers) gained a better understanding of co-operative learning. However, it must be admitted that the learning gains varied across pre-service teachers. What is important for this study is that aims of the multimedia case were achieved in varying degrees. One of the intentions of the multimedia case was to facilitate a better understanding of co-operative learning in a real context. The pre-service teachers all learnt something new about co-operative learning. Furthermore, the teachers felt that the multimedia case-based learning environment on co-operative learning was, for most parts, clear, easy to use, congruent with their learning environment and relevant to their learning experiences. It was a practical medium.

3.8 TOWARDS THE FINAL VERSION

Following the evaluation of the CD by the pre-service teachers, and subsequent reflections on the process, the developer/researcher was not fully satisfied with the organisation of the reflection questions. This dissatisfaction prompted the revisit to literature on reflection to gain further insights on how the questions could be

revised to promote deeper reflective thinking. This confrontation of ideas with literature helped to clarify the formulation of reflection questions and led to the adaptation of Posner's (1996) framework for helping teachers to reflect on their field experiences (see section 2.4.2). Figure 3.6 shows how the reflection question for the one of the video segments 'Structuring Groups' was modified to reflect Posner's framework.

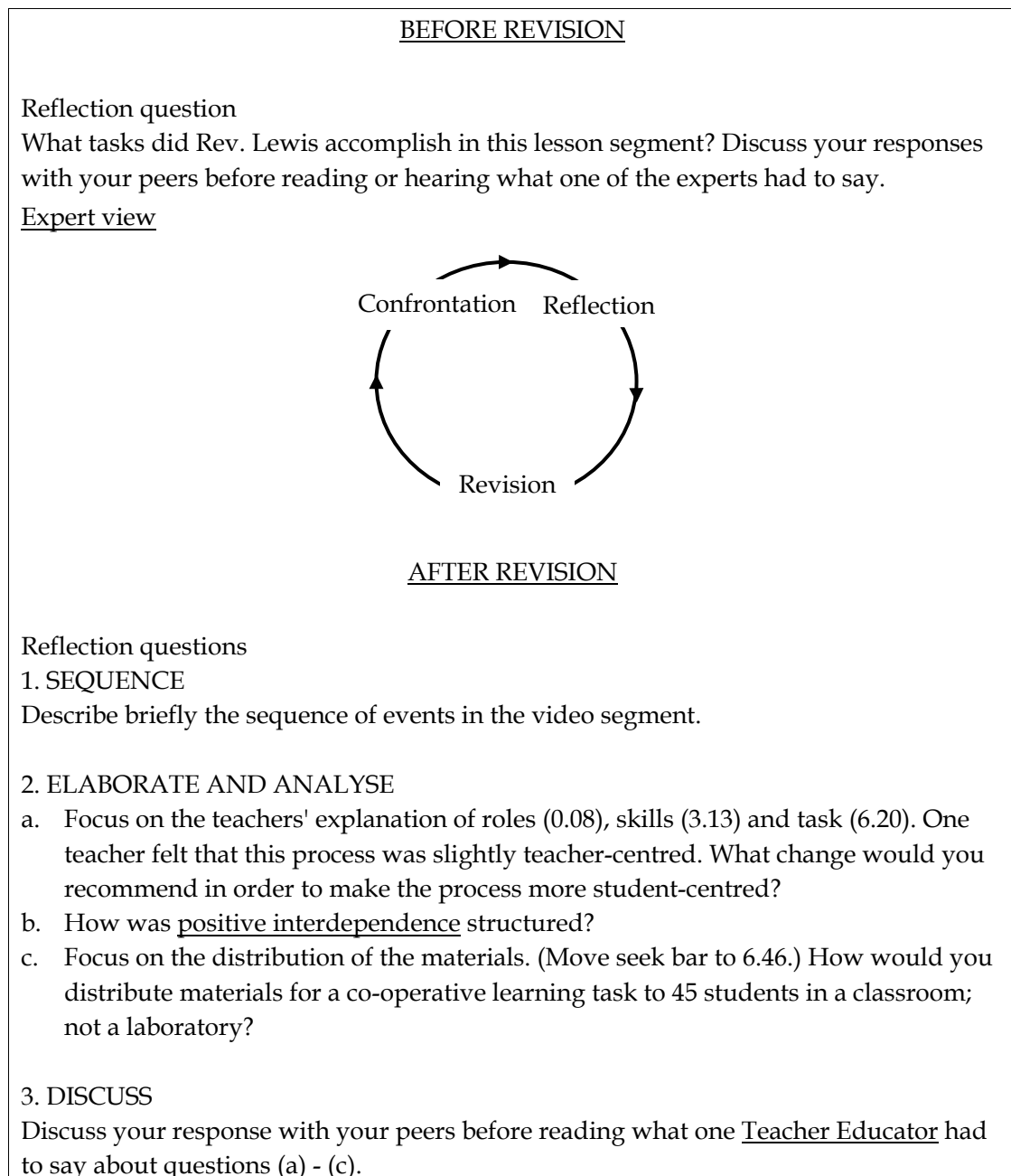


Figure 3.6: Reflection question for the video segment: Structuring Groups – before and after revision

One member of the critical friends group evaluated the new framework for reflection in Figure 3.6. This evaluation was seen as a form of confrontation, in which the revised ideas were brought face-to-face before a critical eye. The critical friend commented that the framework for reflection was useful, but pointed out that reflection also means that a person reframes his initial judgements of the situation. This cognitive restructuring of the video events was lacking in the questions. The suggestion for improvement centred on developing a more holistic dimension for reflection by asking teachers to give their judgement before and after they answer the analytical questions, and then ask how feelings have changed. This suggestion was accepted and included a task asking the pre-service teacher to review his original responses in light of the discussion with his peers and the expert views. Figure 3.7 shows the final version of the video page of multimedia case, with the review task.

The screenshot shows a multimedia case interface. At the top, there is a header with the 'COOPERATIVE LEARNING' logo on both sides and the text 'An innovative approach to science teaching'. Below this, there are two rows of sub-headers: 'Positive Interdependence' and 'Interpersonal Skills' in the first row, and 'Face-to-Face Interaction', 'Group Processing', and 'Individual Accountability' in the second row. A main menu bar contains six items: 'Read about it', 'Watch a video', 'Browse through resources', 'Review and Reflect', 'Journal', and 'About this CD-ROM'. A bracket on the right side of this menu is labeled 'Main menu with six components'.

The main content area is titled 'Video Lesson - "Using the measuring cylinder" STRUCTURING GROUPS'. It includes an 'OVERVIEW' section with a 'VIDEO' subsection containing a list of six items, with '3. Structuring groups' selected. Below this are sections for 'BACKGROUND', 'REFLECTIONS', and 'LESSON MATERIALS'. A central video player shows a teacher pointing at a whiteboard. To the right of the video player is a 'Questions for Reflection' section with four numbered questions: 1. SEQUENCE, 2. ELABORATE AND ANALYSE, 3. DISCUSS, and 4. REVIEW. A bracket on the right side of this section is labeled 'Framework for reflection' and lists 'Sequence', 'Elaborate', and 'Analyse'. A specific annotation points to the word 'classroom' in question 2, with a note: 'Hyperlink to "Positive interdependence" page in Read about it'. Another bracket on the right side of the 'REVIEW' question is labeled 'Question to encourage reframing of ideas'.

Figure 3.7: Annotated picture of the video screen for the final version

Note that the main menu in this revised version now consists of six components instead of eight, and there is the review component. This version was used in the

effects study, which is documented in the next chapter. The final section makes conclusions about the quality of the multimedia case and lessons learnt during the development process.

3.9 CONCLUSIONS

The purpose of this study was to develop a multimedia case-based learning environment on co-operative learning. The strategies that dominated the development process included prototyping, confrontations and deliberations, and formative evaluations. The formative evaluation proved to be a useful activity as it provided prudent suggestions for improvement. The evaluation was primarily concerned with the theoretical, technical and practical quality issues and sought to find ways of improving the multimedia case-based learning environment in these areas. The evaluation also sought to get initial insights into the potential of the multimedia case as a learning tool. The following sections make conclusions on the quality of the multimedia case-based learning environment on co-operative learning, and its potential as a learning tool.

3.9.1 Theoretical quality

The experts regard the multimedia case-based learning environment is a welcomed innovation for the pre-service teacher education programme. Such a software product fits into the curriculum and can be used to facilitate a better understanding of teaching methods e.g. co-operative learning. However, it is important to note that when developing such a product, careful attention must be paid to (a) the linking of various components to improve internal coherence and (b) the formulation of questions to stimulate reflection. Increasing the interconnectedness of the various components through hyperlinks emphasises the "real world complexity and ill-structuredness of many knowledge domains" (Spiro, Feltovich, Jacobson, & Coulson, 1992).

3.9.2 Practical quality

The pre-service teachers see the multimedia case as a practical innovation. The case is easy to use; addresses the pre-service teachers' needs and fits into their learning environment to a large extent. The science teacher educators welcomed the innovation with much enthusiasm and acknowledged its potential as a learning tool. There is, however, a cautionary note. Some students felt that the time required to use the CD was too long (two hours). In addition, some of them were not used to

using the computer as a learning tool, and this could have influenced the time taken to use the CD. These observations stand to impinge on its practicality. Doyle and Ponder (1977) note that practices, which depart drastically from normal conditions, are viewed as impractical. It is therefore important that this innovation fits into the college practices as much as possible.

3.9.3 Potential of the case as a learning tool

Pre-service teachers' understanding of co-operative learning improved after using the CD. However, the results on the learning of the five features of co-operative learning have generated concerns for further use. As stated earlier, some pre-service teachers reported the five features as written in the *Read about it* while others were able to report, in their own words, one or two features. What caused this difference in the type of learning observed? It could be that some of the students explored the *Read about it* section first and identified the features, then looked at the video while others did not get a chance to read about the five features before watching the video. The latter group would be depending on the video to return in two hours the five features that were derived from several years of research by Johnson and Johnson (1999). How then should the case be presented to the pre-service teachers and still embrace the constructivist design principles? Should the pre-service teachers be provided with guidelines for using the case (restricted exploration) or should they be allowed to freely explore the case (open exploration)? Answers to these questions are explored in the final chapter of this book.

CHAPTER 4

Learning and reflecting with a multimedia case

*This chapter describes an investigation coined **L**earning and **R**eflecting with a **C**ase (LRC) study, that was conducted to explore the potential of the case to facilitate teacher learning and reflection. The first section presents the aim and research questions of the investigation, which is followed by a description of the method of the LRC study in the second section. The data analysis techniques and the results of the study are outlined in the third and fourth sections respectively. The final section makes conclusions about the effects of using the multimedia case in the science methods course.*

4.1 AIM AND RESEARCH QUESTIONS

The aim of the LRC study was to explore the effects of using the multimedia case-based learning environment in the science methods course. The central research question was:

What are the effects of multimedia case use on pre-service teachers?

Three sub-questions were formulated to guide the investigation and are discussed in the following paragraphs.

The multimedia case provided a real life classroom captured on video within which essential features of a co-operative learning lesson could be identified and elaborated. The three features of co-operative learning highlighted in the video were: positive interdependence, individual accountability, and group processing. Information on these features was addressed in the *Read about it* component of the case-based learning environment and the accompanying resource booklet. If pre-service teachers could transfer what they read about co-operative learning in the *Read about it* section and the booklet, to help identify features of co-operative learning in the video, the multimedia case could be viewed as a medium facilitating learning. Therefore, the first sub-question was:

1. What do the pre-service teachers learn from the case-based learning environment?

The case-based learning environment provided a framework to guide pre-service teachers' walk on the road to reflection. In this study, reflection is viewed as process in which an individual reviews his initial interpretation of an issue in light of other perspectives, reframes and articulates his renewed version of the issue having considered the other perspectives (cf. section 2.4.2). The second research sub-question was:

2. How does the multimedia case function in facilitating reflection?

Before a person reflects, she needs something on which to reflect, for example, something she has observed or experienced. How she reports her description is crucial to the reflection process as such descriptions help to create insight out of what might seem to be routine and commonplace. In addition to describing what is seen and heard, analysing the video event also serves to provide material for subsequent reflection. During analysis, an individual has the opportunity to make his tacit knowledge public. This externalisation of personal theories allows for the confrontation of ideas with similar or conflicting views, thereby setting the stage for reflection. Not only is it useful for the reflection process if pre-service teachers express their opinions, but it is also essential that they elaborate on their ideas. Elaborating on their ideas can help them to better understand why they do what they do. Analysing video events can therefore aid the reflection process by shifting an individual from one experience into the next with deeper understanding of its relationships with other experiences and ideas. The reflection framework included tasks requiring pre-service teachers to describe and analyse events before reflecting on these events, in order to help them clarify subsequent issues emerging from the video. Consequently, the study saw it prudent to examine how they described and analysed such events. Being good observers and recorders of classroom interactions, and being analytical are hallmarks of the reflection process. In order to address the second research sub-question, two other questions were formulated:

- (a) How do pre-service teachers describe video events?
- (b) How do pre-service teachers analyse video events?

In the multimedia case-based learning environment, commentaries from science teacher educators (experts) and the video teacher were included to provide pre-service teachers with additional perspectives for the reflection process (see L. Shulman, 1992, p.12). Therefore, the study sought to find out:

- (c) What role do the commentaries in the case-based learning environment play in facilitating reflection?

Answers to the research questions will help to make conclusions about the effects of the multimedia case-based learning environment, in terms of its potential to foster teacher learning, and reflection. The next section describes the instruments, participants and procedure.

4.2 METHOD

4.2.1 Instruments

The instruments used in this study were developed to document information on pre-service teachers' in two areas: (a) the pre-service teachers' learning and reflection and (b) their background. The instrument that was used to keep a record of teachers' learning and reflection will be referred to as the *learning task sheet*. Background information on the pre-service teachers was obtained through an instrument referred to as *Personal Data Form*. The next paragraphs describe these instruments.

Learning task sheet

The learning task sheet formed the primary data source for this study. The task sheet was designed so that the pre-service teachers could write their responses to a learning task formulated for four video clips. Each learning task comprised a set of questions focusing on three features of co-operative learning, and student-teacher interactions. The three features that were addressed in the video component of the multimedia case were:

1. positive (role) interdependence – when each member is assigned interconnected roles that specify duties that the group needs to perform in order to complete a joint task;
2. individual accountability – assessment of whether or not each group member has achieved the group goal;
3. group processing – reflecting on a group task to (a) describe what member actions were helpful and unhelpful and (b) decide how to improve for the next task.

The learning task consisted of three main components, which asked the pre-service teachers to sequence, analyse and review their interpretations of the video events in light of other interpretations of the events and educational literature.

The *Sequence* task on each task sheet required pre-service teachers to describe briefly the events in the video segment. Being able to describe a sequence of events after they have happened can be seen as a pre-requisite for the reflection process and as such, was included in the task.

The questions for *Elaborate and Analyse* task were of two types. One group of questions, content questions, served to elicit pre-service teachers' ideas about three co-operative learning features and thereby come to a better understanding of the learning potential of the multimedia case-based learning environment. The questions addressed a particular feature of co-operative learning and asked pre-service teachers to think about how the feature was exemplified in the video, and the importance of that feature. The second group of questions, critical thinking questions, asked pre-service teachers to evaluate the video teacher's actions and student-teacher interactions, and suggest alternative ways of addressing particular situations in the video lesson.

The *Review* task was formulated to encourage pre-service teachers to listen to or view other perspectives or commentaries on the video events, revisit their initial ideas on those events and then reflect. Reflection can be seen as a mental process of framing and reframing a problem or existing knowledge in light of other perspectives. Commentaries were provided for all clips. However, the video teacher commented only on events in video clips 4 and 5: 'Monitoring groups' and 'Evaluating groups' respectively (see Appendix D for details of the video lesson). Figure 4.1 shows an example of a set of questions on the learning task sheet.

SEQUENCE	ELABORATE and ANALYSE	REVIEW
Describe briefly the sequence of events in the video segment.	<ul style="list-style-type: none"> a. Focus on the teacher intervention and the discussion that took place between the teacher and Group 2. What are your views about the way in which the teacher intervened? b. How would you have dealt with the lack of consensus among the members of Group 2? c. To what extent was positive interdependence in effect? Use examples from the video to support your answer. 	After listening to the other views on how the teacher intervened, review your original response and modify it if your response has changed in any way.

Figure 4.1: Example of learning task for video clip 4, Monitoring groups

A complete overview of the tasks for each video clip, and examples of learning task sheets that have been completed by the pre-service teachers are in Appendices F1-F5. The next section provides background information on the participants.

Personal Data Form

The personal data form consisted of four sets of questions, which were geared at eliciting specific information about the pre-service teachers (Appendix G1):

- computer literacy;
- knowledge of co-operative learning;
- expectations
- personal data such as age, previous teaching experience.

The information on the Personal data form was used to form a profile of the pre-service teachers and served to help with interpretation of the results of the study.

4.2.2 Participants

The LRC study was conducted with second-year pre-service teachers enrolled in the Diploma in Teaching programme at a coeducational teachers' college in Kingston. This college was selected because of: (a) the willingness of the science teacher educators and pre-service teachers to accommodate the study and (b) its proximity to the researcher's base. Although a total of thirty-one pre-service teachers agreed to participate in the study, at the end, eighteen teachers (7 men and 11 women) completed using the multimedia case. Two reasons given by teachers who did not complete working with the case were (a) the demands that the preparation for teaching practice made on them and (b) the workload from other courses. Of the eighteen teachers who completed working through the case-based learning environment, twelve of them were following the Single Option programme and while the remainder were Double Option students (see section 1.2.2). The age of the participants ranged from 17 years to 29 years. Table 4.1 summarises background information on the participants.

Table 4.1: Background information on participants

	Number of Participants			Age of participants	
	<i>Total</i>	<i>Men</i>	<i>Women</i>	<i>Mean</i>	<i>SD</i>
Single Option	12	3	9	21.8	3
Double Option	6	4	2	19.3	2.1
	18	7	11	20.5	2.5

Generally, the participating pre-service teachers were young with little or no teaching experience. Four of the participants taught before entering the teacher's

college. The teaching experience of these teachers ranged from 6 months to 4 years. At the time of the study, the participating teachers were doing the unit 'Methods of teaching science' in the Science Education I course, which addresses the teaching of science at the Grade 7-9 level. One of the methods addressed in this unit is co-operative learning, which was the method featured in the multimedia case. All but two persons in the study were not familiar with a computer system at the beginning of the study, but they quickly learnt how to manipulate the hardware and navigate through the multimedia case. Appendix G2 summarises background information on each participant. The next section describes how the study was conducted.

4.2.3 Procedure

The data collection process began in October 2002 and proceeded in three main stages: (1) orientation, (2) whole group use of multimedia case and (3) small-group use of multimedia case (Box 4.1).

Box 4.1: Description of the implementation of the multimedia case

Stage	Activity	Approximate time (min)	Data collection technique
1. Orientation	Pre-service teachers are introduced to the study and then asked to complete <i>Personal data form</i> . (N=28)	30	Questionnaire
2. Whole-group use of case	Teachers watch first two clips and discuss learning task as a whole group. (N=28)	30	-
3. Small-group use of case	Teachers use multimedia case and complete viewing all clips. (N=18)	120 (Two sittings)	Learning task sheet

The orientation session to the programme was conducted during the regular two-hour Science Education I class. During the orientation, the teachers were introduced to the purpose of the study and what part they would play if they agreed to participate. Twenty-eight students signalled their intent to participate by completing and signing the Personal data form, which comprised questions on participants' background. The following week, the concept of co-operative learning was discussed with the pre-service teachers and each teacher was given a copy of the co-operative learning resource booklet, which contained inter alia, an overview of co-operative learning, sample planning sheets for a co-operative learning lesson and the video lesson materials. The teachers were then asked to watch the first two (out of six) video segments--Introduction and Review--as a whole group, and then

discuss the questions accompanying each video segment. Following the whole class viewing of the video clips, arrangements were made to meet students individually or in small groups, to view the remaining four clips and respond to the reflection questions¹. The venue for the use of the multimedia case varied as it depended on the availability of rooms at the college and the teacher's time.

Three more teachers joined the sample before one group of teachers started to use the multimedia case making the total number to thirty-one. However, as time progressed, the data from thirteen teachers had to be eliminated from the sample because they did not complete the viewing of the four video clips. Working through a case involved viewing the four clips, accessing information on co-operative learning from other components of the learning environment such as *Read about it* and responding to questions on the learning task sheet, (Figure 4.2).

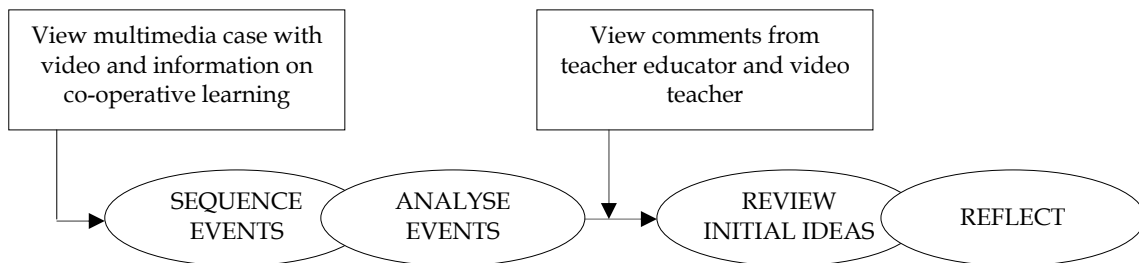


Figure 4.2: Steps involved with multimedia case use

The viewing of each clip and the subsequent responding to the learning task took about 30 minutes. In general, the teachers viewed two of the four clips in one sitting. Arrangements had to be made for them to view the remaining two at another time. After the teachers completed working through the multimedia case, they went on teaching practice for three weeks.

4.3 ANALYSIS OF DATA FROM THE LEARNING TASK SHEET

This section describes how the responses to the questions on the learning task sheet were analysed, and is organised into four sections:

- a. describing video events;
- b. identifying co-operative learning features;

¹ The decision to meet pre-service teachers individually or in small groups deviated from the original plan, which would have seen the pairs or small groups of teachers working in the computer laboratory, at a computer station. However, because of the lack of working computers in the computer laboratory, the original plan had to be modified which involved the procurement of two laptop computers and meeting teachers at varied times.

- c. analysing video events;
- d. role of commentaries in reflection

The four methods of analysis are presented in the subsequent paragraphs.

4.3.1 Describing video events

The first task was an open activity to gain insight into how the pre-service teachers describe video events without prompts. The teachers' responses to the Sequence task for each of the four clips were first analysed using a checklist, which was developed by the researcher. Each checklist comprised the list of main events in the video as they unfolded (see Figure 4.3). The data was analysed in the following way.

Events	Student number							Total
	1	2	3	...	17	18		
1. Teacher asks the students to complete task individually								
2. Teacher hands out worksheets to each student.								
3. Teacher says the task will help them to improve skills for using cylinder.								
4. Teacher reminds students it is not group work								
5. Teacher tells time frame of activity.								
6. Each student does work on his/her own								
Total								

Figure 4. 3: Section of checklist for Sequence task, Clip 6

Appendix H summarises responses to the sequence tasks for the four clips.

1. The events identified by each pre-service teacher were compared to those on the checklist and quantified to see if there were any themes in what pre-service teachers reported. The commonly reported events were then noted. The results of this analysis gave an indication of what pre-service teachers considered significant in each video clip, and events that were seemingly trivial to them, and hence not reported. Figure 4.3 shows the checklist that was used to analyse the sequence task for Clip 6.
2. Responses were also examined to see if there were any trends in how pre-service teachers formulated their descriptions. For example, when describing video events, pre-service teachers' responses were examined for evidence of observations and interpretations (cf. section 4.2.1). Observing involves adherence to description, rather than confounding the description with

analysis, for example, attributing a particular motivation for an action (e.g. 'trying to get attention') or inferring a trait (e.g. 'lazy'). The ideal description of a video event would be one consisting of observations.

The analysis of the Sequence task sought to find out the type of events that appealed to pre-service teachers when describing classroom interactions and how they formulated the descriptions of such events.

4.3.2 Identifying co-operative learning features

The teachers' responses to seven of the twelve questions in the Elaborate and Analyse task were analysed using coding techniques. A start list of codes (Miles & Huberman, 1994) was developed from Johnson and Johnson (1999) and the expert comments. The teachers' responses were analysed to see how they compared to the start list of pre-determined codes, which was viewed as the 'ideal response'. The number of teachers' responses with elements of the ideal response for each question was quantified. For example, pre-service teachers were asked to explain how positive interdependence was structured in one of the video clips. Their responses were compared to the ideal response (Figure 4.4).

Elements of ideal response	Student Number								
	1	2	3	4	5	6	...	18	Total
Assignment of roles	•	•	•	•	•	•			
Explanation of roles					•			•	
Emphasise need for each student to perform role well	•	•	•	•		•	...	•	
Total									

Figure 4.4: Example of how responses to question b, clip 3 were analysed
(The dot indicates the presence of a response.)

Then, the number of responses with elements of the ideal response was tabulated. This analysis gave an indication of the profundity of pre-service teachers' concepts of the co-operative learning feature. If pre-service teachers' responses had additional ideas to the one in the ideal response, these ideas were coded accordingly and recurring patterns described qualitatively.

4.3.3 Analysing video events

Five of the twelve questions in the Elaborate and Analyse section of the learning task sheet were developed to facilitate the practice of the analysing classroom

events. The questions required pre-service teachers to assess a video event and suggest alternative courses of action for four scenarios.

The responses to the questions were examined to see if pre-service teachers provided new information and elaborated on their ideas. The rubric system in Figure 4.5 was used to analyse the questions.

Category	Description of response
1	No new information
2	New information given No evidence of elaboration by giving examples or reasons
3	New information given Evidence of elaboration <ul style="list-style-type: none"> ▪ provides examples ▪ includes reasons, examples, ▪ uses case illustrations to support responses ▪ considers consequences

Figure 4. 5: Rubric system used to analyse critical thinking questions

The number of responses that fell into each category was tallied and tabulated. Examining the responses to the critical thinking questions in this way can facilitate a better understanding of how pre-service teachers analyse the video events. The emerging patterns in pre-service teachers' responses are described quantitatively and qualitatively in the section 4.4 of this chapter.

4.3.4 Role of commentaries in the reflection process

The review task for each clip asked students to review their original response after listening to comments from an expert and/or video teacher, and then modify their response if there were any changes in their ideas. The approach to analysing the responses to this task was three-fold.

1. The pre-service teachers' responses to the questions for the Elaborate and Analyse task were compared to the responses they gave for the Review task to see if there was any change. For example, some of the responses showed a consideration of the commentaries, while other responses offered no new information. Both categories of responses were tabulated.
2. The responses that reflected ideas from the commentaries were further analysed to see how pre-service teachers used the information from the commentaries. Analysing the responses in this way yielded three categories describing how the pre-service teachers used the information from the commentaries.

3. For each clip, the categories of responses that emerged from the previous analysis exercise were tabulated, and trends across clips discussed both qualitatively and quantitatively.

The next section presents the results of the analysis.

4.4 RESULTS

This section describes the results of the LRC study, which sought to find out how pre-service teachers described video events, what pre-service teachers learn about co-operative learning features, how they analysed video events, and the role commentaries played in reflection. The results are presented in the next four sections.

4.4.1 Describing video events

This sub-section reports on (a) the events that pre-service teachers focused on when viewing video clips and (b) how they formulate their descriptions of such events.

Events pre-service teachers deem important

All the responses to the sequence task were compared to the sequence of events on the checklists and are presented in Appendix H. Based on the results, pre-service teachers are focusing on certain events more than on others. An analysis of the pre-service teachers' responses revealed that for a given clip where teacher actions dominated the video segment (Clips 3, 5 and 6), the pre-service teachers focused more on teacher behaviours and less on the student behaviours. Events involving teacher actions were reported more frequently than those involving only student behaviours.

Pre-service teachers also focused more on events directly related to group work and less on events relating to classroom management issues. For example, few teachers reported events involving the video teacher giving the students the time frame of the activity (Clips 3 and 6) or praising the students (Clip 5).

However, one interesting trend was identified in the responses for video clip 3, Structuring groups (Table 4.2).

Table 4.2: Summary of pre-service teachers' responses to the Sequence task for Clip 3

Events in ideal response	No. of teachers noting event (N = 18)
1. The teacher:	
a. Identifies roles: recorder, materials manager, checker and timekeeper	10
b. Explains duties of each role	17
c. Explains the behaviours associated with task skills	10
d. Explains working relationship skills	10
e. Tells the students the metric unit for volume	3
f. Explains the task at hand	6
g. Tells the materials manager what they should collect	1
h. Invites materials managers to collect the materials.	7
2. Students collect/are given materials	3
3. The teacher gives time frame; says 40 minutes	2

When analysing descriptions of events for Clip 3, there was the tendency for the pre-service teachers to pay greater attention to the assignment of student roles (Item 1b in Table 4.2) than the explanation of skills (Items 1c & 1d). For example, the video teacher devoted the same amount of time to structuring positive role interdependence and establishing interpersonal skills. Yet, only ten of the eighteen pre-service teachers reported events involving explanation of the skills. The establishment of group skills is just as important as structuring positive role interdependence. It could be that the pre-service teachers are not making the distinction between roles and skills, that is, they could be viewing roles and skills as similar, when in fact they are not. This glossing over of the skills could have implications for their teaching practice in that they might stress roles to the exclusion of interpersonal skills.

How pre-service teachers describe video events

Two general patterns were identified in the way pre-service teachers described the events. One group of responses consisted of only observations while the other group of responses contained both observations and interpretations. Table 4.3 summarises the number of teachers' responses containing only observations and those containing both observations and interpretations.

Table 4.3: Classification of pre-service teachers' responses to the sequence tasks

Clip	Title of clip	Number of pre-service teachers' responses (N = 18)	
		Observations only	Observations and interpretations
3	Structuring groups	12	6
4	Monitoring groups	10	8
5	Evaluating groups	16	2
6	Evaluating individuals	18	0

All pre-service teachers' responses contained observations. The following response to clip 3, from Stacy illustrates this finding:

The teacher told the students about the different types of roles that would be use. He gave the function of each (1) timekeeper, recorder, checker, materials manager. He then told the students about the different task skills or co-operative skills, skills that they will learn while carrying out each function. He then allowed the students to start the activity by the collection of their material and set a time frame for them to work within.

Stacy's response focused on what she saw and heard. She provided no interpretation of the events in video.

All but one clip, clip 6 (the final clip) prompted interpretations from the pre-service teachers. Clip 3, the first clip that pre-service teachers worked with caused six of the pre-service teachers to adopt an interpretative stance. However, Clip 4, Monitoring groups, appeared to have generated more interpretations than the other clips in the minds of the pre-service teachers. This could have been as a result of the dilemma-based situation (lack of consensus in the group) that occurred in the lesson. The scenes that unfolded in clip 4 showed student interactions and teacher-student interactions. For the other clips, dilemmas were not explicitly present. Clip 5 on group processing had the potential to generate debate about how the teacher handled students' responses, but this was not explicit in the video. It would appear that when dilemmas are not overtly presented, the possibility for interpretations to be made is low.

The following response from Sandra to clip 3 sequence task is an example of a response that included interpretations (*italicised*) of the video teacher's actions in addition to observations.

The teacher spoke clearly *so that all the students were clear on what he was saying* [italics added]. He ensured that he gave specific roles to members of each group along with informing the class about the function of each role given. He did this in an orderly fashion reinforcing where necessary. He also gave specific direction *to ensure that the students understood what was to be done* [italics added]. The teacher ensured that he spoke in an orderly way *to be more specific* [italics added].

Sandra's response had three instances of interpreting the events in addition to her observations. Her response explained why the teacher did what he did. Like other pre-service teachers' responses that contained interpretations, Sandra's response appears to give some substance to the observed events by accounting for the video teacher's actions through lenses of her prior knowledge and personal experience. Five of the six responses to clip 3 that contained interpretations reported events that did not occur; in other words, they inferred that the event occurred. For example, George started his description with, "Students were placed in small groups." This was not shown in the video, but pre-service teachers who responded like George appear to have had an image of how a normal lesson ought to proceed, and filled in the gaps as they saw fit. Their prior image influenced their perception of the video event.

In summary, a third of the sample reported at least fifty percent of the events in the ideal response. The teachers extracted events that

- a. focused more on teacher actions and less on student actions,
- b. addressed group work rather than classroom management issues and
- c. concentrated more on the assignment of roles rather than group skills.

When describing events, their responses indicate that they tend to make observations rather than interpretations. Reporting what they observed at the beginning stages of the reflection process, rather than giving reasons for what happened is desirable; it is a good starting point for better analysis and reflection on the classroom events.

4.4.2 Identifying co-operative learning features

The multimedia case-based learning environment also comprised a set of questions aimed at finding out pre-service teachers' ideas about the features of co-operative learning. The three features that were addressed in the video component of the multimedia case were: positive (role) interdependence, individual accountability and group processing. The results about the teachers' learning are organised around these three features. See Appendix F1 for details of the questions on the learning task sheet.

Positive interdependence

Pre-service teachers were asked to explain how positive interdependence was structured in video clip 3. Their responses were compared to the ideal response, which had three core elements: (a) assigning roles, (b) explaining roles and (c) stressing the need for students to perform their roles in order for the group task to be successful. Sixteen of the eighteen pre-service teachers responded to this question; thirteen of these responses had elements of the ideal response. Table 4.4 shows the number of pre-service teachers with elements of the ideal response.

Table 4.4: Number of teachers whose responses contain elements from the ideal response for video clip question 3b

Question: How was positive interdependence structured?	
<i>No. of elements from ideal response^a</i>	<i>No. of pre-service teachers (N = 18)</i>
Zero	5
One	3
Two	10
Three	0

Note: ^aMaximum number of elements from ideal response = 3.

Ten of the pre-service teachers' responses reflected up to two of the elements that were present in the ideal response. Nine of these responses identified assigning roles and stressing the importance of performing these roles as indicators for structuring positive interdependence (see Table 4.5).

Table 4.5: Number of teachers' responses with named elements of the ideal response for question 3b

Elements in ideal response	No. of pre-service teachers (n = 13)
1. Assignment of roles	9
2. Explanation of roles	4
3. Emphasise need for each student to perform role well	10

In general, the pre-service teachers focused on the teacher naming the roles to be performed and the need for interdependence in the group.

Lisa's response shows the presence of these two elements, which are in italics:

Positive interdependence was so structured by *assigning tasks* to individuals. One such [task] was that the materials manager was to act as reader. The *success of the group depended on each member*. There was accountability among members of the group. Each member had to display responsibility for the group's performance to succeed.

Lisa's response did not indicate that the teacher explained the roles, an event that many teachers omitted from their responses, see Table 4.5.

Pre-service teachers were also asked to identify the extent to which positive interdependence was in effect in the subsequent video clip, Clip 4. Fourteen of the pre-service teachers were able to apply what they had learnt about positive interdependence in Clip 3 to another clip, Clip 4. Of this fourteen, the five teachers whose responses did not reflect any element of the ideal response showed in their responses for Clip 4 that they had new information on positive interdependence, as they were able to identify evidence of this feature in Clip 4. For example, Andrea said previously that positive interdependence was structured in Clip 3 when the "teacher gave out the aim of each group: that is to work together." Andrea's response made no reference to assigning roles, explaining roles or stressing interdependence. However, after working through the questions (including the review task) in Clip 3, Andrea was able to identify at least one element of positive interdependence at work in Clip 4. She said:

Positive interdependence was working in that they were trying to reach a final consensus. The time keeper was reminding them of the time left.
Recorder takes the final consensus.

Andrea was able to apply ideas about positive interdependence from Clip 3 to a new situation in Clip 4.

In summary, the pre-service teachers' concepts of positive interdependence can be described as sound but limited. At least half of the teachers indicated that they all associate positive (role) interdependence with assigning roles, and stressing need for each student to perform his role in order for the group performance to be successful. However, few are reporting the explanation of roles as part of structuring positive interdependence.

Group processing

Pre-service teachers were asked to identify how group processing was achieved in the fifth video clip. The ideal response centred on group processing being achieved by students discussing among themselves how well they worked together as a group. Thirteen of the eighteen pre-service teachers were able to identify how group processing was achieved. Lisa wrote:

In this lesson segment, group processing is achieved through questioning. The groups were required to answer specific questions about working the group. On a ... form, questions were placed to use to guide their reflection.

They discussed each question, ensured that everyone agreed on a decision before placing answer on paper.

Lisa's response focuses on the students' involvement in group processing. Another trend was identified in the pre-service teachers' responses (see Figure 4.6).

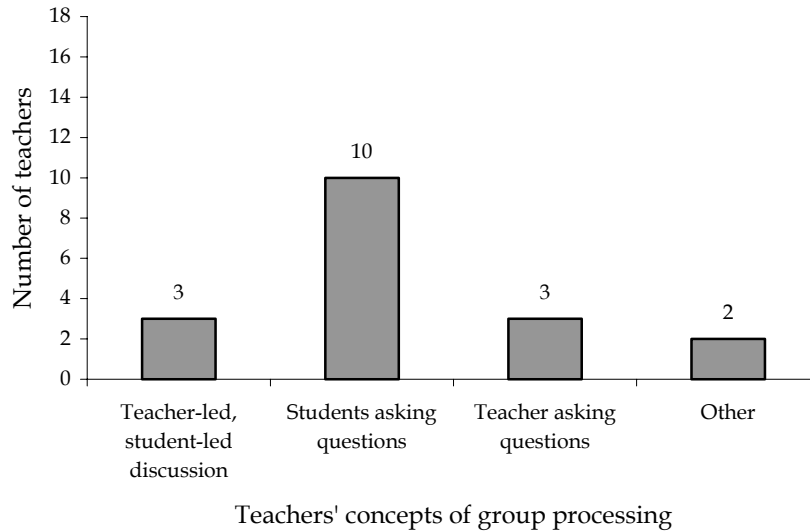


Figure 4.6: Pre-service teachers' concepts of group processing ($N = 18$)

Six of the eighteen teachers included the video teacher's discussion of the group's performance as part of group processing, with three of these teachers referring to both teacher-led and student-led discussions as integral to group processing. Lorna, one of three, wrote:

Students carried out group processing by completing a form, with questions. They discussed each question in the group and come to a conclusion, such as how quietly they worked etc. At the end of that the teacher asked each group to report on how well they worked as a group. When they reported having quarrel, he tried to find out why.

Lorna's response to Clip 5a

This inclusion of the teacher being part of group processing is accepted as correct (Johnson & Johnson, 1999), although the handout on the features of co-operative learning (Appendix A1) did not include the teacher's involvement. It could be that these six pre-service teachers saw the merits of the video teacher discussing students' performance in the whole class and as such deemed the teacher-led discussion essential to group processing.

Pre-service teachers were also asked about the importance of group processing in co-operative learning. The ideal response noted that group processing was important as it:

- a. allows group members to evaluate their effectiveness as learners;
- b. promotes co-operative goal achievement;
- c. promotes individual accountability;
- d. allows groups to plan how they may improve for next task and

Seventeen of the eighteen pre-service teachers responded to this question (see Table 4.6).

Table 4.6: Number of teachers whose responses contain elements from the ideal response for video clip question 5b

Question: What is the importance of group processing in co-operative learning?	
<i>No. of elements from ideal response^a</i>	<i>No. of pre-service teachers (N = 18)</i>
Zero	5
One	9
Two	4
Three	0
Four	0

Note: ^aMaximum number of elements from ideal response = 4.

Of the seventeen, thirteen responses reflected elements of the ideal response. Thirteen pre-service teachers were able to ascribe some importance to group processing. The common concept in their responses was that group processing allows group members to evaluate how well they done. Table 4.7 shows the number of teachers' responses that contained a particular element of the ideal response.

Table 4.7: Number of teachers' responses with named elements of the ideal response for question 5b

Elements in ideal response	No. of pre-service teachers (n = 13)
1. Allows group members to evaluate their effectiveness as learners	8
2. Promotes co-operative goal achievement	4
3. Promotes individual accountability	3
4. Allows groups to plan how they may improve for next task	2

Two pre-service teachers' responses reported that group processing allows groups to decide on improvement strategies. This could have been attributed to the weak display of this aspect in the video lesson, and would have to be interpreted from events in the video, rather than explicitly observed. The four responses that did not reflect elements in the ideal (Table 4.6) focused on group processing being important for the development of communication skills. Note. One pre-service teacher did not respond to this question.

In general the pre-service teachers are gleaned from the multimedia case-based learning environment ideas about group processing, the majority of the responses indicating that this feature involves students assessing how well they worked together as a group.

Individual accountability

The final feature that the multimedia case highlighted was individual accountability. Pre-service teachers were asked how did the teacher structure individual accountability in clip 6. The ideal response to this question was that the video teacher gave each student a worksheet to complete individually. Fourteen of the teachers' responses to this question were similar to the ideal. Their concept of structuring individual accountability in Clip 6 was by asking students to complete a worksheet on their own. The four remaining teachers' ideas were either unclear or did not directly address the question.

Pre-service teachers were asked how important it was for students to be assessed individually. The ideal response contained two elements:

1. Assessing students individually allows them to receive feedback on their progress;
2. Assessing students individually allows the teacher to have information on students' performance (if each person has successfully learnt the material, areas to improve).

Eight teachers' responses had one element of the ideal response. These teachers' responses explicitly stated for whom—teacher or student—the individual assessment was important. For example, Simone noted, "It is important in that it allows the teacher to see whether or not the student has grasped the lesson fully." Simone mentions that the teacher will gain information on students' progress, while George focused on individual accountability being important for the students when he wrote, "It helps them to see how much they gained from the group activity." The remaining ten teachers did not indicate for whom the assessment was important. For example, Daniel wrote that it was important for students to be assessed individually "to ensure that all the members of the group can effectively carry out the task." His response is general and does not elaborate on who will benefit from students being assessed individually.

The pre-service teachers' ideas of individual accountability were not confined to individual student assessment. When asked in which other video segment was individual accountability structured, nine out of sixteen teachers were able to do

so. They identified the assignment of roles in Clip 3 as another way that individual accountability was structured. (Two teachers did not get this question.)

This section has presented results on the pre-service teachers' concepts of three features of co-operative learning – positive interdependence, group processing and individual accountability – after analysing the video clips. The pre-service teachers' ideas were in line with Johnson and Johnson (1999), to some extent. The teachers were able to use what they read about the features in the learning environment, to identify the enactment of features in the video lesson. The potential for the multimedia case to facilitate learning is therefore promising.

4.4.3 Analysing video events

This section is concerned with how pre-service teachers responded to five questions aimed at helping them to analyse video events. The questions were aimed at helping pre-service teachers practice critical thinking, which for this multimedia case involved assessing a situation and suggesting alternatives. The responses fell into three broad categories:

- a. no new information;
- b. new information, no elaboration;
- c. new information, elaboration.

Table 4.8 summarises the categories of responses.

Table 4.8: Classifying responses to five questions in the analyse tasks

Number of pre-service teachers' responses (N=18) showing ...				
<i>Clip number and question</i>	<i>No response</i>	<i>No new information</i>	<i>New information, no elaboration</i>	<i>New information, elaboration</i>
3a	0	0	3	15
3c*	1	12	0	3
4a	0	1	2	15
4b	0	11	4	3
5c	1	4	0	13

Note. The asterisk (*) indicates that only 16 pre-service teachers were provided with this question.

Based on the results in Table 4.8, at least thirteen of the eighteen pre-service teachers are elaborating on their ideas for three of the video clips. They elaborate by using case illustrations, giving examples, giving reasons or considering consequences. Simone's response to the question on the teacher intervention process (question 4a) typifies elaboration of ideas by using case illustrations (italicised).

The teacher intervened at a right time because *group 2 could not reach a consensus* [italics added] and a consensus is important because in order for the *recorder* [italics added] to have the right result. Also they would take a longer time and not being able to finish the task.

Simone's analysis also exemplified another finding. She considered the consequences of no intervention when she noted that the students would have taken a longer time to finish the task response.

Lorna's response to the question asking for another way that the video teacher could have handled the students' answers (question 5c) provided an example to support her ideas. She wrote:

Teacher should have spent more time discussing problems students faced in their groups e.g. Groups said person quarrelled; he could give them hints on avoiding quarrelling the next time around.

Lorna generated an idea, and elaborated on it by giving an example.

For two of the questions 3c and 4b, almost two thirds of the responses in the sample contained no new information. The pre-service teachers, who responded to these questions that asked for alternatives, either agreed with the video teacher's way of handling the situation or offered no new course of action.

In general, the pre-service teachers are elaborating on their ideas by giving examples from their personal knowledge base or case illustrations. The next section presents the results on the Review task, which focused on reflecting on video events.

4.4.4 Role of commentaries in the reflection process

This section presents the results of analysing pre-service teachers' responses to an invitation to reflect. Reflection involves reconstructing initial ideas in light of additional perspectives. With respect to the multimedia case-based learning environment, these additional perspectives were presented in the form of commentaries. Before reflecting, the teachers were asked to read or listen to the comments, review their original responses to the video clip questions and then reflect by framing and reframing their initial ideas (see Figure 4.1 in section 4.2.1 for an example of the Review task).

All eighteen pre-service teachers responded to the invitation to reflect, but their responses indicated that not all incorporated ideas from the commentaries in their response to each video clip question. Table 4.9 shows the two categories of

responses to the Review task for the video clips: (a) responses referring to the commentaries and (b) not referring to ideas from the commentaries.

Table 4.9: Classification of responses to Review task for each video clip

Clip number and question	No. of responses (N=18) not referring to commentaries	No. of responses (N=18) referring to commentaries
3a	16	2
3b	13	5
4 a &b	3	15
5a	16	2
5b	5	13
5c	6	12
6b	1	17

Note. See Appendix I for text of the commentaries.

Four of the seven video clip questions evoked a reference to commentaries from over half of the pre-service teachers. The commentaries on the video clip questions encouraged pre-service teachers to consider the new information, albeit in varying degrees per clip. For example, the comments on video clip questions 4a,b and 6b appeared to have prompted a greater consideration of the commentaries than those made for video clip questions 3a and 5b. Fifteen responses to video clip questions 4a,b referred to the commentaries while only two responses made reference to the comments made on video clip question 3a. This difference in how the pre-service teachers responded across clips could be attributed to the type of questions that teachers were asked. The questions 3b and 5a required pre-service teachers to identify co-operative learning features after they had read about such features. Most of the teachers were able to do identify the co-operative learning features. However, the questions 4a & b, 5b and c, and 6b required the pre-service teachers suggest alternative courses of action to the ones showed in the video and explain the importance of two co-operative learning features. These questions engaged pre-service teachers in higher levels of thinking, and their initial responses did not possess all elements in the ideal response (see section 4.4.2). After reading the commentaries, the teachers included ideas from the commentaries in their responses.

A deeper analysis of their responses revealed that the pre-service teachers used information from the commentaries in one of three ways and consequently three categories of responses emerged which were labelled as: recall, rephrase and reconstruct (Table 4.10).

Table 4.10: Categories of responses considering commentaries

Clip	Total number with comments (N=18)	Categories of responses considering commentaries		
		Recall	Rephrase	Reconstruct
3a	2	0	2	0
3b	5	0	3	2
4 a & b	15	1	11	3
5a	2	1	1	0
5b	13	4	8	1
5c	12	3	5	4
6b	17	3	13	1

The pre-service teachers' responses that were classified as *recall* did not refer to their original statements and either (a) restated the invited comments or (b) indicated an agreement with the comments. For example, question 5c asked pre-service teachers how the video teacher could have handled the students' responses during group processing. Before reading the commentaries, Shauna wrote, "Can't think of anything else." After reading commentaries, she wrote the exact words used by expert, "Students could have been allowed to determine how they could improve their performance for next co-operative group task." Then there were those responses that used the information from the invited comments with some transformation or paraphrasing, but still made no reference to their original views. These responses were classified as *rephrase*.

The third category of responses was called *reconstruct* if there was evidence in the response, implicitly or explicitly, that the pre-service teacher considered his/her original response and reframed his/her ideas in light of the invited comments. Natasha's responses to video clip 5c illustrate this finding. Before reading the commentaries, Natasha wrote, "The teacher could tell them the various solutions to the problems they faced during their group work. After reading commentaries, her response showed signs of reflection when she wrote, "Before offering solutions to problem(s), ask them their opinion on the best way to solve their own problem(s)." Natasha's response showed signs of modifying her initial ideas to incorporate new information. Words such as 'Before offering solutions' indicate a consideration of previously held views, followed by an act of restructuring such views. This response exemplified reflection. A teacher, who previously had no response to the question but formulated an answer in his own words after reading the comments, was also seen to be reconstructing his ideas.

In general, the commentaries are playing a role in the reflection process. For eight of the questions on the video events, commentaries on five of these questions

prompted more than half of the teachers to incorporate ideas from the commentaries in their responses, albeit at rephrase and recall levels, and not the reconstruct level. If the pre-service teachers are recalling and better still rephrasing, they can be seen as being at the penultimate point in the reflection process. Perhaps guidance will be needed to help the pre-service teachers think more deeply about how to integrate the new ideas with their initial ones, through framing and reframing mental processes. The final section discusses in more detail how the multimedia case-based learning environment could be improved to aid teachers in their walk on the road to reflection.

4.5 CONCLUSIONS

The Learning and Reflecting with a Case (LRC) study set out to explore the effects of using the multimedia case-based learning environment in the science methods course. Of particular interest to the study was the case's potential to facilitate learning and reflection. The LRC study sought to find out what do pre-service teachers learn about co-operative learning from the multimedia case, and how the case functions in facilitating reflection. The following paragraphs make conclusions about the multimedia case in these areas.

4.5.1 Learning with a multimedia case

Pre-service teachers' concepts of features co-operative learning reflected those proposed by Johnson and Johnson (1999). With respect to positive interdependence, the general view of the pre-service teachers is that it involves assigning roles and emphasising that the students perform their roles for the success of the group task. The pre-service teachers viewed group processing to a greater extent as students assessing their performance in the groups and to a lesser extent as one that involves the teacher discussing the group's performance. They see group processing to be important for the students as it allows the students to evaluate how well they worked together as a group. The pre-service teachers were able to identify how individual accountability was structured in the video – by giving students a quiz to be performed on their own. The multimedia case facilitates learning of co-operative learning features.

4.5.2 Describing and analysing video events

Pre-service teachers were asked to view four video clips and describe the events as they unfolded. The teachers' responses were analysed to determine what type of events were important to them. When describing video events, pre-service teachers

1. reported more teacher actions and less student actions
2. addressed group work rather than general classroom management issues such as giving duration of activity and praising students
3. concentrated more on the assignment of roles rather than the structuring of group skills.

The pre-service teachers' attention to the video teacher's actions rather than on the students suggests that they could have been more concerned with implementing their role as teachers. They tend to identify with the teacher. This interest in the video teacher's actions is important, as is the focus on the students in the class. In order to help pre-service teachers go beyond looking at what the teacher did, the reflection questions in the video component could encourage the pre-service teachers to think about what the students said and did, and not only the students but also the subject matter and the context (surroundings). Posner (1996) suggests that descriptions should aim to consider the learners, the teacher, subject matter and context.

Pre-service teachers describe events by making observations and/or interpretations. However, the general pattern is that they observe with minimal interpretation. Describing video events at first with observations is a learning outcome in line with the intentions of Posner's framework for reflection. Posner notes that it is helpful to distinguish between description and analysis. This distinction minimises the possibility of pre-service teachers making unexamined assumptions when describing events, without giving themselves the chance to reflect critically on those assumptions.

When analysing video events, the pre-service teachers elaborate on their ideas using varied sources to support their ideas. These sources include their personal knowledge base or case illustrations, which they draw on for examples and explanations.

The components of the reflection framework – describing and analysing – aid the reflection process. Including tasks of this type can help pre-service teachers to hone their observation and analytical thinking skills, and consequently provide them with a foundation for the reflection process.

4.5.3 Reflecting with a multimedia case

An important part of the study focused on finding out how the case functioned in facilitating reflection. Commentaries from experts and the video teacher were integrated into the case-based learning environment. The commentaries positively

influenced the reflection process for less than one third of the sample of pre-service teachers, as these teachers used the information in the commentaries and reframed their initial ideas of the video events. However, the majority of teachers used the commentaries in ways other than to reconstruct their original ideas. These teachers were not seen as having reflected because they did not refer to their original ideas; they did not say whether they had rejected them, modified them or still held on to them. There is a discussion in literature about the use of commentaries, which centres on users of cases suspending their beliefs in favour of the expounded wisdom from experts (cf. Merseth, 1996; Van den Berg, 2001). From this study, it could also be case that the pre-service teachers deferred the revisit and reframing of their ideas when they stated that they simply agreed with the comment without attempting to integrate their personal ideas with those of the expert. This apparent 'discounting' of their personal ideas could be a cause for concern as the commentaries could be deemed as a liability rather than an asset to the reflection process.

This study, however, adopts a more positive outlook not just because of the few who restructured their thinking after hearing the comments, but also because there were pre-service teachers who took the ideas expressed by the experts and the video teacher and rephrased these ideas after considering their original views. Although rephrasing is not reflecting, it is a beginning of the reflection process. This finding suggests that there is the inherent potential for the commentaries to stimulate reflection. Reflection requires time to be fully meaningful and the case-based learning experience lasted for two hours. If there were few pre-service teachers who reflected on the events in two hours, then there is the possibility that more pre-service teachers could develop the practice of reflection. What might be needed to enhance the reflection process is greater scaffolding.

Since most of the teachers are not referring their original ideas, perhaps greater scaffolding is needed. In the future, it might be useful to include on the learning task sheet starter sentences such as "After reading the invited comments, my original ideas... (have changed, are still the same)." Providing sentence stems might stimulate thoughtful reflections or serve as an option for those who need a 'jump start' for the reflection process (Costa & Callick, 2000). In keeping with the long-term goals of this study, one of which includes fostering reflective habits, scaffolds are seen as a useful means to achieve this end. Pre-service teachers need to be encouraged to pen their thoughts on changes made in their thinking, and scaffolds are seen as one way to enhance this part of the reflection process. The multimedia case-based learning environment therefore has the potential to facilitate the practice of reflection in the science methods course.

CHAPTER 5

Effects of multimedia case use on teachers' practice

This chapter describes a study that was conducted to find out if pre-service teachers transfer what they learn from the case-based learning environment to the classroom and if they do transfer, what do they take with them to the classroom. Exploring effects of the case at this level will help to better understand the assertions about multimedia case-based learning being a means by which the gap between theory and practice could be bridged (see Chapter 2). This chapter first presents the aim, research questions, and research approach of the study, which for clarity will be referred to as the Teaching Practice Study. The method is described in section 5.2 and is followed by the data analysis techniques and the framework for presenting the results in section 5.3. The results of the study, which involved four case studies, are presented in sections 5.4 – 5.7. A cross-case analysis is presented in section 5.8. The final section makes conclusions about the effects of multimedia case use on pre-service teachers' practice.

5.1 AIM, RESEARCH QUESTIONS AND RESEARCH APPROACH

The Teaching Practice Study aimed to find out how pre-service teachers used the information they gained from the case-based learning experience in their teaching practice. The study, which followed a case study approach, was guided by the following central research question:

How does the multimedia case-based learning environment affect classroom practice?

Yin (1994) describes a case study as an in-depth investigation of a contemporary phenomenon within its real-life context, especially when boundaries between phenomenon and context are not always distinguishable. For the Teaching Practice study, the contemporary phenomenon was the implementation of a co-operative learning lesson by pre-service teachers (heart of the case) in a real classroom context (boundary of the case). The study sought to gather detailed information about how pre-service teachers implemented co-operative learning after viewing the

multimedia case and how they regarded the influence of the case on their teaching. The case study approach was classified as a collective case study (see Creswell, 2002) as it used four cases to illuminate the issue of the influence of the multimedia case on pre-service teachers' enactment of a co-operative learning lesson.

5.2 METHOD

5.2.1 Setting and participants

The participants for the Teaching Practice Study were eight of the second-year pre-service teachers (4 men and 4 women) who participated in the Learning and Reflecting with Case (LRC) study (see section 4.2). They were selected using convenience sampling. This sampling technique involved asking pre-service teachers if they were willing to be observed when conducting a co-operative learning lesson. Teaching practice at the teachers' colleges requires that pre-service teachers work in pairs. Therefore, four pairs of teachers were observed teaching a lesson, with each pair constituting a case. Table 5.1 summarises the background information on the eight participants.

Table 5. 1: Background data on participants for the Teaching Practice Study

Case	Name (Pseudonym)	Age ^a (yr)
Case 1	1. Sandra	19
	2. Shauna	29
Case 2	3. Samuel	18
	4. Natasha	19
Case 3	5. Karl	23
	6. George	20
Case 4	7. Oliver	20
	8. Naomi	19

Note: ^a Mean = 20.9 and SD = 3.6.

Two participants, Sandra and Oliver had prior teaching experience before they started the diploma programme at the college. The remaining pre-service teachers in the sample were entering the classroom for the first time. Samuel and Natasha were the Double Option students in the sample (see section 1.2).

5.2.2 Procedure and data collection techniques

The Teaching Practice Study took place in four stages (Table 5.2). The participants in the study were asked to indicate to the researcher when they would be using co-

operative learning on teaching practice so that arrangements could be made to observe the lesson. The normal procedure during teaching practice at the colleges is for teacher educators to assist pre-service teachers with planning. For the sake of the study, the researcher adopted that role to ensure that all pairs had similar information during the lesson preparation. Therefore, before conducting classroom observations, the researcher assisted the pre-service teachers with the planning of the lesson. During the planning session, teachers were encouraged to use the *Planning sheet* (Appendix J) in the co-operative learning resource booklet and air any content issues they might have had.

On the day that the pre-service teachers were slated to teach the co-operative learning lesson, the researcher visited the class and observed the teachers conducting the lesson. During each classroom observation, the researcher made notes of the actions of the pre-service teachers and students as they unfolded, as well as descriptions of the physical environment that could have impinged on the implementation process, for example, noise level, shortage of chairs. The lesson was recorded on audiotape to augment the observation notes. The notes from the audio recordings proved useful as they enabled the researcher to capture events that were inadvertently omitted from the observation notes. The recording of one lesson had to be abandoned due to the high levels of noise in neighbouring classes. The researcher played the role of a non-participant observer in all the lessons.

Table 5. 2: Description of the procedure for the Teaching Practice study

Stage	Activity	Approximate time (min)	Data collection technique
1. Planning session	Pre-service teachers plan co-operative learning lesson with researcher acting as facilitator	30	Researcher's notes
2. Classroom observation	Observation of teachers conducting a co-operative learning lesson (n=8)	60-80 (per lesson)	Observation and notes
3. Interview	Researcher interviews pairs of teachers after co-operative learning lesson	30	Interview
4. Teachers' opinions of the case-based learning environment	Pre-service teachers complete questionnaire on the case-based learning environment	20	Evaluation questionnaire

At the end of the lesson, the pre-service teachers were interviewed to determine which aspects of the multimedia case had influenced their teaching. The questions asked varied slightly for each lesson, but in general, they revolved around what the pre-service teachers did, why they did it and the role the multimedia case played in their teaching. For example, they were asked if they recalled any aspect of the multimedia case that informed their action in the lesson. An audio recording was made of the interviews.

Following the three-week teaching practice, the eight pre-service teachers were asked to evaluate the case-based learning environment by completing a questionnaire. The questionnaire, which shall be referred to as *Evaluation questionnaire* (see Appendix K) comprised eight 5-point Likert type items, and focused on the participants' opinions of four components of the multimedia case-based learning environment in general. The four components that the pre-service teachers were asked to comment on were:

- video clips;
- reflection questions;
- commentaries;
- resource booklet – contained information from the Read about it component and the learning tasks in the Review and reflect component.

These four components were highlighted on the evaluation questionnaire because the teachers mainly used these components while working with the case. Time did not allow them to use the other components such as Browse among resources and Journal. Answers to the evaluation questions can serve to provide insights into pre-service teachers' perceptions of the case-based learning environment and how using the case might have affected their teaching practice.

5.3 ANALYSIS AND PRESENTATION OF DATA

5.3.1 Primary data sources

The primary data sources for this study were: (a) researcher's augmented observation notes, (b) transcript of the audio recording of the interview notes, and (c) evaluation questionnaire.

Researcher's observation notes and audio recording of lesson

The observation notes were supplemented with the audio recording of the lesson and a summary of the lesson written and reported. The supplemented notes were

then analysed using a checklist (Appendix L), which featured the five features of a co-operative learning lesson:

- a. structuring positive interdependence;
- b. establishing group skills;
- c. structuring individual accountability;
- d. conducting group processing;
- e. promoting face-to-face interaction.

The checklist provided an opportunity to present an objective summary of the pre-service teachers' lesson.

Interview notes

The interviews conducted after the lesson were transcribed and analysed using coding techniques (Miles & Huberman, 1994). Codes are labels that give meaning to information accumulated during a study. At the start of the analysis, initial codes were developed based on the research questions. The pre-specified codes were: (a) aspects of the case-based learning environment that pre-service teachers mentioned influenced their teaching, (b) aspects of co-operative learning that they remembered from the learning environment but did not enact, (c) reasons for not enacting the co-operative learning they remembered from the multimedia case. The information was further sorted to identify any emerging patterns and in so doing gain deeper insights into how the multimedia case might have influenced their teaching.

Evaluation questionnaire

The data gathered on the evaluation questionnaire were analysed by first noting the pre-service teachers' extent of agreement with the Likert-type items on the components of the case-based learning environment. Their overall opinion was reported as positive, negative or undecided depending on their response to the item. Then, the reasons given for their overall opinions were analysed to see if mention was made about the components that were helpful for teaching practice and enhanced their understanding of co-operative learning.

Within- and cross-case analyses

To assist with making conclusions, the primary data sources were further analysed per case into 'within-case displays' in which judgements were made on the results of the analysis. Comparisons were also made between how the pre-service teachers enacted a specific part of their lesson (e.g., structuring positive interdependence) and what they wrote on the learning task sheet about the video teacher's way of enacting this feature (see LRC study in chapter 4). Such a comparison can help to

determine if what they learned about structuring positive interdependence from the multimedia case influenced their enactment of that part of the lesson. Finally, in search of additional conclusions, a cross-case analysis was conducted.

General framework for presentation of data

For each of the four cases, the findings will be organised around four headings.

- Background information: a description of the environment in which the lesson took place.
- The lesson: the pre-service teachers' implementation of the features of co-operative learning.
- Looking back at the lesson: explanations for why the teachers included and/or excluded certain co-operative learning features.
- Opinions of the case-based learning environment: Components of learning environment that they found useful for teaching practice and their understanding of co-operative learning as a whole.

Each case description concludes with a within-case analysis, in which the general patterns are discussed in order to understand how the multimedia case-based learning environment affected their teaching.

5.4 CASE 1: SANDRA AND SHAUNA'S LESSON

5.4.1 Background

Sandra and Shauna did their teaching practice at a high school for girls. The grade 7 lesson, which was entitled 'Measuring volume of liquids' was taught to a group of 35 students. Sandra taught the lesson while Shauna assisted. This was the second co-operative learning lesson for their teaching practice and it was similar in content and methodology to the video lesson in the multimedia case. Their lesson was conducted in the science laboratory, which was arranged for face-to-face interaction before the students entered the lab. The materials for the activity were delivered late, but that did not prevent the teachers from starting the lesson as soon as the students arrived. The next paragraph summarises how the pre-service teachers conducted the lesson.

5.4.2 Summary of the lesson

Before the lesson began, the pre-service teachers prepared the room by placing a chart with descriptions of roles on the chalkboard. When the students arrived at the door, they were directed where to sit, and role badges given to each student.

Sandra and Shauna introduced the lesson by discussing the concept of volume, and the importance of measuring volume.

Sandra then explained to the students the roles they would be expected to perform in their groups and the duties of the roles. She told the students who were performing the role of materials manager that she had already given out some of materials because time was 'going'. She further asked the students to make as little noise as possible and to indicate when they having a difficulty understanding the task when working in their groups. She then told the students that they were going to start the activity and distributed the group worksheets by walking around to each table. Before the students started to use the worksheet, she asked them to read from a chart on the chalkboard instructions on how to use the measuring cylinder to measure volume and demonstrated to the students on how to take the measurement. The students were then asked to do the group worksheet.

During the group activity, Sandra and Shauna monitored the groups. Sandra intervened during one group's task to deal with a lack of consensus on the volume measurement. After the activity, Sandra asked members of the group at random, questions about measurement. Students were then given an individual task to complete. The pre-service teachers did not provide the opportunity for students to assess their performance as a group, that is, no group processing was done. The checklist in Table 5.3 summarises the co-operative learning features that were observed during the lesson.

Table 5.3: Completed checklist for Sandra and Shauna's lesson

Elements of co-operative learning lesson	Enacted
1. Structures positive interdependence	x
2. Establishes group skills	✓
3. Structures individual accountability	✓
4. Provides opportunity to do group processing	x
5. Arranges classroom to promote face-to-face interaction	✓

Note. The five key co-operative learning features are italicised. The symbol '✓' means yes and 'x' means no.

From Table 5.3, the pre-service teachers implemented three of the five co-operative learning features: group skills, individual accountability and face-to-face interaction. They missed the finer detail of structuring positive interdependence, as they did not stress the importance of the performing roles for the success of the task.

5.4.3 Looking back at the lesson

Sandra, the pre-service teacher who enacted the lesson for the most part, referred to three aspects of the case-based learning environment that she used to inform her practice. These aspects were (a) the use of the roles chart, (b) the way in which the video teacher intervened when a group could not reach consensus, and (c) the commentaries on the teacher intervention process. The roles chart was used to help Sandra explain the duties of each role. Sandra said she got the idea of the roles chart from the video lesson.

While monitoring groups, Sandra encountered a similar situation to one in the lesson video - students could not reach a consensus on the volume of liquid in the measuring cylinder. In dealing with this situation, she drew on the video lesson, and reflections of the video teacher to inform her actions. She said:

I remembered in the video where ... the group was having a problem trying to come to a consensus where volume was concerned of a particular liquid and he was showing them how to do it. But there was this girl around the other side [of the measuring cylinder] and he mentioned that she probably did not know how they came to that measurement because she was around the next side.

In the video lesson, all the students in the group were not directly facing the side of the measuring cylinder with the scale and that probably accounted for the differences in reading. Sandra, recalling the video teacher's reflections, asked all the students to face the scale of numbers and take the reading at eye level.

Sandra and Shauna were asked if they recalled in the video the use of a skills chart or the explanation of skills. Shauna recalled seeing the skills chart but did not remember the video teacher explaining the skills. Sandra did not recall the mention of the skills. Concerning group processing, they intended to enact this feature but did not as the time for the class had ended.

Based on the lesson summary and the interview, the multimedia case influenced the pre-service teachers' enactment of the lesson. They remembered two events from the video and implemented these events. Time constraints prevented them from enacting group processing and distributing materials in way that would have had the students coming to the designated area to collect the materials. One aspect of the case that did not stand out in their minds was the video teacher's enactment of establishing group skills.

5.4.4 Opinions of the learning environment

The pre-service teachers' opinions of the case-based learning environment are presented in Table 5.4.

Table 5.4: Summary of opinions of the components - Case 1 teachers

	General opinion	Elaborated responses			
		Enhanced understanding of co-operative learning		Helpful for teaching practice	
		Sandra	Shauna	Sandra	Shauna
Video clip	Positive	Yes	Yes	Yes	Yes
Reflection questions	Positive	Yes	Yes	-	-
Comments	Positive	-	-	Yes	-
Booklet	Positive	Yes	-	-	Yes

Note. The dash indicates that the teacher did not link these components to their understanding of co-operative learning or teaching practice.

For both pre-service teachers, the video clips improved their understanding of co-operative learning and were helpful for their teaching practice. Sandra wrote that the features such as individual accountability were evident in the video lesson. Sandra noted that she found the commentaries useful as they gave her suggestions for making her class more interesting. Shauna also found the comments useful, but she did not state explicitly if they were useful for teaching practice or her understanding of co-operative learning. She wrote that the comments helped her to compare her response with the experts. The booklet was useful for both teachers. Sandra said that the booklet helped her in another course and Shauna wrote that she used some of the 'pages' for teaching practice.

Both pre-service teachers indicated that they benefited from using the case-based learning environment. Sandra wrote, "The CD-ROM gave me ideas as to how I should arrange my class for instructions on T.P. [teaching practice]." The multimedia case-based learning environment influenced their understanding of co-operative learning and subsequent teaching practice.

5.4.5 Within-case analysis

This section presents a further analysis of the findings reported for Case 1, which is documented in Box 5.1. First a conclusion or interpretation is made on the pre-service teachers' implementation of the co-operative learning features and two other aspects of the lesson – materials distribution and monitoring of groups. This is followed by a description of the type of enactment of co-operative learning

features and other elements of lesson. Two terms are used to describe the enactment– *according to the multimedia case* and *deviated from the case*. The assumption was that the pre-service teachers would enact their lesson as close to the video lesson as possible, with minimal deviations. Based on the results, it was possible to identify two ways in which the teachers enacted various elements of co-operative learning in their lessons. Finally, the influence of the multimedia case on the pre-service teachers' teaching is highlighted.

Box 5.1: Summary of Case 1

Implementation of co-operative learning features	
▪ Structuring positive interdependence	Incomplete; enacted assignment of roles according to the case
▪ Establishing group skills	Yes, deviated from case.
▪ Structuring individual accountability	Yes, according to case.
▪ Conducting group processing	Did not do due to time constraints
▪ Promoting face-to-face interaction	Yes, according to case.
Enactment of other elements of the lesson	
▪ Materials distribution	Smooth, but deviated from case due to time constraints
▪ Monitoring of groups	Good, according to case; used ideas from video teacher's commentary.
Influence of the multimedia case	
▪ Video	Positive, enhanced understanding and influenced practice for both Events deemed influential – role assignment, monitoring of groups for both
▪ Reflection questions	Positive, enhanced understanding for both
▪ Commentaries	Positive, influenced practice for Sandra
▪ Booklet	Positive, enhanced understanding (Sandra) and influenced practice (Shauna)

The pre-service teachers made a good attempt at implementing the co-operative learning features. Although they were teaching a lesson with a topic similar to the one in the video lesson, they did not follow the video lesson to the letter. Sandra deviated from the way materials distribution was portrayed in the video lesson (having students go to a designated area to collect materials) because of time constraints. Instead, she and Shauna distributed the materials. Sandra also deviated from the video teacher's way of enacting group skills due to the apparent low impact of the multimedia case - she did not remember the video teacher addressing group skills. She established skills in the lesson by telling the students the

behaviour for the group skill, although she did not recall skills being addressed in the video. (Sandra's response on the evaluation questionnaire indicated that she was exposed to co-operative learning in another college course.) This lack of recall could be attributed to the design of the case-based learning environment. First, the reflection questions in the learning environment stressed the structuring of positive (role) interdependence and not the establishment of skills, although skills were highlighted with text as it unfolded in the video segment. Perhaps, if there were explicit questions on the establishment of skills, the pre-service teachers might have been more attuned to its importance in the lesson. Another reason for the low impact of skills could be attributed to its positioning in the video segment. The video segment dealing with the establishment of roles and skills was approximately eight minutes in length. Roles were addressed in the first half of the segment, and then skills were featured. Maybe if the segment was divided further into two parts, with one part focusing on roles and the second part on skills, then the possibility that the pre-service teachers would have grasped the significance of skills would have greater.

Based on the observation notes, interviews and pre-service teachers' evaluation of the case-based learning environment, it can be interpreted that the multimedia case-based learning environment had a positive influence on the pre-service teachers' practice. The pre-service teachers value particular components for different reasons. Both pre-service teachers had positive opinions of the components of the case-based learning environment. They found that the video lesson, booklet and reflection questions enhanced their understanding of co-operative learning, while the first two components were helpful for their practice. Sandra found that the commentaries influenced her practice. J. Shulman (1992) regards commentaries as an important component in case-based learning environments as they provide multiple perspectives on a particular issue and can suggest alternate strategies. The commentaries from the video teacher and teacher educator in the MASTER-Jam case served these purposes for Sandra and influenced her practice in a positive way.

Three scenes from the video lesson registered more strongly than others in the pre-service teachers' minds and consequently were stressed in the lesson. Assigning roles, monitoring groups, and structuring individual accountability were identified as events that they drew from the video lesson and were clearly established in their lesson. For Sandra, the monitoring and intervening in groups by the video teacher and his subsequent reflection on his actions made an indelible impression on her mind. In the interview she recalled the video teacher's reflective comments on the way he intervened in the groups and used his suggestions for improving the

intervention process to inform her practice. Although monitoring and intervening in groups was not billed as part of the five-feature model, it was seen as a substantive feature for Sandra and an unanticipated learning outcome for the researcher. Lobato (2003) affirms that what experts consider a surface feature may be structurally substantive for a learner.

The multimedia case-based learning environment helped the pre-service teachers to enact certain features of co-operative learning. They found it beneficial and could identify particular components that informed their practice. However, a causal relation between multimedia case and enactment cannot be drawn, because amongst others, co-operative learning is a topic that is covered in other courses of the teacher education programme.

5.5 CASE 2: SAMUEL AND NATASHA'S LESSON

5.5.1 Background

Samuel and Natasha's Grade 7 lesson was entitled 'Grouping things' and was conducted with 36 students. The lesson was observed in two sittings because on the first day, time for the class ended before the lesson was completed. The lesson was conducted in the science laboratory of a co-educational high school. Some students had to take chairs to the laboratory because of insufficient stools in the laboratory. The pre-service teachers had to ensure the students were settled before starting the lesson.

5.5.2 Summary of the lesson

Samuel began the lesson by introducing the concept of grouping things and then proceeded to discuss how things can be grouped. The co-operative learning segment of the lesson followed. Samuel told the students that they would be placed in groups of six. He invited a member of each group to come to the teacher's table and collect the materials. He then told the students the three roles that should be performed in their six-member group. Natasha intervened at this point, and said five students in the group will have roles to play and then proceeded to discuss the duties of each role with the students. She asked at random students from the groups to explain their role. The roles were not placed on the chalkboard or a chart. Natasha also explained the task to the students. Before the students could begin the group activity, the time for the class ended and the activity had to be continued in the next lesson. (There was a misunderstanding about the dismissal time for the lesson.)

The following week, Natasha placed the students in groups and then Samuel explained the group activity. The task was written on the chalkboard, along with the roles and reporting format for the activity. Students were asked to go a designated area, one by one, and collect a role badge (card with name of role). After collecting the role badge, the students carried out the activity, during which the pre-service teachers monitored the groups and intervened when they thought it necessary. At the end of the activity, Samuel and Natasha asked the students to return the materials to the teacher's table. Samuel then called on students at random to report their results from the group activity. The pre-service teachers did not ask the students to assess how well they worked together as a group; in other words, no group processing was done. Table 5.5 summarises the co-operative learning features present in the lesson.

Table 5.5: Completed checklist for Samuel and Natasha's lesson

Features of co-operative learning lesson	Enacted
1. Structures positive interdependence by	✓
2. Establishes group skills	x
3. Structures individual accountability	✓
4. Provides opportunity to do group processing	x
5. Arranges classroom to promote face-to-face interaction	✓

Note. The five key co-operative learning features are italicised. The symbol '✓' means yes and 'x' means no.

The pre-service teachers implemented three of five co-operative learning features. Natasha structured positive interdependence in its entirety by explaining the duties of the roles and stressing the importance of each student performing the roles for the success of the group. The two features, individual accountability and arranging students to promote face-to-face interaction were also enacted in the lesson.

5.5.3 Looking back at the lesson

After the first lesson, two aspects of the lesson were discussed with the pre-service teachers: (a) assignment of roles and (b) establishing interpersonal skills. Samuel and Natasha were asked if they remembered seeing a roles chart being used in the video. They both said that they saw the chart in the video lesson, but they did not make one or put the roles with the duties on the chalkboard. This issue was raised with the pre-service teachers because the role assignment process and subsequent structuring of positive interdependence did not proceed smoothly at first. In the lesson summary, it was noted that Natasha intervened when Samuel was assigning roles. She was asked why she did this. She said that she intervened because (a) the idea of positive interdependence was not coming out and (b) examples of duties for

each role were not forthcoming. She therefore took over the lesson, explained the roles, and asked the students for suggestions about the duties of each role, rather than telling the students about the roles that they would be expected to perform. Natasha said that her case-based learning experience helped her to structure positive interdependence in a student-centred way.

The pre-service teachers were next asked if they remembered the establishment of interpersonal skills in the video lesson, as they did not implement this feature. Both said that they remembered the skills chart. Natasha intimated that they needed more time to establish the skills. She would have preferred to use the first session to explain the skills, roles and the next session to do the activity.

After teaching the second lesson, Samuel was asked to give his impressions on how the lesson went. He said that he felt the lesson was more organised than the first lesson, having prepared role badges, and placed the roles and corresponding duties on the board while he was explaining the roles. Because Samuel handled the materials distribution differently from the video in the multimedia case, he was asked if he remembered how the video teacher enacted this element of the lesson. At first, he said he did not recall, but when prompted with a description of how it began in the video, he was able to relate the process. His reason for asking students to go one at a time to a designated area to collect a role badge was to prevent them from "arguing about who is supposed get what [a particular role]." Natasha remembered how the materials were distributed in the multimedia case. Upon reflection, Samuel said that the video teacher's method of distribution was better as it would have prevented the confusion experienced in his lesson. Both of the pre-service teachers recalled how group processing was done on the video, but group processing was not done in lesson. They said that the form with questions to help students evaluate their performance in the group was prepared, but copies were not made in time for lesson.

Based on the observation notes and the interviews, the pre-service teachers do remember the events in the video lesson of the multimedia case. They enact certain features according to the case – face-to-face interaction, structuring positive interdependence (Natasha) and deviate from how certain elements were enacted in the video lesson of the multimedia case – material distribution, role assignment (Samuel). They also omit features such as establishing skills and group processing due to time constraints and technical difficulties respectively.

5.5.4 Opinions of the learning environment

The pre-service teachers' opinions of the multimedia case-based learning environment are presented in Table 5.6.

Table 5.6: Summary of opinions of the components - Case 2 teachers

	General opinion	Elaborated responses			
		Enhanced understanding of co-operative learning		Helpful for teaching practice	
		Samuel	Natasha	Samuel	Natasha
Video clip	Positive	-	Yes	Yes	Yes
Reflection questions	Undecided	-	-	-	-
Comments	Positive (Samuel)	-	-	-	-
Booklet	Positive	-	-	Yes	-

Note. The dash indicates that the teacher did not link these components to their understanding of co-operative learning or teaching practice.

Both pre-service teachers wrote that the video component was helpful for teaching practice, but only Samuel regarded the resource booklet as useful being useful for his practice. He wrote, "When preparing for my co-operative learning class, I used it to make certain adjustments to my preparations." Natasha saw the booklet as a resource that reinforced what was on the video. The teachers viewed the commentaries differently. Natasha was undecided about their usefulness. She said that the comments "basically said the same things" she was thinking. For Samuel, the comments provided "an expert point of view" and allowed for comparison between his views and those expressed in the commentaries, before he made conclusions. Both teachers said that they benefited from using the case-based learning environment, with Samuel reiterating that he applied some of the things he saw in the multimedia case in his co-operative learning class.

The teachers share the view that video component was helpful for their practice but differ in their opinions about the effects of the other components on their knowledge of co-operative learning and their practice. It is interesting that Samuel said the booklet helped him on teaching practice but did not refer to the booklet influencing his understanding of co-operative learning. Perhaps Samuel perceived the booklet to be a practical resource that contained sample worksheets for his lesson rather than a direct resource for influencing his understanding.

5.5.5 Within-case analysis

The multimedia case-based learning environment influenced the pre-service teachers' practice in different ways. Box 5.2 summarises how the case-based learning environment affected the pre-service teachers' practice.

Box 5.2: Summary of Case 2

Implementation of co-operative learning features	
▪ Structuring positive interdependence	Yes, according to the case
▪ Establishing group skills	No
▪ Structuring individual accountability	Yes, according to case
▪ Conducting group processing	Did not do due to technical difficulties
▪ Promoting face-to-face interaction	Yes, according to case
Enactment of other elements of the lesson	
▪ Materials distribution	Not smooth at times, enacted according to case in first lesson, deviated from case in second lesson
▪ Monitoring of groups	Yes, according to case.
Influence of the multimedia case	
▪ Video	Positive, enhanced understanding (Natasha) and influenced practice Events deemed influential – structuring positive interdependence (Natasha)
▪ Reflection questions	Undecided
▪ Commentaries	Positive, but no reference to understanding or practice
▪ Booklet	Positive, influenced Samuel's practice

From Box 5.2, Natasha implemented features--structuring positive interdependence, promoting face-to-face interaction--in a manner similar to the video teacher, while Samuel deviated from the case when distributing materials and assigning roles. His reasons for deviating from case with respect to distributing the role badges were plausible – he wanted to avoid the situation where students would arguing over their which role to perform. Individual accountability was evident in the lesson. The pre-service teachers felt that they needed more time to address the establishment of skills in the lesson.

There were two components of the multimedia case-based learning environment that influenced pre-service teachers' understanding of co-operative learning and ultimately their practice - the video component and the resource booklet. The video

component was deemed instrumental in helping the pre-service teachers enact cooperative learning while for Samuel, the booklet helped him in his preparations for his lesson.

It is indeed a challenging endeavour for the beginning pre-service teachers to incorporate Johnson and Johnson's five-feature model. Their teaching practice experience is a first for them and they make a good attempt at enacting the features, but have reasons for either not enacting certain features or enacting some of features differently from the case. The multimedia case does affect their teaching in ways that result in a successful enactment of certain features and unsuccessful implementation of others.

5.6 CASE 3: GEORGE AND KARL'S LESSON

5.6.1 Background

George and Karl taught a Grade 7 lesson entitled *Grouping things*. The lesson was conducted in a science laboratory with 48 students in a co-educational high school. The laboratory had large tables and stools, with tables accommodating at least eight students. The pre-service teachers had to compete with noise from neighbouring classrooms when they were conducting the lesson.

5.6.2 Summary of the lesson

George and Karl conducted a brief introductory activity and then asked the students to arrange themselves in groups of four. The class was noisy at this point and Karl asked the students to "keep the noise level down". George told the students the roles and the duties that they were expected to perform in their groups. The materials managers from each group were asked to go to the teacher's table and collect the activity sheet. George urged the students to read about the duties of their roles, which were on the group activity sheet. Amidst the high noise level in the class, George explained the task, which involved going outdoors to classify things in the environment. Karl added that a member of the group should read the instructions for the activity. Both pre-service teachers entertained questions about the activity from the students and then asked them to go outdoors and identify living and non-living things in the environment. The pre-service teachers monitored the groups of students during the task. Some students were observed working alone, writing down their findings.

After students returned to the classroom, Karl asked one member of each group to report their findings, that is, what they identified as living and non-living things. Again, the noise level was high, and Karl asked students to 'pay attention'. The next stage of the lesson saw Karl leading a discussion with the students about the characteristics of living things, while George moved from group to group to examine students' work. At the end of the discussion, Karl asked the students to write down notes from the chalkboard in their books. The materials managers were asked to return the worksheets to the teacher. No group processing was done. Table 5.7 summarises co-operative learning aspects of George and Karl's lesson.

Table 5.7: Completed checklist for George and Karl's lesson

Elements of co-operative learning lesson	Enacted
1. Structures positive interdependence by	x
2. Establishes group skills	x
3. Structures individual accountability	✓
4. Provides opportunity to do group processing	x
5. Arranges classroom to promote face-to-face interaction	✓

Note. The five key co-operative learning features are italicised. The symbol '✓' means yes and 'x' means no.

The pre-service teachers implemented two of the five co-operative learning features in the lesson: individual accountability and face-to-face interaction. After the lesson, the teachers were interviewed to better understand why they implemented the lesson the way they did.

5.6.3 Looking back at the lesson

The interview focused on the assignment of roles and interpersonal skills. During the interview, the teachers were asked if they recalled where the video teacher used charts and what these charts were about. George remembered the video teacher using charts to explain "roles like the record keeper, checker..." and he added, "He [video teacher] spent a good while explaining it." He vaguely remembered the video teacher using a chart with skills. The teachers were asked why they did not use the charts. Karl said that the duties of the roles were included on the activity sheet rather than a chart. George said that he used the activity sheet to save on time, as he "wanted to get on with the lesson." George said that he did not spend much time explaining the individual roles, because he thought that it was "just enough" to have the duties of the roles written on the worksheet.

The teachers were asked why they did not address the performance of skills. Karl said that he did not "fully explain the skills." He said, "I went to each group and I

told them that they were to work together, but I didn't address the class on a whole...I did it individually." Although the pre-service teachers remembered how group processing was done in the video, they did not implement this feature due to time constraints. When asked if there was any aspect of the video lesson that stood out in their minds and that they used to inform their practice, Karl and George referred to the video teacher's monitoring of the groups and intervening. The pre-service teachers said that they intervened, when some of the students were having conflicts and they tried to help the students individually. The pre-service teachers remember aspects of the video lesson in the multimedia case, but they implement these aspects differently because of time and classroom management concerns.

5.6.4 Opinions of the learning environment

The pre-service teachers were asked to give their opinions about specific components of the multimedia case-based learning environment as well their overall opinion of the learning environment. Table 5.8 presents a summary of their opinions of the four components they largely used.

Table 5.8 Summary of opinions of the components - Case 3 teachers

	General opinion	Elaborated responses			
		Enhanced understanding of co-operative learning		Helpful for teaching practice	
		George	Karl	George	Karl
Video clip	Positive	Yes	Yes	Yes	Yes
Reflection questions	Positive	Yes	Yes	-	-
Comments	Positive	Yes (Expert)	Yes (Expert)	-	-
Booklet	Positive	Yes	Yes	-	-

Note. The dash (-) indicates that the teacher did not link these components to their understanding of co-operative learning or teaching practice.

The video was seen as an essential component for influencing both pre-service teachers' understanding of co-operative learning and teaching practice. Karl wrote, "It shows me ways in which I can have them actively involved in the lesson." George said he found the booklet useful as it acted as a guide "as to what should be involved in co-operative learning." Although the reflection questions and the comments were considered to be useful in enhancing the pre-service teachers' understanding of co-operative learning, the influence of these components did not extend to their practice. They both mentioned that they found the multimedia case-based learning environment a beneficial medium, as they were able to implement a co-operative learning lesson.

5.6.5 Within-case analysis

The main results of George and Karl's case are summarised in Box 5.3.

Box 5.3: Summary of Case 3

Implementation of co-operative learning features	
▪ Structuring positive interdependence	No, only told students roles and explained duties on paper
▪ Establishing group skills	No, not with whole class
▪ Structuring individual accountability	Yes, according to case but weak
▪ Conducting group processing	Did not do due to time constraints
▪ Promoting face-to-face interaction	Yes, according to case
Enactment of other elements of the lesson	
▪ Materials distribution	Yes, smooth and enacted according to case
▪ Monitoring of groups	Yes, according to case
Influence of the multimedia case	
▪ Video	Positive, enhanced understanding and influenced practice Events deemed influential – Monitoring of groups
▪ Reflection questions	Positive, enhanced understanding
▪ Commentaries	Positive, expert comments aided understanding
▪ Booklet	Positive, aided understanding

The pre-service teachers' overall enactment of co-operative learning features was weak. They enacted two features--individual accountability and face-to-face interaction--according to the case but deviated deliberately from the case when attempting to structure positive interdependence and establish group skills. The pre-planned deviations, though done with reason, downplayed the co-operative learning aspects of the lesson. George and Karl's lesson hardly resembled a co-operative learning lesson because for much of the time the students were engaged in individual work. A re-examination of their classroom context helps to understand the reasons for deviating from the case - they had to cope with over 40 students in a noisy environment. When in such situations, a pre-service teacher wants to "get on with the lesson", as George puts it.

This statement by George, though, raises another issue as it suggests that he places more emphasis on the content rather than organising the co-operative learning experiences for the students. Perhaps the pre-service teachers were not won over

by the benefits of co-operative learning. The multimedia case-based learning environment addresses the benefits of co-operative learning but it is possible that these pre-service teachers did not get a chance to examine this part of the case. Maybe they would have spent more time organising co-operative learning if they were convinced of the benefits. Another issue that has emerged from the analysis is the mismatch between topic of the pre-service teachers' lesson and the co-operative learning approach. The multimedia case did not address the suitability of topics for co-operative learning, an omission that might have resulted in the pre-service teachers' weak attempt at organising the co-operative learning in their lesson.

All the components that the pre-service teachers used were instrumental in facilitating a better understanding of co-operative learning, but only the video was considered to directly influence their practice. They were selective in what they extracted from the video and further adapted what they learnt about the co-operative learning features to suit their teaching context.

5.7 CASE 4: OLIVER AND NAOMI'S LESSON

5.7.1 Background

Oliver and Naomi co-taught a Grade 8 lesson entitled 'Movement of water in plants'. The lesson was not conducted in a four-walled classroom, but was held in an open area, with a roof (similar to a veranda, but with no walls). There were other classes on either side of the pre-service teachers' class area. Classes were separated from each other by chalkboards. The surrounding noise level was extremely high and at times, it was difficult to hear teachers and students. In spite of these drawbacks, the lesson proceeded as planned.

5.7.2 Summary of the lesson

Naomi and Oliver placed the students in groups of four and ensured that each group had two boys and two girls where possible. Students were seated facing each other. While Naomi was organising the students in groups, Oliver went around to the groups and distributed the role badges. Naomi placed a chart with a list of roles on the chalkboard. She then explained the roles to the students. She asked the students from each group who had the role of reader to stand and read aloud from the chart the duties of their role. Naomi then asked the readers to go to Oliver and collect the instruction sheet for the group task. She then asked all the students from each group who had the role of materials manager to stand and read

aloud their duties from the chart. After reading their duties, Naomi asked the materials managers to go to Oliver to collect the materials for the task: the plant and coloured liquid. She dealt with the other roles--timekeeper and checker--in a similar fashion, that is, asking students with a particular role to stand and read their duties from the chart. Naomi talked about the importance of students performing their roles. This was seen as a way of structuring positive interdependence.

Neither Naomi nor Oliver explicitly emphasised the display of skills, however, Naomi told the students that they must work quietly in the groups. During the activity, all the students were asked to write up the activity in their lab books. Both teachers monitored the groups and intervened predominantly to explain content-related matters, such as how to write up the activity. Naomi told the students that she does not know whose book will be collected so everybody should complete the task. Next, Naomi asked one person from each group to report their findings, and then asked each group to submit one book. No group processing was done. See Table 5.9 for a summary of the co-operative learning features displayed in the lesson.

Table 5.9: Completed checklist for Oliver and Naomi's lesson

Elements of co-operative learning lesson	Enacted
1. Structures positive interdependence	✓
2. Establishes group skills	✓
3. Structures individual accountability	✓
4. Provides opportunity to do group processing	x
5. Arranges classroom to promote face-to-face interaction	✓

Note. The five key co-operative learning features are italicised. The symbol '✓' means yes and 'x' means no.

The pre-service teachers implemented four of the five features in spite of the difficult context with its cramped class area and noise from neighbouring classes. They captured the essence of the co-operative learning in their lesson.

5.7.3 Looking back at the lesson

Naomi and Oliver were asked to elaborate on three aspects of the co-operative learning lesson: (a) materials distribution, (b) interpersonal skills, and (c) group processing. In the lesson, Oliver distributed the materials by placing the different role badges on the desk of each student, while Naomi was organising the students in groups. This action was a bit distracting as students attention was diverted from

Naomi to Oliver. The pre-service teachers were first asked if they recalled how the video teacher distributed the materials in the video lesson. Both pre-service teachers remembered that video teacher called the students to his table and had them collect the materials. When asked to explain why they distributed the materials the way they did, Omar justified his action by saying, "these students are a bit different." He felt that "it would cause confusion" if the students had left their seats to come and collect the materials. Naomi attributed Omar's actions to the small size of the class area. She said:

It's not like an indoor classroom, so because it's outside and it's just separated by blackboards, it is so small, so we don't have enough space at the table as you can see, that the class is so clustered, we don't have enough space.

During the lesson, it was observed and recorded that interpersonal skills were not explained. The pre-service teachers were also asked to why they did not explain the interpersonal skills. In Naomi's mind, she had explained the skills. Naomi said, "I told them that they should work quietly and work together and should they understand each other, and everybody should come to one conclusion." She mentioned in the interview that maybe the skills should have been written on a chart. (In the video lesson, the video teacher stressed that the students should try to develop certain skills needed for the effective functioning on the group. These skills were written on a chart, which was placed on the chalkboard.) Concerning the absence of group processing in the lesson, Naomi said that she intended to do it, but the time for the class had ended.

The pre-service teachers were asked if there were any ideas in the video that they used to help them conduct the lesson today. Naomi referred to the video teacher's explanation of the duties associated with each role. She said, "I like that and I think that contributed a lot." She was asked where she got the idea of having the students stand and read their roles (this was not done in the video). She said, "I just had it there because they were making so much noise and I just wanted to get their attention so I just asked them. I just got it right there where I was standing." Omar said that the video teacher's intervening and monitoring of the groups stood out in his mind, and as such, he was walking around and looking at what the students were doing. He added, "Well if they weren't doing anything, I ask questions, because they supposed to be doing something. So I got that aspect of it."

The pre-service teachers gained information from the video lesson in the multimedia case-based learning environment and used this information to guide

their practice. Each pre-service teacher considered different aspects of the video lesson that were important to them and tried to develop on those aspects in their practice. For Naomi, the explanation of roles appealed to her. She did it in a manner similar to the video teacher. For Omar, it was the video teacher's monitoring of groups. However, they were observed deviating from the case when enacting certain features. Although they remember how the features were done in the video, factors such as limited time and cramped classroom space, prevented implementation of certain features according to the case.

5.7.4 Opinions of the learning environment

Pre-service teachers' responses to the questions on the evaluation questionnaire on specific components of the multimedia case-based learning environment are summarised in Table 5.10.

Table 5.10: Summary of opinions of the components - Case 4 teachers

	General opinion	Elaborated responses			
		Enhanced understanding of co-operative learning		Helpful for teaching practice	
		Oliver	Naomi	Oliver	Naomi
Video clip	Positive	Yes	Yes	Yes	Yes
Reflection questions	Positive	Yes	Yes	-	-
Comments	Positive	Yes	Yes	-	-
Booklet	Positive	Yes	-	-	Yes

Note. The dash (-) indicates that the teacher did not link these components to their understanding of co-operative learning or teaching practice.

All four components were regarded as being beneficial for the pre-service teachers' learning experience. The recurring theme in their responses was the impact that the components had on their understanding of co-operative learning and subsequent teaching practice. The commentaries affected Naomi and Oliver differently. Whereas Naomi regarded both the commentaries from the expert and the video teacher as being helpful, Oliver reported that only the expert comments were helpful. For him, the video teacher's comments were not helpful, as "the experts had already cleared up the mistakes." Oliver reported that the video clips helped him to use the approach to some extent. Naomi's response struck a chord with Oliver's opinion when she wrote, "I benefited a lot as it helped me on my teaching practice on how I should organise my lesson and class." The pre-service teachers' opinions of the multimedia case-based learning environment are positive.

5.7.5 Within-case analysis

The main results of Oliver and Naomi's case are summarised in Box 5.4.

Box 5.4: Summary of Case 4

Implementation of co-operative learning features	
▪ Structuring positive interdependence	Yes but partly according to the case
▪ Establishing group skills	Yes but inadequate
▪ Structuring individual accountability	Yes, according to case
▪ Conducting group processing	Did not do due to time constraints
▪ Promoting face-to-face interaction	Yes, according to case
Enactment of other elements of the lesson	
▪ Materials distribution	Not smooth at times, enacted according to case for part of the lesson, deviated from case for other parts.
▪ Monitoring of groups	Yes, according to case.
Influence of the multimedia case	
▪ Video	Positive, enhanced understanding and influenced practice Events deemed influential – structuring positive interdependence (Naomi), monitoring of groups (Oliver)
▪ Reflection questions	Positive, enhanced understanding
▪ Commentaries	Positive, enhanced understanding (Oliver found only expert commentaries helpful.)
▪ Booklet	Positive, enhanced Oliver's understanding and influenced Naomi's practice

The pre-service teachers made a very good attempt at implementing the co-operative learning features in the lesson. All the aspects were enacted according to the case either fully or partly. Any deviations enacted were done with good reason, with one aspect, assigning roles being enacted with on-the-spot creativity. Both pre-service teachers realised that although the video teacher enacted the lesson in a particular way, they could not follow the lesson faithfully due to differences in their classroom situation – outdoor classroom, time constraints and high noise level from surrounding classrooms. Their deviations, which were both deliberate and unintentional, were driven by complexities of the real classroom. Nevertheless, the

multimedia case made an impact on them in such a way that they did not lose the quintessence of the co-operative learning features in their lesson. They regarded the video component of the learning environment as instrumental in enhancing their understanding of co-operative learning and affecting their practice. For pre-service teachers with little (Oliver) and no (Naomi) teaching experience, they did a good job of enacting the lesson.

5.8 CROSS-CASE ANALYSIS

This section presents the cross-case analysis. The data obtained in the teaching practice study for the four pairs of pre-service teachers will be compared and contrasted. The analysis focuses on pre-service teachers' implementation of the co-operative learning lesson, the components of the case that influenced their teaching and their opinions of the components of the case-based learning environment.

5.8.1 Implementation of co-operative learning

Pre-service teachers were exposed to the features of co-operative learning in the case-based learning environment (chapter 4). How they used the information that they gained varied also across cases. Table 5.11 summarises their enactment of the essential elements of a co-operative learning lesson. The essential elements include the five (primary) features the Johnson and Johnson model and two other elements, materials distribution and monitoring of groups, which are referred to as secondary features in Table 5.11.

The aim of the multimedia case-based learning environment was to present a model of how co-operative learning could be organised in a real-life classroom. The assumption was that the multimedia case would be so compelling that that pre-service teachers would faithfully enact the elements of co-operative learning they observed and reflected on in the multimedia case in their classroom. However, this assumption was challenged as the analysis of the four cases showed that the enactment of the elements of co-operative learning took place not only according to the multimedia case but also with deviations (Table 5.11).

Table 5.11: Description of pre-service teachers' enactment of the lesson

Elements of a co-operative learning lesson	Case 1	Case 2	Case 3	Case 4
<i>Primary features</i>				
Positive interdependence	Not enacted; only explained roles	According to case	Not enacted; only assigned roles	According to case
Group skills	Deviation (Unintentional)	Not enacted	Not enacted	According to case
Individual accountability	According to case	According to case	According to case	According to case
Group processing	Not enacted	Not enacted	Not enacted	Not enacted
Face-to-face interaction	According to case	According to case	According to case	According to case
<i>Secondary features</i>				
Materials distribution	Deviation (Deliberate)	Deviation at times (Deliberate)	According to case	Deviation at times (Deliberate)
Monitoring groups	According to case	According to case	According to case	According to case

Three elements of co-operative learning were implemented according to the multimedia case: individual accountability, face-to-face interaction and monitoring groups. However, the enactment of two aspects took place with deviations from the case: structuring positive interdependence and the distribution of materials. Deviations were both deliberate and unintentional, with deliberate deviations being either impromptu or carefully thought out before the lesson. Unintentional deviations occurred when there was no recall of how a feature was enacted in the case-based learning environment.

The pre-service teachers' departure from the case can be seen as a way of coping with their new classroom context, which confronted them: a large class size, noise from surrounding classes, and an urgency to complete the teaching of the lesson in the allocated time frame. When placed in novel situations, pre-service teachers tend to resort to a teaching style that affords them control over their class. To relinquish control and invite questions might have impinged on the time allocated for the lesson. Time management, teaching expected lessons and classroom management have been noted as some of pre-service teachers' procedural concerns on teaching practice (Moore, 2003).

Group processing was the only co-operative learning feature that was not enacted across the four cases. The recurring reason for this feature not being enacted in three of the cases was, not surprisingly, the lack of time in the lesson. It was expected that time constraints might have prevented group processing from being enacted in the lesson as time was used to not only address subject matter but also the organisation of learning experiences by structuring groups and promoting face-to-face interaction. It must have been challenging for the beginning teachers to attempt to implement the five primary features of co-operative learning in the given time frame, so the absence of this feature in the lesson observed is understandable.

Establishing group skills was the other feature that was not enacted because of time constraints for two cases and was addressed with little emphasis by the other two cases. It was anticipated that this feature might not have been addressed adequately on practice, as it was not stressed in the video component of the case-based learning environment. Although the event--establishing skills--was highlighted with text as it was unfolding in the video lesson, no reflection questions were formulated to speak directly to this feature. This omission in the design of the learning environment impinged on the pre-service teachers' learning and subsequent practice. In spite of the deviations and the inadequate implementation of certain elements, the pre-service teachers attempted the full and part enactment of some of the elements of co-operative learning in their lesson, a feat that is challenging even for professional teachers.

5.8.2 Influence of components

The pre-service teachers' worked with specific components when using the case-based learning environment. Table 5.12 summarises the components that the pre-service teachers in all four cases perceived to influence their understanding of co-operative learning.

For three of the four cases, the pre-service teachers considered the video clips and the reflection questions helpful in facilitating a better understanding of co-operative learning. The pre-service teachers' perceptions of the role that the comments and the booklet played in enhancing understanding differ across cases.

Table 5.12: Case components that facilitated understanding of co-operative learning

	Case 1		Case 2		Case 3		Case 4	
	Sandra	Shauna	Samuel	Natasha	George	Karl	Oliver	Naomi
Video clips	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Reflection questions	Yes	Yes	-	-	Yes	Yes	Yes	Yes
Comments	-	-	-	-	Yes (Expert)	Yes (Expert)	Yes (Expert)	Yes
Booklet	Yes	-	-	-	Yes	Yes	Yes	-

Note. The dash (-) indicates that the component was not considered by the pre-service teachers to have influenced their understanding.

Only two cases regarded the comments as useful, particularly the expert comments. The expert comments are valued over the comments from the video teacher. The booklet was seen to be useful resource for pre-service teachers in three of four cases. For at least three of the four cases, three components are facilitating a better understanding of co-operative learning: video clips, reflection questions and the booklet.

The pre-service teachers also noted components that made an impact on their practice. Table 5.13 summarises the components that were considered by the pre-service teachers in all four cases to influence their practice.

Table 5.13: Case components that influenced practice

	Case 1		Case 2		Case 3		Case 4	
	Sandra	Shauna	Samuel	Natasha	George	Karl	Oliver	Naomi
Video clips	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reflection questions	-	-	-	-	-	-	-	-
Comments	Yes	-	-	-	-	-	-	-
Booklet	-	Yes	Yes	-	-	-	-	Yes

Note. The dash (-) indicates that the component was not considered by the pre-service teachers to have influenced their practice.

For all the cases, the video was the only component of the multimedia case-based learning environment that influenced pre-service teachers' enactment of the co-operative learning lesson. Different events from the video made an impact on the pre-service teachers and influenced their teaching (Table 5.14).

Table 5.14: Video events that had a positive impact on practice

	Case 1	Case 2	Case 3	Case 4
Structuring positive interdependence	Yes (Sandra); but only assigning roles	Yes (Natasha)	-	Yes (Naomi)
Establishing skills	-	-	-	-
Distribution of materials	-	-	-	Partly
Monitoring groups	Yes (Sandra); especially teacher intervention	-	Yes	Yes (Oliver)
Individual accountability	-	-	-	-
Group processing	-	-	-	-

Note. The dash (-) indicates that the pre-service teachers did not refer to the event as influencing their practice.

The video events focusing on structuring positive interdependence (first video clip to be studied) and monitoring groups (dilemma-based event) influenced the teaching of three of the four cases (Table 5.14). There were events that did not appear to make an indelible impression in the teacher's minds – establishing skills and individual accountability – but an observation of such video events by the pre-service teachers still facilitated a transfer of the elements of a co-operative learning lesson to the classroom. Using a video of a real-life classroom setting served to help the pre-service teachers acquire mental models of authentic classroom events so they could better implement the features.

An analysis of the influence of the other components across cases revealed that these components – reflection questions, comments and resource booklet – made an impact on few pre-service teachers' practice. It was expected that the commentaries would have had a greater impact on practice. (The commentaries spoke to issues encountered in video lesson, such as structuring groups and intervening in groups in a teacher-centred way, addressed the importance of the elements, and described on how the features were enacted in the lesson.) However, this optimistic expectation was not realised as only one case attested to power of the commentaries in influencing her teaching. The pre-service teacher's lesson that was observed (case 1) was similar to one in the video lesson and furthermore encountered a situation similar to the one in the video. The similarity in the setting acted as trigger for recalling how the video teacher reflected on his handling of the situation and also the expert's perspective on the matter. For the other cases, the topic of their lessons were not similar to the one in video, and maybe this could

have minimised the impact of the commentaries, some of which were specific to the science content of the lesson.

The booklet was designed to provide print versions of the video lesson materials and information on co-operative learning. The inclusion of the booklet was prompted by the results of the field-testing (chapter 3). It was expected that this medium would have influenced the pre-service teachers' practice by providing them additional information on the co-operative learning features, reproducible worksheets for their lesson, and co-operative learning lesson plan template. This expectation was realised as three cases mentioned that they used the booklet as a guide for their teaching practice.

Interestingly, not all components that enhanced understanding were considered to make an impact on practice (cf. Table 5.12 & Table 5.13). The reflection questions were useful for enhancing understanding for three cases, but did not impact pre-service teachers' practice. The same was for the comments. The pre-service teachers in two cases found the comments useful for promoting a better understanding of co-operative learning but the views in the comments did not seem to inform their practice. Only for Case 1, as mentioned previously, did the comments make an impact on practice. The pre-service teacher in this case valued the comments because they allowed her to make a connection between the video event and her teaching context.

5.9 CONCLUSIONS

The Teaching Practice Study sought to investigate how the multimedia case-based learning environment influenced the pre-service teachers' classroom practice. The study was guided by a case study approach and involved four pairs of pre-service teachers to illuminate the issue of the effects of case use on pre-service teachers practice. It was expected that the multimedia case would furnish teachers with concrete ideas of how co-operative learning features can be enacted in reality and subsequently influence the teachers' implementation of these features in a positive way in a real life classroom. This expectation was realised in varying degrees and has led to following conclusions.

The multimedia case-based learning environment has a positive influence the pre-service teachers' understanding of co-operative learning and their classroom practice. Pre-service teachers are selective in what they take from the learning environment to

inform their practice. They make the effort to preserve the essence of co-operative learning in their lesson, the realities of the context prompt deviations.

Case components have a varying impact on pre-service teacher's practice. The video, in particular is a powerful medium in helping the pre-service teachers to implement co-operative learning. It afforded the pre-service teachers opportunities to see how a co-operative learning unfolded in a real classroom. The impact of the commentaries on practice is not as powerful as the video. The commentaries are effective only if they address specific content and pedagogical content issues such as problems in measuring volume, rather than general pedagogical issues like structuring groups or individual accountability. The booklet is useful for practice as it furnishes the pre-service teachers with resources that they can use directly or adapt for their lessons. Providing teachers with concrete reproducible resources helps them to survive the preparatory hours for practice.

Using the multimedia case-based learning environment in the science methods course serves to mirror real classroom settings, with all its complexities and uncertainties. It acts as a launch pad for the enactment of co-operative learning, an enactment that involves both a faithful translation of certain elements of the case and deviations, which are prompted by the challenging realities of the pre-service teachers' teaching context.

CHAPTER 6

Discussion

This chapter summarises and discusses the main findings of the MASTER-Jam study. The chapter begins with a recapitulation of the main problem, aim and research approach. In section 6.2, the major findings are summarised. The third and fourth sections (6.3 & 6.4) discuss salient issues in relation to the findings and the research approach respectively. The fifth and final section (6.5) presents conclusions and recommendations for multimedia case-based learning.

6.1 RECAPITULATION OF THE RESEARCH PROBLEM AND APPROACH

In Jamaica, a curriculum reform effort under the Reform of Secondary Education (ROSE) was launched in 1993 to address problems of quality and equity in secondary schools. As a part of the ROSE initiative, a professional development programme, aimed at preparing in-service teachers to deliver the new curriculum, also commenced in the same year. ROSE intended to improve education but research and observations by teacher educators said otherwise. Although the professional development programme was intensive, it was not having the large-scale desired impact on professional teachers, who did not enact ROSE methods as the curriculum developers had envisioned. In the field, the pre-service teachers' practical experiences were often lacking in 'observation by apprenticeship' opportunities, since in-service teachers were having difficulties implementing ROSE methods. At the teachers' college, the pre-service teachers' learning experiences were inadequate as these experiences were not enabling them to implement the ROSE methods as intended, and their subsequent reflection on practice was weak. Therefore, to provide vicarious encounters with a real-life 'ROSE' classroom, the use of a multimedia case-based learning environment by pre-service teachers was explored in the MASTER-Jam study.

A multimedia case-based learning environment capitalises on the power of computer technology to present digital videos of real-life classroom situations, and is often supplemented with learning tasks and context information. The multimedia case had a two-fold purpose:

- to present an example of how the features of co-operative learning are enacted in a real-life setting;
- to provide opportunities to practise reflection on real and innovative classroom events.

The study was based on the assumption that if pre-service teachers saw a video lesson of how methods such as co-operative learning were enacted in real classrooms and were engaged in structured reflective learning tasks on the events in the video lesson, they would be better supported in their understanding and enactment of the theoretical aspects of the methods in practice. Furthermore, if multimedia case use in the science methods course could encourage reflection on real classroom events, then increased case-based learning experiences could improve reflection on practice in the long run. The MASTER-Jam study therefore aimed to explore the potential of the multimedia case-based learning environment to stimulate reflection, facilitate learning of co-operative learning and influence teachers' enactment of a co-operative learning lesson.

The study was conducted within a development research framework, which comprised (1) preliminary investigation, (2) development of the case with its iterative cycles of deliberative design, evaluation and revision; and (3) empirical testing of its effects. The preliminary investigation involved an analysis of the pre-service teacher education context, a review of literature on teacher learning and case methods, and the viewing of examples of multimedia cases. The development process involved collegial consultations about the design and content of the case, generation of prototypes, formative evaluations of the prototype versions and subsequent revisions until a final delivery was obtained. The formative evaluations were concerned with theoretical, technical and practical quality issues and sought to find ways of improving the multimedia case-based learning environment in these areas. The evaluation also sought to get initial insights into the potential of the multimedia case as a learning tool. Once suggestions for improving the learning environment were incorporated, the final delivery was produced.

The final delivery of the multimedia case underwent empirical testing which served to provide insights into the effects of the multimedia case-based learning environment in the pre-service teacher education programme. The first effects study, Learning and Reflecting with a Case (LRC), which is described in Chapter 4, sought

to investigate the potential of the case to facilitate learning and reflection. The second study, termed Teaching Practice Study, aimed to find out whether the multimedia case-based learning environment had any effect on teachers' practice (see chapter 5).

6.2 SUMMARY OF FINDINGS

This section discusses the findings and lessons learnt from the MASTER-Jam research.

6.2.1 Case-based learning as a starting point

As stated earlier, in search of a deeper understanding of case-based learning, three activities were conducted: analysis of the teacher education context, viewing inspiring examples of multimedia cases, and a literature study. The findings from these activities resulted in the formulation of seven constructivist-based principles for designing a multimedia case-based learning environment. These principles informed the selection of the components of, and strategies for, designing the learning environment and are described in Box 6.1.

Box 6.1 Components of the multimedia case-based learning environment

<u>Design principles</u>	<u>Components of the case</u>
1. Create an authentic context	Non-scripted <i>video</i> lesson, with background information on teacher, students and school
2. Provide access to multiple perspectives	<ul style="list-style-type: none"> a. <i>Commentaries</i> from teacher educators and video teacher on video lesson b. Short <i>notes on co-operative learning</i> c. Hyperlinks to co-operative learning <i>websites</i>
3. Create opportunities for meaningful reflection	<ul style="list-style-type: none"> a. <i>Reflection questions</i> accompanying video segments b. <i>Learning task</i> for teachers to write a reflection report on their classroom practice
4. Encourage collaborative knowledge construction	<ul style="list-style-type: none"> a. Peer discussion of responses to reflection questions b. Internet-based <i>discussion group</i> on teaching practice
5. Accommodate a coaching and scaffolding role	Formulation of reflection questions in two or three parts to help the learner to gradually see essential features of co-operative learning
6. Provide authentic assessment activities	Learning tasks address the objectives in the science methods course and relate to teaching practice
7. Allow for the free exploration of the case	Main menu appears at the top of every page thereby reflecting a non-linear design and allowing the learner to visit any page at any time

The heart of the multimedia case-based learning environment included the video component with reflection questions and hyperlinks to commentaries and notes on co-operative learning. The supporting components, which included the discussion group and websites, allowed for additional exploration of co-operative learning issues.

6.2.2 Design and formative evaluations of the multimedia case

The development of the multimedia case involved the design, generation, formative evaluation and revision of three prototypes (versions 1.0, 1.1 and 2.0) until a final delivery was produced. The formative evaluations sought to assess the quality of the multimedia case in three areas: theoretical, technical and practical and gather insights into the potential of the case as a learning tool. The formative evaluations were of three types: expert appraisal, one-to-one user evaluation and field test. The expert appraisal was mainly concerned with assessing and improving the theoretical quality; the user evaluation focused on the technical quality, while the field test with pre-service teachers was concerned with both technical and practical quality. In addition, the potential of the multimedia case-based learning environment as a learning tool was explored in the field test.

Expert appraisals

The early stages of the development of the multimedia case-based learning environment were concerned with the translation of the design principles into a paper-based prototype, generated with Microsoft PowerPoint. This translation was facilitated by frequent discussions with a group of experts who acted as critical friends. Once the general design was mapped out, and components identifiable by named hyperlinks in the learning environment, the first prototype, version 1.0 emerged. Attention now turned to selection and organisation of the co-operative learning content. Educational literature documents various methods of planning co-operative learning experiences, but one method had to be chosen. The primary concern and subsequent focus of the expert appraisal was which method of planning co-operative learning experiences should be presented to the users - a five-feature model (Johnson & Johnson, 1999) or three succinct strategies (Kagan, 1994). The appraisal by the critical friends groups resulted in presenting co-operative learning using one of the succinct strategies called Think-Pair-Share. Version 1.0 was subsequently revised to reflect this strategy and the co-operative learning content areas developed further.

The improved prototype (version 1.1) was evaluated by Jamaican science teacher educators. They were asked to comment on the way the co-operative learning

methodology was represented in the case-based learning environment. The Jamaican experts felt that the Think-Pair-Share co-operative learning strategy did not encapsulate the essence of co-operative learning that they wanted the pre-service teachers to grasp. They recommended that the five-feature model was more appropriate as it would provide pre-service teachers with a more comprehensive picture of a co-operative learning setting. Also, the five-feature model was promoted in the in-service professional development programme. The results from the appraisal led to the abandonment of the Think-Pair-Share strategy and the adoption of the in-depth five-feature model developed by Johnson and Johnson. Additional suggestions were offered on how to improve the co-operative learning content in the notes section (text-based) of the learning environment. The suggestions included elaborating on the five features of co-operative learning, and referring to the difficulties which teachers and students face when involved with co-operative learning. Revisions were made and an improved prototype emerged, version 2.0. Version 2.0 incorporated edited segments of the video lesson as well as questions for each segment to facilitate reflection on the events in the video.

The final expert appraisal, which was conducted in Jamaica, warranted a look at the theoretical quality of version 2.0. The results called for improvements in the internal coherence between components using additional hyperlinks, more perspectives on co-operative learning and a revision of the reflection questions accompanying the video segments. With respect to the reflection questions, the science educators commented that the questions reflected a more direct instruction than constructivist active learning principles. Therefore, questions that were more open-ended were formulated. However, the researcher was not fully satisfied with the revised reflection questions as the reflective element was weak. Consequently, a revisit to the relevant literature followed and a process model for reflection was adapted from Posner (1996). This model comprised tasks asking pre-service teachers to describe, analyse and reflect on events in the video in light of commentaries on those events.

The expert appraisal also involved checking the technical quality by a specialist in instructional technology, the findings of which focused on minor technical hitches, and useful tips for improving the navigation through the learning environment and the screen layout (colour, font, positioning of text and graphics).

User evaluation

The one-to-one user evaluation was conducted with version 1.1 to get an insight into the technical quality of the learning environment and its acceptance by the pre-

service teachers. Observing the pre-service teacher use the case-based learning environment revealed technical difficulties, which were minor and subsequently corrected. The teacher affirmed that pre-service teachers would accept the multimedia case if it was used in the teachers' college science education programme.

Field test

Version 2.0 of the multimedia case-based learning environment underwent field-testing with pre-service teachers in Jamaica. The field test was concerned with the practical and technical quality of the learning environment, and aimed to get insights into the potential of the medium as a learning tool. The pre-service teachers found the multimedia case-based learning environment to be a practical innovation. The findings revealed that the multimedia case was considered to be clear, interesting, and easy to navigate. Comments such as useful, practical, relevant and motivating were evident in their responses. The pre-service teachers commented that the screen layout was appropriate, with text and pictures easily seen. There were suggestions for improving technical aspects of the video component such as sound and quality of the lighting in some of the clips. Nevertheless, because it was not possible to change the video lesson itself, only the sound problem was addressed by incorporating text. The findings also revealed the need for more explanations on the video events. Consequently, a resource booklet was developed for use in conjunction with the multimedia case. The booklet consisted of video lesson materials, more information on co-operative learning features, response sheets for the reflection questions and other relevant information on co-operative learning.

Not only did the field test findings reveal that the multimedia case was a practical innovation, but also important was that the multimedia case had the potential to facilitate learning. However, the findings showed that learning was not entirely as the designer expected. Allowing the pre-service teachers to freely explore the case (thereby abiding by the constructivist design principles) resulted in certain essential elements of co-operative learning being overlooked. This led to a decision to deviate from the wholesale constructivist use of the case and instead, direct pre-service teachers to work with the specific core case components initially and then explore the remaining components later. Consequently, for the effects study on learning and reflection with the case, guidelines were formulated which required the pre-service teachers to examine specific parts of the case first, then if time allowed, they could explore the remainder of the case. The use of cases (free exploration vs. guided exploration) is discussed in section 6.3.1.

6.2.3 Reflecting and learning from a multimedia case

The reflection component of the LRC study sought to find out how the multimedia case functioned in facilitating reflection. A process model adapted from Posner (1996) aided the reflection. This model comprised tasks requiring the pre-service teachers (a) describe the events in the video segment, (b) elaborate on, and analyse the video event, (c) view commentaries from teacher educators and the video teacher on certain video events and reflection questions, and (d) review and modify their original ideas in light of the additional perspectives. Asking pre-service teachers to describe and analyse events is seen as a means to guide them on their journey to reflection. The responses from the last stage of the model were analysed for evidence of reflection or reframing of ideas.

Posner argues that the reflection process should start with observations, rather than confounding description of events with interpretations or other analytical comments (Posner, 1996). The reason for refraining from the interpretations in the early stages of the reflection process is to help pre-service teachers to develop observation skills. In so doing, they will construct a better picture of what happened in the lesson, a picture that is free from initial (hasty) interpretations or judgements. All the pre-service teachers described the events as they unfolded in the video by recording their observations of such events. There were instances of spontaneous interpretations before recording observations by some pre-service teachers especially when the video segment portrayed a dilemma-based situation. The appeal of the video seemed to have evoked colourful remarks from the pre-service teachers albeit too early in the reflection process.

In the next stage of the process, analysing events, the expectation that pre-service teachers would be able, when prompted, to suggest alternatives to how the video teacher enacted an event, and elaborate on their suggestions, was confirmed. The case provided sufficient information to support the pre-service teachers' analysis of the events. There were video events that were more conducive to analysis than others. Events portraying the teacher giving explanations and talking with a group of students produced analytic responses, while the event involving minimal talking evoked very little writing, which offered no new information.

The final task of the reflection model involved pre-service teachers reading commentaries and then reviewing their original ideas before reframing their ideas. After reading the commentaries, the pre-service teachers responded to the task in one of three ways: reframing, rephrasing or recalling. Only a few reframed by referring to their original comment in their response and indicating a change in

their original position. The pre-service teachers' responses classified as rephrasing indicated a re-wording of the commentaries, but no mention was made of their original ideas. The responses categorised as recalling had ideas from the comments verbatim, or a statement of agreement with the comments. The pre-service teachers who rephrased or recalled ideas from the comments showed no evidence of an attempt to integrate original ideas with new information or modify original ideas.

Learning about co-operative learning from the multimedia case was explored in the study. The pre-service teachers' responses to the learning tasks showed that they constructed ideas of co-operative learning features that were stressed in the multimedia case. In addition to learning about co-operative learning features, the findings revealed that the multimedia case functioned as learning tool for practising, to a greater extent observation and analysis of classroom events, and to a lesser extent reflection.

6.2.4 Practising to teach from a multimedia case

The Teaching Practice Study sought to find out how the multimedia case affected classroom practice. The pre-service teachers faithfully enacted specific co-operative learning features as exemplified in the lesson video and deviated, either deliberately or inadvertently, from how some aspects of the video lesson were portrayed. The classroom observation notes indicated that all pairs of pre-service teachers considered at least three out of five features of co-operative learning in their lessons: (a) assignment of roles in an attempt to structure positive interdependence, (b) structuring individual accountability, and (c) promoting face-to-face interaction. In addition, the pre-service teachers monitored groups of students while they were on task.

When the pre-service teachers were asked what aspects of the video lesson in the multimedia case they used to inform their teaching, the common response was the segment addressing the structuring of positive interdependence by assigning of roles. Other aspects appealed to different pre-service teachers such as the teacher's monitoring of groups, and distribution of materials. All the pre-service teachers confirmed that the video was helpful for their understanding of co-operative learning and teaching practice. The comments on the usefulness of the other components (reflection questions, commentaries, and booklet) varied among the pre-service teachers. The pre-service teachers did not consider the reflection questions useful for their practice. One pre-service teacher found commentaries from both the video teacher and teacher educator helpful for her practice, while few noted that the resource booklet helped them on practice.

The multimedia case, particularly the video lesson, influenced the pre-service teachers' practice in different ways. They enacted some video events according to the case, but deviated with reason from the case when enacting other events. The influence can be regarded as positive but the extent of that influence is inconclusive. There lies, however, potential within multimedia cases to have an effect on pre-service teachers' practice.

6.3 DISCUSSION OF FINDINGS

6.3.1 Using cases – restricted exploration versus free exploration

The multimedia case-based learning environment was designed using constructivist guidelines. The multimedia case comprised several layers of information (video, background data, commentaries, notes, and links to websites) all of which could be accessed through hyperlinks inserted in the environment. From a constructivist perspective, the use of the multimedia case affords the pre-service teachers control over their learning, yet requires much time if they are to freely explore and make sense of the rich learning environment in manner aligned with constructivism. The reality of the teacher education context does not allow for sufficient time to study meaningfully the learning environment as such free exploration is difficult to realise. Free exploration in a short time causes some pre-service teachers not to extract from the multimedia case critical information. Consequently they stand to miss the quintessential elements of the case. The findings from the formative evaluation showed that all teachers did not explore the whole multimedia case due to time constraints and as such, some essential features were missed (section 6.2.2). L.S. Shulman (1992) noted that with case use very little content is covered in rather long periods. Furthermore, some pre-service teachers are not familiar with using the layered and hyperlinked information consisting of video clips, commentaries, and co-operative learning notes with computers. As stated earlier the notion of learning with multimedia cases from a constructivist perspective needed to be revisited and adapted to the pre-service teachers' context of learning. Consequently, guidelines for using the case were formulated in order to have pre-service teachers work with the essential or core elements of the case, thereby increasing the possibility of grasping the essence of the method being portrayed. This restricted exploration was conducted in the Learning and Reflecting with a Case Study, documented in chapter 4, and helped to guarantee a level playing field among all pre-service teachers for the subsequent enactment of co-operative learning in practice.

6.3.2 Commentaries and cases

The commentaries in the multimedia case were originally intended to facilitate the reframing of pre-service teachers' ideas by providing them with additional perspectives on video events for further consideration. J. Shulman (1992) regards commentaries as an important component in case-based learning environments as they provide multiple perspectives on a particular issue and can suggest alternate strategies. Findings indicate that asking pre-service teachers to make this transition from reviewing their ideas to reframing proved to be a big leap as few reframed their ideas after reading the commentaries. In retrospect, it was over-optimistic to expect that the commentaries would provide thought-provoking perspectives on the issue in question and be so compelling to stimulate reframing of the pre-service teachers' ideas. Merseeth (1996) is sceptical about the use of commentaries in cases as they may inhibit the construction of knowledge by novices. She explains that when novices read what 'experts' have said about the case, they may be inclined to abandon or suspend their own beliefs in favour of the 'delivered wisdom'. For the MASTER-Jam case, reading comments from an expert or a professional (video) teacher might have been intimidating for the novice pre-service teachers, and consequently most refrained from reframing their ideas by integrating their previous knowledge with views expressed in the commentaries, and simply agreed with what the expert said or rephrased the views expressed in the comments.

Another reason for the low impact of commentaries could be due to the aim of the case-based learning environment – to present a model of an exemplary video lesson of co-operative learning. Perhaps, the modelling character of the video downplayed the need to reframe. The pre-service teachers accepted the video teacher's way of enacting the lesson and the commentaries on events in the multimedia case.

In retrospect, to expect the reflection approach to facilitate the reframing of pre-service teachers' original ideas might have been slightly ambitious. To expose the pre-service teachers to different points of views on an issue, and then ask them to reframe their original ideas in light of these viewpoints might have been a big leap for them, especially when they are still learning how to articulate their personal ideas on educational issues. Further research is needed to better understand how commentaries can be used to stimulate reflection.

6.3.3 Practising to teach from a multimedia case

Deviations from the multimedia case

One of the aims of the multimedia case was to present an example or model of how a co-operative learning lesson could be enacted in a real-life setting. The

assumption was that the multimedia case would be so compelling that pre-service teachers would transfer the features they observed and reflected on in the video component into their respective classrooms. This assumption was partly true. All pre-service teachers faithfully translated certain features of the case into their practice: assigning roles, promoting face-to-face interaction, and monitoring groups. In addition to enacting certain features according to the case, there were instances of deviations from the case for all the lessons observed. The deviations were either planned, that is the pre-service teachers decided during their lesson preparations to enact a particular feature in a certain manner or they were unintended, that is, on the spur of the moment. Planned deviations were done with reason – large class size and pressure to teach the lesson in the allotted time. Those who deviated unintentionally planned to enact the features according to the case, but resorted to traditional teacher-centred routines when they were confronted with the realities of their classroom context, such as large numbers of students, noise from neighbouring classes, and late start to the lesson. These types of deviations could be seen as a way of surviving in their new classroom context, but in so doing the essence of the co-operative learning feature was lost.

There was one case in which the pre-service teacher deviated from what the video teacher did in his lesson; but her deviation was warranted. She learnt from the commentaries how the video teacher's action could have been improved and enacted in her lesson what she learnt about his action when she encountered a similar situation. Her deviation is a positive one and lifts the impact potential multimedia case-based learning environment on that point.

From theory to practice – making the transition

There is a discrepancy between what pre-service teachers learned and how they implement the lesson. This second finding is derived from two data sets. The first is their written responses to the learning task in Learning and Reflecting with a Case (LRC) Study (chapter 4), and the second is the classroom observation notes of pre-service teachers' practice (chapter 5). In the LRC study, pre-service teachers were asked to suggest a way that a particular video event – (the way in which the video teacher structured groups) could be more student-centred, given that it was deemed teacher-centred by a teacher. All pre-service teachers gave suggestions as to how they would make the lesson student-centred. Yet, all except one pre-service teacher who implemented a co-operative learning lesson structured the groups in a manner similar to the video teacher, that is, in a teacher-centred way. Their written responses indicated that they were 'expert learners' in the theory of pedagogy, having given the 'correct answer', but in practice, they were not only novice teachers, but also traditional teachers. When placed in novel situations, pre-service

teachers tend to resort to traditional didactic modes of teacher telling rather than being a facilitator of learning. It is powerful universal problem that teachers teach as they are taught. Being a facilitator of learning and having students in their class air their ideas can be a tricky situation for novice teachers. They may fear that if students are given too many opportunities to talk, then this might lead to disruptions in the lesson. Beginning teachers also are more concerned with teaching the expected lesson in the allocated time frame and classroom management (Moore, 2003). Having students' input on matters not related to the science content of the lesson might be viewed as time consuming. So, although they know from their experience as expert learners how to answer questions in theory, the reality of the classroom setting causes them to respond in a different way.

The pre-service teachers' enactment of this particular event according to the case could also be attributed to the appeal of video. They remembered more what they saw as opposed to what they wrote. This finding suggests that if the purpose of the case is to present a model or example of how a teaching method can be enacted, then the case should be exemplary throughout. One might argue that there is no perfect lesson, but in light of this finding, the case should fit the purpose, especially for beginning pre-service teachers.

6.4 SALIENT ISSUES IN USING DEVELOPMENT RESEARCH APPROACH

Development research was used throughout MASTER-Jam study because it afforded a unique combination of practical and theoretical orientations. This design-based research approach, which blended empirical research with the development of a constructivist-based multimedia case-based learning environment, proved an important methodology in understanding how this educational innovation functioned in the Jamaican teacher education context. Although the approach offered opportunities to explore the innovation at work in an uncertain and sometimes 'messy' context, tensions arose between the opportunities and challenges presented by this approach. The tensions revolved around: multiple roles played by the researcher and the emergent features within the teacher education context that tested the theory-driven design of the learning environment. These two issues are discussed in the following paragraphs.

Multiple roles – maximising benefits, minimising risks

The MASTER-Jam study saw the researcher playing triple roles: deliberately as designer, critic, and unconsciously as teacher educator. As developer, there was the

possibility of pursuing personal ideals of what should go into case. These personal ideals surfaced occasionally due to the researcher's past experiences in teacher education. At times, the ideals were in line with the constructivist design principles while at other times they conflicted, and thereby ran the risk of comprising the design process. However, this possible tension between 'subjective and imaginative involvement' and 'objective and critical distance' is not necessarily negative (Van den Akker, 2002b). The subjective creativity brought to the design table a wealth of context information, which might have filtered into the design process even if the researcher were not so intimately involved in the process. What mitigated the possible negative effect of 'researcher-developer' was the group of critical friends who acted as a buffer when they provided immediate feedback on decisions that deviated from the constructivist design principles and literature on multimedia case-based learning environments. The objective and distant critique mitigated the risk factor of subjectivity.

As researcher, the multiplicity of roles enhanced the design decision-making process. First, as teacher educator, the researcher was able to fuel context-based ideas into the design process. Second, as developer-designer, the researcher, who was schooled in the use of a flexible authoring tool, could run these ideas as they were generated into the iterative design cycle of prototyping, formative evaluation/deliberations and revision. The rapid iteration helped to refine the theory-driven design of the learning environment and make it more responsive to the teacher education context. As the developer-critic, the researcher engaged in reflective evaluations after major formative evaluations with experts and users in the real context. This 'private' evaluation, along with consultations with a member of critical friends groups, proved beneficial as it resulted in the improvement of the reflection questions video component of the learning environment.

The Design-Based Research Collective (2003) acknowledges that there is no simple solution to the inevitable tension surfacing from the coupling of empirical research to design. However, they affirm that specific research techniques such as data triangulation can be employed to challenge a designer-researcher's tacitly held assumptions. For the MASTER-Jam study, steps were taken to use different kinds of data—observation, written work, interviews, audio recordings, and questionnaire—to connect intended and unintended outcomes to the enactment of the multimedia case. Such triangulation of data provided significant evidence to support claims about the effects of the multimedia case-based learning environment in the teacher education programme, and thereby help to increase the reliability of the findings (cf. McKenney, 2001).

Responding to real-world contexts

As stated earlier, one of the roles that the researcher unconsciously played was that of teacher educator, who was rooted in an instructivist tradition but trying to make the shift to constructivism. Making this transition was not easy at the teachers' college as attempts to deliver the science methods course from a constructivist orientation proved challenging at times. The pre-service teachers were also from an instructivist tradition and often struggled with attempts by the teacher educator to organise learning experiences from a constructivist perspective. There was a dilemma in the making when the MASTER-Jam study aimed to develop a multimedia case-based learning environment (rooted in constructivism) and explore its effects in the real context of the science methods course. Initially, for the researcher, using constructivism to drive the design was an enduring tension for the researcher-teacher educator, but this was this tension was gradually relieved as the development process progressed. However, emergent features of the real-world context, which involved implementing the case in the science methods course, prompted a return of the instructivist-constructivist tension.

When the multimedia case was confronted with the real-world setting, a dilemma resulted in how the case should be used by the pre-service teachers. Allowing them to freely explore the case in the allocated time resulted in some pre-service teachers overlooking the essential parts of the case. The multimedia case-based learning environment consisted of layered and hyperlinked information. Learning with such an environment was new for the pre-service teachers. In response to this emerging dilemma, a compromise had to be made, if the multimedia case was to gain acceptance by the teacher education community. The compromise was to impose guidelines for using the multimedia case to ensure the core components of the learning environment were covered. Development research afforded the MASTER-Jam study this luxury of responding to an emergent finding, which in turn drove the empirical testing of the multimedia case in the following year. Such a reinterpretation of the constructivist design of the case, helped to tailor the use of the innovation to the needs and characteristics of particular educational contexts and still preserve the pedagogical essence of this learner-centred theory.

6.5 CONCLUSIONS AND RECOMMENDATIONS

The MASTER-Jam study set out to explore the potential of the multimedia case-based learning environment on co-operative learning to stimulate reflection, facilitate learning and influence pre-service teachers' practice. The conclusions and recommendations are discussed in the following paragraphs.

Constructivism and case use

It is possible to develop a multimedia case-based learning environment according to constructivist design principles. Adhering to these principles resulted in a case-based learning environment with a high degree of layering and authentic information. The authenticity of the learning environment mirrored the real-life challenges of teaching and provided opportunities for analysis. However, the pre-service teachers' learning environment tempered the use of the case in a wholly constructivist way, that is free exploration. Much time is required for the free exploration of the case, a commodity that is not abundant in the science methods course. Time constraints demanded that a compromise be sought when using the case. Since time is a constraint, the multimedia case is best used with guidelines rather than free exploration to ensure the pre-service teachers cover the core elements of the case-based learning environment.

Learning and reflection

Learning about teaching methods such as co-operative learning is likely with a multimedia case-based learning environment. In addition to learning about features of co-operative learning, pre-service teachers also have opportunities to practise observation and analytical skills. These skills are part of the reflection process. To complete the process of reframing ideas, the study shows that for beginning pre-service teachers the multimedia case brings them to the door of the reflection process. However, the multimedia case-based learning environment is weak in bringing pre-service teachers through the doorway and thereby allowing them to experience the reflection process. There is therefore the need for a deliberate effort in the teacher education programme to teach pre-service teachers how to reflect. Embedding reflective activities in multimedia case-based learning environment is one way, but not the only way. Multimedia case use should be complemented with additional strategies in the science methods course such as discussion in order to provide pre-service teachers additional perspectives for the reflection process and opportunities for them to practise articulating their ideas in light of these perspectives.

In the MASTER-Jam study, the multimedia case use took place before pre-service teachers were immersed for the first time in real classroom settings. A future consideration for case use in the teacher education programme could be to have pre-service teachers first experience the complexities of enacting certain methods, and then viewing cases highlighting those methods. Such a reversal approach—practice before case use—could help pre-service teachers acquire a broader knowledge base for analysing other multimedia cases that depict classroom

experiences. This development of a broadened knowledge base from their first-time experience in the classroom could set the stage for subsequent meaningful reflections on issues that might arise in the multimedia case. Further research on this approach to using multimedia cases could shed light on the potential to enhance reflection and learning.

To facilitate reflection and learning, case-based pedagogy could unfold in following manner. First, allow the pre-service teachers to work with the exemplary multimedia case-based learning environment. Second, ask them to plan lessons to include the essential elements of the teaching method portrayed in the case. Third, provide the opportunity for the pre-service teachers to videotape the enactment of their lessons and note their initial reflections on lesson. Finally, in pairs, allow them to not only view the videotapes of their teaching but also the one in the exemplary case; and focus on a specific type of classroom interaction that is common to all three 'cases' (e.g., how the teacher structures group work). This peer review across cases can help pre-service teachers to not only observe and analyse the enactment of a particular teaching method with possible variations, but also furnish them with a better understanding of how to enact that aspect of the teaching method. The peer review can also provide them with multiple perspectives on issues that might emerge from the 'across case' analyses and in so doing help them to engage in more meaningful reflection about their teaching (cf. Sherin, 2000).

Practising to teach from a multimedia case

The multimedia case-based learning environment does influence pre-service teachers' practice in different ways. The pre-service teachers translate certain events from the multimedia case faithfully into practice and deviate from the case for other features in response to emergent realities of their context. The multimedia case gives the pre-service teachers ideas on how to deal with issues in their classroom that they construe similar to the case-based learning environment. However, the multimedia case should not be seen as 'quick-fix' innovation that will magically have pre-service teachers enacting lessons with great efficacy, as the reality of their setting will evoke 'survival tactics'. Multimedia case-based learning is not a stand-alone method, but its potential for positively influencing practice can be maximised if used in conjunction with other innovative research-based methods. The blend of case-based learning with other reflective learning experiences will help to facilitate a better enactment of theoretical principles of ROSE teaching methods in their practice.

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ENGLISH SUMMARY

Exploring the effects of a multimedia case-based learning environment in pre-service science teacher education in Jamaica

BACKGROUND

In the 1980s, the Ministry of Education in Jamaica turned the spotlight on the secondary education system when it commissioned several persons and organisations to conduct studies in secondary schools. The purpose was to find out the status of the system, and major problems being experienced at that level of the education system. Findings from the studies revealed, among others, absence of a common curriculum, graduates unprepared for the world of work, and the need for trained teachers in the system. Subsequently, the government started to develop plans aimed at rationalising the secondary education system, under the reform initiative called Reform of Secondary Education, ROSE project. The ROSE project, which was funded by the World Bank and the Government of Jamaica from 1993 to 1998, aimed to (a) provide a common curriculum for Grades 7 to 9 in all schools providing secondary education in Jamaica, (b) introduce student-centred learning strategies, (c) develop textbooks to support the new curriculum and pedagogy, (d) revise the existing teacher education programmes at the pre-service and in-service levels to be consistent with the objectives of ROSE, and (e) to conduct in-service teacher training programmes to help teachers acquire the skills necessary to execute the new curriculum.

In 1993, the ROSE project was launched, and saw the in-service professional development programme being conducted to expose professional teachers to the methodologies of the ROSE curriculum, such as co-operative learning and concept teaching. The pre-service teachers were also exposed to these new methods through the revised Science Methods syllabus. However, as the years progressed with ROSE, teacher educators observed that (a) in-service teachers were

experiencing difficulty enacting the ROSE methods, despite the training efforts of the in-service team, and (b) pre-service teachers were not implementing the methods on teaching practice as intended and their subsequent reflection on practice was weak. The lack of opportunities for 'observation by apprenticeship' in the field for the pre-service teachers meant that the teachers' college programme would need to be supplemented with additional learning experiences that would connect to, and inform pre-service teachers' practice. Therefore, to provide pre-service teachers with real-life encounters with professional teachers enacting ROSE methods, the intervention involving the use of a multimedia case-based learning environment was explored.

CONCEPTUAL FRAMEWORK

Research on case-based learning has been gradually gaining prominence in education literature over the past twenty years. Much of the early literature has focused on narrative cases. A narrative case can be viewed as a descriptive document based on a real-life situation, developed primarily for discussion and incorporating sufficient context information to promote analysis and interpretation by users.

Narrative cases, which are text based, have been described as having a linear sequence since they are designed to be read from the first page to the last page. However, in recent years educational researchers have capitalised on the use of hypertext to design cases. Hypertext is a representation of multiple and flexible links between distinct chunks of data, which allow users to move along numerous paths through a network of units of information and to construct and store their own links. When the data to be linked comprise a variety of communication media such as video, audio, graphic and text-based information, the representation is called hypermedia or multimedia. Hypermedia is perceived to be a beneficial educational medium to present cases because of its non-linear property. This non-linear property coupled with the power of computer technology allows users to cross-reference various sources of information making up a multimedia case such as a video lesson, audio recording of varied views on aspects of the lesson, and text version of the video lesson plan. This in turn paves the way for pre-service teachers to access an array of information and in so doing develop a broad perspective of teaching issues. Therefore, a multimedia case can be viewed as a vehicle by which a slice of a real life classroom event is brought into the learning process, usually by video, to be thoroughly dissected and assembled again by its users, through personal reflection and/or discussion.

Multimedia cases are considered to be effective in enhancing teacher learning because case-based learning has roots in three contemporary constructivist-based theories: situated learning, cognitive flexibility theory, and reflective practice. Situated learning perspectives draw on the image of apprenticeship in a professional community as a powerful form of learning. Cases can function as that apprenticeship model by bringing pre-service teachers face to face with professional teachers in real classroom settings so that they can explore the richness and complexity of genuine pedagogical problems that may arise in such settings. A multimedia case-based learning environment also promotes cognitive flexibility. The non-linearity of this hypermedia system, the opportunity to visit and revisit different sources of information quickly and easily, and the capabilities of hypertext allow users to reflect on multiple perspectives on an issue simultaneously. Reflective practice can be nurtured through multimedia case use. Cases provide opportunities for pre-service teachers to observe real classroom settings, construct a representation of the real world practice, analyse such practices, hear other perspectives on the practice, and reflect by framing and reframing their ideas of such practices.

Like narrative cases, multimedia cases have the potential to:

- stimulate reflection;
- broaden teachers' content knowledge and pedagogical content knowledge of science; and
- foster habits of praxis that is, critical, reflective practice that enables prospective teachers to adapt to the many varied contexts they may meet in the field.

However, there are some limitations associated with case use in teacher education. Multimedia cases, like narrative cases can be difficult to teach well as they require teacher educators who are competent in, and comfortable with moderating discussions. Furthermore, much time is needed to prepare questions for a case discussion. Compared to narrative cases, multimedia cases are more costly and time-consuming to produce, and can result in greater overgeneralisations, because video is more appealing than written text. To offset the possibility of overgeneralisation, particularly with exemplary cases, student teachers should be encouraged to discuss the trade-offs and tensions that come with teaching or they may run the risk of resorting to easier methods when these tensions occur in their practice.

In spite of these limitations associated with multimedia case use, multimedia cases warrant the attention of teacher educators and students alike. Multimedia cases motivate by stimulating interest in the problems they represent.

AIM, RESEARCH QUESTIONS AND APPROACH

The MASTER-Jam study sought to explore the potential of the multimedia case-based learning environment to stimulate reflection, facilitate learning of co-operative learning and influence pre-service teachers' enactment of a co-operative learning lesson. The purpose of the multimedia case was two-fold:

- to present an example of how the features of co-operative learning are enacted in a real-life setting;
- to provide opportunities to practice reflection on real and innovative classroom events.

Two central research questions guided the study. The first question was addressed through a literature study.

What are the essential principles for designing a multimedia case-based learning environment?

The second question focused on how pre-service teachers benefited from using the multimedia case:

What are the effects of multimedia case use on pre-service teachers?

Three research sub-questions were formulated to guide the effects study

What do pre-service teachers learn from the case-based learning environment?

How does the multimedia case function in facilitating reflection?

How does the multimedia case affect classroom practice?

Addressing these questions helped to test the assumption of the MASTER-Jam study, which was built on the supposition that if pre-service teachers viewed and reflected on a video lesson of how ROSE methods such as co-operative learning were enacted in real classrooms, they would be better supported in their modelling of the theoretical aspects of the methods in practice. Furthermore, if multimedia case use in the science methods course could encourage reflection on real classroom events, then increased case-based learning experiences could improve reflection on practice in the long run.

The MASTER-Jam study followed a development research approach, which involved (a) a preliminary investigation, (b) development process, and (c) empirical testing of the effects of the case-based learning environment. Three main activities marked the preliminary investigation: analysing the Jamaican teacher education context, reviewing of literature on cases and teacher learning, and viewing of inspiring examples of multimedia cases. The development process was characterised by iterative cycles of design, generation of prototypes, formative evaluation and revision, until a final delivery emerged. The final delivery was used

in two effects studies, the first of which explored pre-service teachers' learning and reflection with the case. The second effects study investigated the influence of the multimedia case on the pre-service teachers' practice.

RESULTS

Preliminary investigation

The insights gained from the preliminary investigation led to the formulation of seven constructivist design principles.

1. Create an authentic context

A non-scripted video lesson, with background information on teacher, students and school was included in the case-based learning environment and formed the heart of the case.

2. Provide access to multiple perspectives

Commentaries from teacher educators and video teacher on video lesson, short notes on co-operative learning, and hyperlinks to co-operative learning websites all reflected this design principle.

3. Create opportunities for meaningful reflection

Reflection questions were formulated for each video segment. In addition, there was a task asking pre-service teachers to write a reflection report on their classroom practice.

4. Encourage collaborative knowledge construction

This was achieved through peer discussion of responses to reflection questions and an Internet-based discussion group on teaching practice.

5. Accommodate a coaching and scaffolding role

The reflection questions were formulated in two or three parts to help the learner to gradually see essential features of co-operative learning.

6. Provide authentic assessment activities

Learning tasks addressed the objectives in the Science Methods course and related to teaching practice.

7. Allow for the free exploration of the case

The main menu appears at the top of every page thereby reflecting a non-linear design and allowing the learner to visit any page at any time

These guidelines were incorporated in the development of multimedia case-based learning environments. The video lesson, along with the reflection questions, background information and hyperlinks to notes on co-operative learning and commentaries formed the core of the multimedia case. The remaining components functioned as supplementary features and were seen as a useful resource to broaden pre-service teachers' knowledge base on co-operative learning.

Formative evaluations

The formative evaluations—expert appraisal, user-evaluation, and field test—focused on the assessing the theoretical, technical and practical quality of the multimedia case, and to get insights into its potential as a learning medium. The main findings are described below.

The findings from the expert appraisals, which involved teacher educators, revealed the need to improve the theoretical quality in the following ways.

- Present co-operative learning in a comprehensive way by using the five-feature Johnson and Johnson (1999) model.
- Increase the internal coherence between the components by strategically inserting more hyperlinks in the case-based learning environment.
- Include additional perspectives on co-operative learning.
- Formulate reflection questions to enhance the potential for stimulating reflection. In response to this finding, a process model for reflection was constructed. This model asked pre-service teachers to describe, analyse, and reflect on video events, in light of the commentaries presented.

The expert appraisal also involved checking technical quality by a specialist in instructional technology, the findings of which focused on minor technical hitches, and useful tips for improving the navigation through the learning environment and the screen layout (colour, font, positioning of text and graphics).

The user evaluation sought to assess the technical quality of learning environment and get insights into its acceptance by pre-service teachers. The findings revealed technical difficulties, which were subsequently corrected. The pre-service teacher considered the case-based learning environment a medium that would gain acceptance by her peers.

The field test aimed to evaluate the practical quality of the multimedia case, and its potential as a learning tool with a larger number of the pre-service teachers. The pre-service teachers considered the multimedia case to be a practical innovation. The case-based learning environment was clear, motivating, easy to use and relevant to the pre-service teachers' context. The findings also revealed that the case had the potential to facilitate learning.

Another finding emerged from the field test exercise. Allowing pre-service teachers to freely explore the multimedia case in the teacher education context did not ensure that all pre-service teachers covered the essential elements of the case-based learning environment. In response to these findings, guidelines for using the case were formulated for the effects studies that followed to increase the chances of pre-service teachers' working with the essential components of the case.

Effects studies

The first effects study, *Learning and Reflecting with a Case Study* aimed to find out what do pre-service teachers learn about co-operative learning and how the case functions in facilitating reflection. The findings are outlined below.

- The pre-service teachers learnt about the five features of co-operative learning in way that was consistent, for the most part, with the Johnson and Johnson five-feature model.
- All the pre-service teachers described the events as they unfolded in the video by recording their observations of such events. There were instances of spontaneous interpretations before recording observations by some pre-service teachers especially when the video segment portrayed a dilemma-based situation.
- The case provided sufficient information to support the pre-service teachers' analysis of the events. There were video events that were more conducive to analysis than others.
- Only a few pre-service teachers engaged in reflection by framing and reframing their original ideas, after reading the commentaries in the case.

The second effects study, the *Teaching Practice Study* was conducted with a small sample of pre-service teachers who participated in the *Learning and Reflecting with a Case Study*. The study sought to find out how the multimedia case-based learning environment affected their practice. The major findings are outlined below.

- The pre-service teachers faithfully enacted specific co-operative learning features as portrayed in the lesson video and deviated, either deliberately or inadvertently, from how some aspects of the video lesson were portrayed.

- The component of the multimedia case that was considered most useful in influencing their practice was the video lesson.

The multimedia case case-based learning environment influenced the pre-service teachers' practice in a positive way.

CONCLUSIONS

The MASTER-Jam study was initiated to explore the effects of multimedia case-based learning environment in the pre-service teacher education programme in Jamaica. The study set out to investigate the potential of the multimedia case-based learning environment to stimulate reflection, facilitate learning and influence pre-service teachers' practice. Based on the findings, the following conclusions have been made.

Constructivism and case use

Developing a multimedia case-based learning environment according to constructivist design principles is possible. The product is a rich and complex learning environment with a high degree of layering and authentic information. However, emergent features in the teacher education context, mainly time constraints, force restrictions to be imposed on case use. These restrictions involve guiding pre-service teachers' exploration (instead of a free exploration) of the case to ensure that they work with specific components of the case in order to grasp the essential elements of co-operative learning.

Learning and reflection

Learning about teaching methods such as co-operative learning is likely with a multimedia case-based learning environment. Besides learning about features of co-operative learning, pre-service teachers also have opportunities to practise observation and analytical skills. These skills are part of the reflection process and the multimedia case nurtures the development of such skills. However, the multimedia case is weak in facilitating the framing and reframing processes of reflection and is not an adequate means for practising reflection. There is therefore the need for a deliberate effort in the teacher education programme to also teach pre-service teachers how to reflect, when they are engaged in case-based learning experiences.

Practising to teach from a multimedia case

The multimedia case-based learning environment does influence pre-service teachers' practice in different ways. The pre-service teachers translate certain events from the multimedia case faithfully into practice and deviate from the case for other features in response to emergent realities of their context. The multimedia case furnishes the pre-service teachers with ideas on how to handle issues in their classroom that they perceive to be similar to those encountered in the case. The full potential of case-based learning to influence practice can be realised if intertwined with other strategies such as discussion and reflective learning experiences in order to help facilitate a better enactment of theoretical principles of ROSE teaching methods in their practice.

