

**Information Technology teachers' experience of multimedia-based professional development**

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## **ABSTRACT**

### **INFORMATION TECHNOLOGY TEACHERS' EXPERIENCE OF MULTIMEDIA-BASED PROFESSIONAL DEVELOPMENT**

Professional development of teachers is a much-investigated area of research; however, teachers still complain that these endeavours do not cater for their specific needs. This problem arises from teachers' need to have more frequent professional development activities whereby it is possible to enhance their knowledge and skills regarding specific areas effectively.

Multimedia, in other words the use of various media such as video, pictures, narration and animation, is a possible tool to address certain needs in professional development. Furthermore, the incorporation of multimedia into professional development by making use of a digital versatile disc allows for professional development to occur within a distance mode of delivery setting.

This research was done to investigate and understand how Information Technology teachers experience the incorporation of multimedia into professional development by means of digital versatile disc. In order to accomplish this research endeavour, an investigation into the body of scholarly knowledge was executed focused on professional development of teachers, specifically with regard to needs expressed in previous studies. Furthermore, the body of scholarly knowledge regarding the implementation of multimedia as an enhancement to professional development was also investigated in order to synthesise how the researcher should go about implementing it. From the knowledge gained, the researcher developed the professional development digital versatile disc, specifically focused on the programming language Scratch. This programming language is an addition to the Information Technology syllabus and therefore teachers were assisted in their endeavour to acquire knowledge and skills regarding the implementation of such a new programming language.

An empirical study was conducted, specifically focusing on the experience of three teachers to determine how they experience multimedia-based professional development. All three participants expressed that they enjoyed the use of multimedia in professional development and that a digital versatile disc of this type had a place in their professional development endeavours; however, a need for personal interaction with the facilitator as well as colleagues still exists.

Keywords: Professional development, teacher training, multimedia, distance mode of delivery, multimedia-based professional development and Information Technology teachers

## **OPSOMMING**

### **INLIGTINGSTEGNOLOGIE-ONDERWYSERS SE ERVARING VAN MULTIMEDIA- GEBASEERDE PROFESSIONELE ONTWIKKELING**

Professionele ontwikkeling van onderwysers is 'n navorsingsgebied waaroor al redelik sorgvuldig navorsing gedoen is, tog kla onderwysers steeds dat die professionele ontwikkelingsaktiwiteite nie in hul behoeftes voorsien nie. Hierdie probleem spruit voort uit die feit dat onderwysers meer gereelde professionele ontwikkelingsaktiwiteite benodig waar hulle kennis en vaardighede rakende spesifieke gebiede effektief verbeter kan word.

Multimedia (die gebruik van verskeie media soos video, prente, animasie en vertelling) is 'n moontlike instrument wat gebruik kan word om die behoeftes van onderwysers in professionele ontwikkeling die hoof te bied. Verder maak die samevoeging van multimedia in professionele ontwikkeling, afstandsonderrig deur middel van 'n digitale veelsydige skyf moontlik.

Hierdie navorsing is gedoen om Inligtingstegnologie-onderwysers se ervaring van multimedia-gebaseerde professionele ontwikkeling deur middel van 'n digitale veelsydige skyf te ondersoek asook te verstaan. Om hierdie navorsingsdoelstelling te bereik, is ondersoek ingestel rakende die literatuur ten opsigte van professionele ontwikkeling van onderwysers (spesifiek met betrekking tot behoeftes wat in vorige studies vasgestel is), asook na die implementering van multimedia as 'n metode vir die verbetering van professionele ontwikkeling. Hierdie twee elemente is gekombineer om vir die navorsers 'n aanduiding te gee oor hoe multimedia in professionele ontwikkeling geïnkorporeer kan word. Op grond van die kennis oor die implementering van multimedia in professionele ontwikkeling wat bekom is, het die navorsers die digitale veelsydige skyf ontwikkel wat spesifiek op die programmeertaal Scratch gefokus is. Hierdie programmeertaal is 'n byvoeging tot die Inligtingstegnologie-sillabus en dus het onderwysers ondersteuning ontvang in hulle poging om die nodige kennis en vaardighede rakende die implementering van hierdie nuwe programmeertaal te bekom.

'n Empiriese studie, gemoeid met die ervarings van drie onderwysers, is uitgevoer om vas te stel wat hulle ervarings van multimedia-gebaseerde professionele ontwikkeling is. Al drie deelnemers het genoem dat hulle die inkorporering van multimedia in professionele ontwikkeling geniet het en ook dat 'n digitale veelsydige skyf van hierdie aard tog 'n plek in professionele ontwikkelingspogings het. Daar bestaan egter steeds 'n behoefte aan persoonlike interaksie met die fasiliteerder sowel as aan samewerking met kollegas.

Sleutelwoorde: Professionele ontwikkeling, onderwysersopleiding, multimedia, afstandsonderrig, multimedia-gebaseerde professionele ontwikkeling en Inligtingsteknologie-onderwysers

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## LIST OF ABBREVIATIONS

CAPS	Curriculum Assessment Policy Statement
CD	compact disc
CSE	Computer Science Education
DVD	digital versatile disc
INSET	In-service training
IT	Information Technology
ITE	Information Technology Education
NCS	National Curriculum Statement
ROM	read only memory

## CHAPTER 1

### ORIENTATION

#### **1.1. GENERAL PROBLEM STATEMENT**

The Department of Basic Education (2012:7) describes Information Technology (IT) as the study of various technologies that are used to process, capture and manipulate data in order to utilise it in a meaningful way, as well as engaging in activities that deal with problem solving by means of logical thinking. IT, as a school subject, is one of the elective subjects learners may study from Grade 10 to Grade 12. The Department of Basic Education brought about change in the IT syllabus by replacing the 2003 National Curriculum Statement with the new 2012 Curriculum and Assessment Policy Statement (CAPS), to be implemented in 2012 (Department of Basic Education, 2012:2). This change implied that content within the subject has changed, resulting in a need for teachers to be re-trained and assisted in mastering the new content.

In 2006, the Department of Education introduced the National Curriculum Statement and required teachers to attend a five-day, 37-hour training programme (Department of Education, 2006:3) where they had to attend many lectures and complete various activities. Consequently, not only did teachers lose valuable time because they were often absent from classes, but the Department also had to go to great costs in order to host and facilitate these training programmes. These once-off training sessions failed particularly because they overlooked the specific needs and contexts of the participants (Bowker *et al.*, 2009:20). Participating teachers also complained about the inappropriate length and timing of workshops as well as about the incompetence of the trainers (Conco, 2004:129). Despite their complaints, these teachers realised that they needed the training.

In-service training can be described as the process used to continue teachers' education after completion of their formal training (Bayrakci, 2009:11). Teachers have been described as 'silent stones' when participating in traditional in-service training sessions (Sandholtz, 2002:816). A need for holistic professional development has developed.

Murtaza (2010:213) describes professional development as a dynamic process that gives teachers continuous learning opportunities and which has a great effect on students' learning regarding their skills, knowledge, confidence and/or classroom behaviours. Where in-service training would generally focus on a particular aspect of teachers' work, professional development is considered to be a long-term process to enhance growth and development in the profession (Villegas-Reimers, 2003:11). Borko (2004:23) argues that a well-designed

professional development programme includes activities and materials for teachers, descriptions of facilitator roles and what is expected of teachers; thus, it is clear that traditional lecture-based in-service training cannot be classified as a well-designed professional development programme and a new approach is required.

Chan (2003:1) argues that multimedia-based professional development has the potential to expand traditional in-service training. Galvis (2004:5) agrees on this point and states that multimedia-based professional development has become the new way of doing teacher development. Though South Africa generally makes use of traditional in-service training for the professional development of teachers and probably will do so again, with the new syllabus changes that have been introduced, an alternative, the Shoma project, has been introduced. Shoma, a multimedia approach to professional development of teachers was shown to be successful, but teachers still complained that the training was not accessible to all as they had to travel to a Shoma centre and the costs incurred by either the Department of Education or the school to have teachers attend these programmes were quite high (Capper, 2002:48). Multimedia-based professional development is an initiative in professional development that has been shown to be beneficial, but it will only reach its potential if it is made accessible to all. Up to now, previous attempts to implement this approach have failed because of inaccessibility.

In the light of the above-mentioned discussion, the specific problem that was researched was therefore:

How would a multimedia-based professional development programme meet the needs of Information Technology teachers in terms of their subject content knowledge and pedagogical knowledge and skills?

In order to understand this question better and in an attempt to answer it, an investigation into the body of scholarly work was required. The following section examines literature pertaining to certain aspects that contribute to the understanding of professional development of Information Technology teachers.

## **1.2. INVESTIGATING THE BODY OF SCHOLARLY WORK**

Several components from within the body of scholarly work need to be addressed and will subsequently be discussed.

### **1.2.1. Computer Science and Information Technology Education**

Wilson *et al.* (2010:10) define Computer Science Education (CSE) as the conjunction of several elements including –

“... design, creation of digital artefacts, abstraction, logic, algorithm development and implementation, programming paradigms and languages, theoretical foundations, networks, graphics, databases and information retrieval, information security and privacy, artificial intelligence, the relationship between computing and mathematics, the limits of computation, applications in information technology and information systems and social impacts of computing.”

Perry (2004:28) defines Information Technology Education (ITE) as a combination of several technological aspects of the modern era that focus on creating solutions to everyday problems by using information and communication technologies that can be applied socially and economically. Thus, with the above-mentioned definitions in mind it is reasonable to agree with Athuada *et al.* (2005:125) and Tucker *et al.* (2003:7) who claim that CSE and ITE are mostly used interchangeably and that pedagogical principles that apply to CSE also apply to ITE and vice versa. Martin *et al.* (2002:1) emphasise the importance of professional development in Computer Science Education, which includes the enhancement of pedagogical skills as well as the content knowledge of the syllabi.

### **1.2.2. Information Technology curriculum**

Pedagogical skills are the skills teachers require in teaching content, whereas the syllabi defines the content that learners need to learn (Pears *et al.*, 2007:206). The IT curriculum was compelled to change in order to keep up with the rapid developments in computer science technology (Kong, 2007:130). Gruba *et al.* (2004:7) found that change in the curriculum of CSE is mostly driven by individual, political and fashionable influences rather than by academic needs. Ahlan *et al.* (2008:167), who agree with this view, state that CSE is influenced by business needs rather than academic needs. However, in South Africa, change in the curriculum has been particularly influenced by the commitment to inclusive education (Nel, 2007:1), by a political drive to right the wrongs of the apartheid era and in order to stay up to date with the latest trends in the computer science industry (Stephenson *et al.*, 2006:57-61). In the next section, the latest change brought about in the IT curriculum of South Africa is briefly discussed.

One of the clear similarities between the content described in the 2003 National Curriculum Statement (NCS) and the 2011 Curriculum and Assessment Policy Statement (CAPS) is the

emphasis on programming in the curriculum (Department of Basic Education, 2012:8; Department of Education, 2003:10).

Bills and Biles (2005:44) argue that programming is the fundamental skill of information technologists. While Bruce and Freund (2008:51) agree that programming is a fundamental skill, they go further by noting that, although programming enhances general computer science knowledge and algorithmic thinking and prepares students for a future in Computer Science, programming has been scaled down in the IT curriculum in general. The Department of Basic Education (2012:7) and the Department of Education (2003:9) maintain that programming and programming principles should be emphasised more in the IT curriculum and therefore it still takes up 60% of the IT curriculum as it did in the previous curriculum. However, the 2011 CAPS does include new IT content.

### **1.2.3. Basic programming by means of an introductory graphical programming tool**

One of the topics that have changed from the 2003 NCS to the 2011 CAPS, which were focused on in this study, was basic programming using Scratch as a programming language. According to Haden and Mann (2003:63), basic programming includes knowledge of variable declarations and how to use them, conditionals, loops and basic data structures. Previously in South Africa, basic programming skills were taught by means of the programming language Delphi or Java (Department of Education, 2003:9), whereas the 2011 CAPS now requires teachers to introduce learners to basic programming by means of an introductory graphical/visual programming teaching tool such as Scratch (Department of Basic Education, 2012:11).

Visual programming environments aim to create a platform where programming is learnt in a fun, non-threatening environment (Meerbaum-Salant *et al.*, 2010:69). Westphal *et al.* (2003:1) mention how their first-year engineering students struggled to deal with syntax and details of programming languages and how the introduction of a graphical programming tool has helped these students to foster problem-solving skills much more quickly than students who were taught according to the traditional methods. Carlisle (2009:275) also found that students become consumed in the programming syntax rather than in the underlying algorithmic skills and that a visual programming environment makes programming comprehension much easier. Though graphical programming languages have their distinct advantages, some disadvantages have been noted, such as the frustration a graphical programming language can cause for more sophisticated programmers who enjoy the control they have over a text-based programming language, especially with some expressions that can only be coded in text-based programming

(Begel, 1996:8). Numerous visual programming environments have been designed for the sole purpose of introducing programming. These include Logo, Karel the robot, LEGO Mindstorms, Phrogram, Alice and Scratch (Malan & Leitner, 2007:2; Sivilotti & Laugel, 2008:1). As Scratch is the graphical programming language suggested by the Department of Basic Education, this study also made use of Scratch for the purpose of examples and applications.

#### **1.2.4. Scratch as a new addition to the curriculum**

In 2003, researchers at the Massachusetts Institute of Technology (MIT) started the Scratch project as a result of the needs expressed by young people attending after-school computing classes. This followed the launch of the software in 2007 (Maloney *et al.*, 2010:2). Scratch is a programming language that uses a visual graphical user interface, where programmers program by dragging coding blocks and putting them together to form a script (Maloney *et al.*, 2010:2; Sivilotti & Laugel, 2008:2).

Giganti (2010:30), Malan and Leitner (2007:1) and Maloney *et al.* (2010:14) emphasise how Scratch allows students to enhance their logical thinking, planning, problem-solving and troubleshooting skills, even by just programming a simple program. Though these skills are all of great advantage to students, and Scratch proves to be beneficial, Harvey and Mönig (2010:2) express their concern for the omission of object-oriented abilities such as inheritance and encapsulation in Scratch, as Scratch falls short when it comes to teaching more advanced programming skills. Considering that the Department of Basic Education is only calling for the implementation of Scratch in the Grade 10 year of IT (Department of Basic Education, 2012:11), the lack of these advanced features will not curb the learners' learning as they are only being introduced to basic principles of programming.

With this new addition to the curriculum in mind, appropriate teacher training is necessary. Not only should teachers master subject material, but they should also acquire the pedagogical skills required for them to teach this material to learners (Lapidot & Hazzan, 2003:29). It is this need of teachers to be trained that created the need for appropriate professional development.

#### **1.2.5. Professional development of teachers**

Avalos (2010:10) defines professional development as teachers' learning, learning how to learn and putting what they have learned into practice in order to benefit their students. Hendricks (2004:16), Murtaza (2010:213) and Iheanachor (2007:19) emphasise that professional development should develop teachers' skills, knowledge and attitudes in order to improve their

effectiveness in their classrooms. Hendricks (2004:16) notes that professional development entails educator development, staff development and in-service training (INSET). Conco (2004:4) points out that in-service training in South Africa used to be seen as a form of practical training, short courses and formal programmes but that the focus has now shifted to include professional development in a broader sense. Louw (2008:1) is of the opinion that ‘professional development’ is the term used to describe what was previously known as in-service training, and Bayrakci (2009:10) confirms this view, as his definition of in-service training is the same as that of professional development. Thus it is clear that confusion exists as to how in-service training and professional development relate. Though Engelbrecht *et al.* (2007:581) state that the terms ‘professional development’ and ‘in-service training’ are often used interchangeably, in this study, in-service training was seen as a form of professional development, but not as synonymous with professional development. As in-service training forms part of professional development but falls short on its own, new or additional strategies need to be applied to address the problems of the past, while teachers are still assisted in obtaining the necessary content knowledge and pedagogical skills (Lapidot & Hazzan, 2003:29).

Professional development is not a new concept, but the way in which professional development is conducted is reconceptualised daily (Kriek & Grayson, 2009:186). According to Kennedy (2005:236-237), nine professional development models can be identified, namely “training, award-bearing, deficit, cascade, standards-based, coaching/mentoring, community of practice, action research and transformative”. The following section briefly describes what each model entails, but a more in-depth discussion of each model is presented in Chapter 2 (see 2.4) of this study.

#### 1.2.5.1. Training model

The training model, as described by Maldonado (2002:6), consists of training given to teachers by experts, focusing on skills they need in order to improve their practice in the classroom. This model is still very prevalent in the professional development discourse (Kennedy, 2005:237; MacNeil, 2004:14).

#### 1.2.5.2. Award-bearing model

In the award-bearing model, emphasis is placed on the completion of the professional development programme, followed by an award of some kind, such as a certificate or other qualification (Du Plessis, 2010:123; Kennedy, 2005:237). Though teachers are less reluctant to participate in these programmes, their motivation for completing the course (seeking award or

qualification) can be questioned and thus also whether they would implement what they have learned.

#### 1.2.5.3. Deficit model

Kennedy (2005:237), Algarfi (2010:60) and Tantranont (2009:61) describe the deficit model of professional development as a model that specifically targets a teacher's deficiency in performance and which addresses these needs individually rather than focusing on the general assumption of what teachers need to learn.

#### 1.2.5.4. Cascade model

In the cascade model, one or two teachers from a school attend a training session and are then required to disseminate their knowledge and skills to the rest of their colleagues (Du Plessis, 2010:157). The problem with this approach to professional development is that the focus is on knowledge and skills as generic components while attitudes and values are forced to take a back seat (Kennedy, 2005:240). This means that teachers gain knowledge and skills but are not necessarily changed in order to improve their teaching praxis.

#### 1.2.5.5. Standards-based model

The main focus of the standards-based model is results in terms of empirically measurable data, which implies that this model aims to educate teachers in such a way that their students' results improve and that they themselves are able to compete with other teachers in their field (Beyer, 2002:243). The problem with this model is that holistic development cannot always be measured by means of marks and that many other facets of development need to be considered in order to judge the success of a professional development programme.

#### 1.2.5.6. Coaching/mentoring model

The coaching/mentoring model works on the premise that each individual is assigned a partner (coach/mentor) in order to enhance and build on the professional development received (Du Plessis, 2010:125; Kennedy, 2005:242). This model has the advantage that learning takes place in the teacher's context, taking into account the individual needs of the teacher as well as incorporating cooperative learning benefits as teachers receive one-on-one support.

#### 1.2.5.7. Community of practice model

As with the coaching/mentoring model, a cooperative approach to professional development is taken, but it is normally not done on a one-on-one basis (Kennedy, 2005:242). In the community of practice model, each participant brings a certain set of knowledge and skills to the table and by sharing and receiving participants have the opportunity to change their attitudes and values of their teaching praxis (Tantranont, 2009:62). If this model is not implemented correctly, as with any cooperative endeavour, participating teachers could take a passive role in their learning and thus this approach to professional development needs to be monitored correctly (Algarfi, 2010:61).

#### 1.2.5.8. Action research model

In the action research model of professional development, teachers are seen as researchers in their classrooms, executing strategies learnt and observing whether the strategies were successful and if not, adapting the practice to reach greater heights. Although this model holds benefits such as teachers being in control of their own learning, and development happening specifically within the teacher's own classroom, there is doubt as to how critical teachers can be of their own practice (Kennedy, 2005:246).

#### 1.2.5.9. Transformative model

Kennedy (2005:246) describes the transformative model as a model of professional development that consists of various other models. As each model described above has advantages as well as disadvantages, a combination of the models seems to be the most appropriate approach to professional development (Du Plessis, 2010:128). For the purpose of this study, a transformative model approach to professional development was taken, even though the transformative model incorporates elements of both constructivist and behaviourist nature.

It is important to take note of how professional development has previously been undertaken in South Africa. Many professional development programmes have fallen short of their set goals due to a lack of appropriate research (Steyn, 2010:157). There are however some professional development programmes in South Africa that have succeeded, such as the UNIVEMALASHI programme (Onwu & Mogari, 2004:176). In their report on the UNIVEMALASHI professional development programme, Onwu and Mogari (2004:165-168) describe components of their programme that have contributed to the programme's success, namely workshops, district

specialist visits, cluster meetings, school-based workshops, and a focus on parent involvement. In his study, Bantwini (2009:180) found that teachers do not appreciate workshops as these do not cater for every teacher individually and do not recognise teachers' various individual needs. Kriek and Grayson (2009:195) reported that teachers who participated in their study felt that they had benefited from attending workshops. However, not all teachers could attend the workshops. This confirms that while workshops can be beneficial, there are many factors (like teachers' needs and logistic limitations) that could cause them to fall short (Bowker *et al.*, 2009:19). It is important to ask whether it would not be possible to design a more effective professional development programme that would not only meet teachers' needs but which would also meet them in a more convenient and effective way.

### **1.2.6. Multimedia-based professional development**

One of the alternatives to traditional instruction-based professional development is that of multimedia-based professional development. As early as 1971, Tanem (1971:26) noted that the use of multimedia could be beneficial to teacher training. The use of multimedia, which entails integrating media objects such as text, video and audio to represent information, has the potential to connect aspects of the curriculum to real-world scenarios (Chrichton & Kopp, 2002:1; Mackey & Ho, 2008:387). Galvis (2004:5) and Song and Catapano (2008:76) point out that though different strategies of professional development exist, multimedia-based professional development proves to be a promising approach that will help teachers grow professionally. Pang (2009:3) agrees and reiterates that the use of various technologies (i.e. multimedia) has been well established to improve professional development. Jiménez (2003:311) describes how the possibilities of teacher education can be expanded through the use of multiple technologies as it can provide representations, models, analogies and other pedagogical features that will help teachers connect theory to their real-world situation.

#### **1.2.6.1. Advantages of using multimedia-based professional development**

Some of the advantages of using multimedia as a professional development tool have already been mentioned above. Other advantages are:

- the inclusion of different learning styles of teachers like audio, video and other simulations can be used (Allison, 2007:21; Cherett *et al.*, 2009:1126);
- an increased ability to move information from short-term memory to long-term memory (Zhang *et al.*, 2006:18);
- greater accessibility to all teachers as costs are lowered (Fisher *et al.*, 2010:302); and

- more efficient use of time as teachers can access the material at a time that is convenient to them (Pryor & Bitter, 2008:2669).

#### 1.2.6.2. Disadvantages of using multimedia-based professional development

Literature on the advantages and disadvantages of the use of multimedia as a professional development tool is still limited (McGraw *et al.*, 2007:96). However, the following disadvantages have been noted:

- Teachers might be overwhelmed by their limitation of multimedia usage and spend more time trying to figure out how the tool works than actually participating in the programme (Pryor & Bitter, 2008:2669).
- It can be very expensive to manufacture a multimedia professional development programme, yet it seems as though hosting a professional development workshop will still cost more (Bin Ismail, 2005:9).
- In the use of multimedia, there is a lack of face-to-face interaction (Posey *et al.*, 2010:4).

The above-mentioned disadvantages of the use of multimedia-based professional development play an important role when the researcher designs and implements such a programme. The researcher therefore addressed such disadvantages and aimed to ensure that they did not occur in this study.

Although traditional in-service training for the professional development of teachers is used in South Africa, an alternative (the Shoma project) has been introduced. Shoma, a multimedia approach to the professional development of teachers, has proved to be successful (Capper, 2002:48). Capper (2002:44-48) explains that Shoma training consists of 24 weekly lessons for each phase, and teachers are required to attend a Shoma centre from 13:00 to 16:30 daily. They are taken through various 'rooms' focusing on different skills and development. All the teachers who attended agreed that the training had been beneficial to them. There was, however, a major problem with transport and the costs incurred to host a lesson went well above R50 000.

With the Shoma model in mind and considering the advantages of using multimedia in professional development, it is reasonable to say that there is room for multimedia-based professional development in South Africa. However, costs need to be lowered and training needs to be made accessible to all teachers. In the past, these factors have caused multimedia-based professional development attempts to fail.

### **1.3. AIM OF THE RESEARCH**

This study was of an exploratory nature, as the aim was to propose a multimedia-based method of professional development for IT teachers in Scratch, as this had not yet been done. A further aim was to determine how teachers experienced this particular method.

### **1.4. RESEARCH QUESTION(S)**

In order to achieve the aims of the study, the following research questions led this research:

1. What is the nature of professional development for IT teachers?
2. What are IT teachers' needs in terms of professional development?
3. How could multimedia be implemented in professional development for IT teachers learning Scratch?
4. What should be included in a professional development DVD for the training of IT teachers in Scratch?
5. How do IT teachers experience a multimedia-based professional development programme in the form of a DVD when learning Scratch?
6. Which recommendations regarding professional development could be made to advise the Department of Basic Education?

### **1.5. RESEARCH DESIGN AND METHODOLOGY**

This section is focused on discussing the research design and methodology used in this study.

#### **1.5.1. Investigation into the body of scholarly work**

An investigation into the body of scholarly work was conducted in order to establish what research had already been done in the field of in-service training, professional development of teachers and especially the use of multimedia in the professional development of teachers. Various search engines and databases like Google, EBSCOhost, Eric, Science Direct and Informaworld were used. Specific key words included 'Information Technology Education', 'Computer Science Education', 'in-service training', 'professional development', 'multimedia-based professional development', 'teacher training' and 'Scratch'.

#### **1.5.2. Empirical study**

The empirical study conducted will subsequently be discussed.

### 1.5.2.1. Research design

The choice of a research design plays a vital role in the way data is collected. The research design is guided by the questions the researcher aims to answer as well as how the researcher will go about answering these questions (Flick *et al.*, 2007:36; Nieuwenhuis, 2009:70). Thus the research design needs to be chosen carefully.

Qualitative research describes how individuals view certain aspects in their world as it is focused on individual encounters and descriptions rather than on general assumptions (Creswell, 2009:4). Krauss (2005:763) and Babbie *et al.* (2008:270) explain that qualitative research is concerned with meaning-making as individuals are responsible for forming their own meaning of their world. As the main objective of the current study was to determine how teachers experienced multimedia-based professional development, a qualitative research design was followed.

Nieuwenhuis (2009:57) mentions two paradigms, among others, that are generally used in qualitative research designs: critical theory and constructivism. Judging from the two paradigms, constructivism was regarded the most appropriate paradigm for the purpose of this research, as the researcher aimed at understanding the participant's views and construct her own understanding of the topic at hand, instead of focussing on generalisable data not focused on individual responses.

Another important aspect regarding a qualitative research design is the methodology that is chosen. For the purpose of this study, where the aim was: to understand teachers' experience of a specific phenomenon (multimedia-based professional development), a phenomenological methodology was selected.

### 1.5.2.2. Site selection

The selected research sites were the schools at which the participating teachers were teaching and the venue where the teachers chose to complete the multimedia-based professional development programme. These two sites posed challenges as interferences were probable, but the advantage was that the teachers would most likely be comfortable in those surroundings.

#### 1.5.2.3. Participant selection

With the help of the North West Department of Education and the project in which the study falls, three IT teachers from diverse areas were selected. The researcher therefore made use of purposive sampling. The purposive sampling method forms part of the non-probability sampling as it is not probable that the researcher will be able to transfer from this sample. However, meaningful insights into the topic being researched can be gained (Babbie *et al.*, 2008:166). This method is used when the researcher chooses the sample from his/her own reference with a particular research question and aim in mind.

#### 1.5.2.4. Data collection methods

During the research, a semi-structured interview with each participant was conducted. The interview was based on establishing how teachers experienced the multimedia-based professional development programme. The questions used in the semi-structured interview were formulated based on the study of the body of scholarly work. Furthermore, participants each received a manual (see Addendum A) accompanying the DVD consisting of activities as well as reflection sheets. These reflection sheets also gave participants the opportunity to express their experience regarding each section of the DVD.

#### 1.5.2.5. Data collection

During the first visit to the participants, the researcher explained the professional development programme and expressed the fact that it was developed for IT teachers and not learners. Participants had two months to complete the programme and gather their experiences regarding it.

The second visit entailed a semi-structured interview, which was used to collect data regarding teachers' experiences of multimedia-based professional development. Furthermore, the reflection sheets provided in the user manuals were collected in order to serve as verification of teachers' responses to questions in the semi-structured interview.

#### 1.5.2.6. Data analysis

Gibbs (2008:3) explains that qualitative data analysis focuses on two main aspects: understanding how data can be described and explained, and practical activities that help with examining the data.

During analysis, the researcher identifies codes repeated from each individual's data and then identifies and categorises these codes into themes across all participants' data (Babbie *et al.*, 2008:496; Fossey *et al.*, 2002:728). In this study, the researcher transcribed the recorded interviews, after which emerging codes were identified in each transcription. Once all possible codes had been identified, they were categorised into themes, including all transcription's codes.

From these themes, the researcher aimed to draw conclusions and make assumptions.

#### 1.5.2.7. Trustworthiness

In order to establish trustworthiness in qualitative research, matters of credibility, dependability, transferability and confirmability need to be taken into account (Babbie *et al.*, 2008:276; Sinkovics *et al.*, 2008:691). A short discussion on how each of these aspects were addressed in the study follows.

##### 1.5.2.7.1. Credibility

The credibility of a qualitative research study relies on whether the realities constructed by the respondents are in fact what the researcher made them out to be (Sinkovics *et al.*, 2008:699). In the current research, the researcher made use of recordings to ensure that what respondents answered in the semi-structured interviews was transcribed correctly. This was followed by a peer debriefing session where an objective colleague assisted during the coding phase of the interviews.

##### 1.5.2.7.2. Dependability

Dependability entails that the findings of the research would be similar if the study should be repeated in another setting (Babbie *et al.*, 2008:278). An objective inquiry auditor examined the data as well as the codes and made judgement on whether he/she found it dependable.

##### 1.5.2.7.3. Transferability

As with generalisability in quantitative research, transferability indicates how the findings of the study can be applied in other contexts (Babbie *et al.*, 2008:277; Sinkovics *et al.*, 2008:699). The researcher aimed at making the data and findings as descriptive as possible in order to describe the study in the fullest possible detail. Furthermore, a purposive sample was used in this study, which implied that it would be possible to transfer the results to a similar sample in another setting.

#### 1.5.2.7.4. Confirmability

Confirmability describes to which degree the researcher's biases have been omitted from the research, and confirms that the findings are those of the research that has been conducted (Babbie *et al.*, 2008:278). Before the researcher continued with data analysis and making assumptions of the study, the first codes as well as transcripts were given to an objective inquiry auditor. This auditor ensured that the researcher rightfully made assumptions based on the research and that it was not influenced largely by the researcher's own bias.

As the trustworthiness of the study relied solely on the role the researcher played during the study, the researcher's role will now be described.

#### 1.5.2.8. Researcher's role

Throughout the course of the research, the researcher played several roles: that of an interviewer (during semi-structured interviews), a professional development programme developer (during the development of the DVD), a facilitator (during the briefing of the way to use the DVD as well regarding certain parts of the DVD) and a supporter (throughout the whole course of the research).

#### 1.5.2.9. Ethical aspects of the research

The ethical aspect of the research is of the utmost importance and thus several steps were taken in order to ensure that the research was ethically sound. Ethical clearance from the North-West University (Potchefstroom Campus) was requested before any research endeavours were undertaken.

Once ethical clearance had been obtained from the North-West University (see Addendum B), permission from the North West Department of Basic Education (see Addendum C) as well as the principal of each school (see Addendum D) was requested. After the two above-mentioned parties granted permission, the IT teachers of the selected schools were asked to participate in the research on a totally voluntary basis, being ensured that if they chose not to participate, neither their principal nor any other parties involved would hold it against them (see Addendum E). Participants who chose to participate in the research were asked to complete a letter of informed consent stating that they were willing to participate but still retained the right to withdraw from the research at any given time.

During no stage of the research was any school's name or teacher's name used and thus confidentiality was ensured. Results produced in the study would be supplied to any of the three parties (North West Department of Education, principal of the school or participating teacher) upon request.

## **1.6. STRUCTURE OF DISSERTATION**

Chapters 2 and 3 are directed at an in-depth investigation of the scholarly body of work on professional development and multimedia development respectively. In Chapter 4, the research design, methodology as well as the results are discussed, and in Chapter 5 conclusions are discussed and recommendations are made.

## **1.7. CONTRIBUTION OF THE STUDY**

It was hoped that this study would contribute not only to the subject areas of IT education and professional development but also to the research focus area of teaching and learning praxis of the Faculty of Education Science at the North-West University (Potchefstroom Campus).

### **1.7.1. Contribution to the subject area**

Information Technology as a school subject has taken great strain over the past few years. Teachers are struggling to keep up with the rapid changes and thus a professional development programme, accessible to all teachers, will benefit the subject in such a way that teachers may feel more supported and less overwhelmed.

### **1.7.2. Contribution to the research focus area**

In the research focus area of teaching and learning praxis, a project on empowering Information Technology teachers in economically deprived rural schools, forms part of the area. This study also targeted Information Technology teachers in economically deprived rural schools and thus directly assisted the project and the focus area in this endeavour.

## CHAPTER 2

### PROFESSIONAL DEVELOPMENT

#### **2.1. INTRODUCTION**

In Chapter 1, an overview of the study was given whereas this chapter aims to report on a more in-depth search into the scholarly body on professional development. Specific reference to various models of professional development as well as how these models apply to the development of teachers in general and specifically Information Technology (IT) teachers, who are required to acquire skills particularly for the programming language Scratch, will be described.

#### **2.2. CONCEPT CLARIFICATION OF PROFESSIONAL DEVELOPMENT**

In recent years, professional development has received great emphasis, especially after the legislation of the No Child Left Behind Act of America in 2001 (Smith & Kritsonis, 2006:2). When one considers the concept ‘professional development’ several aspects can come to mind. Some might argue that emphasis should be placed on ‘professional’ and others on ‘development’. The word ‘professional’ is described as someone who engages in one of the learned professions whereas ‘development’ is defined as a specified state of growth or advancement (Merriam-Webster Dictionary, 2011; Oxford Dictionary, 2011c). Thus from a purely semantic point of view, professional development is defined as: The state of growth or advancement of someone who engages in one of the learned professions. However, in the body of scholarly work on professional development, a wider definition can be obtained.

Professional development, within its wider sense, can be described as an ongoing process where professionals have the opportunity to acquire knowledge, skills and attitudes (Pillay, 2011:353; Rage, 2006:8). Guskey (2000:16) describes professional development as having three distinct characteristics, making it an intentional, ongoing and systematic activity. Chikoko (2008:75) notes that professional development is the sum of various activities in order to assist staff growth. In the 1980s, Howey *et al.* (1985:88) defined professional development as in-service training that requires professionals to engage in activities during their service, leading to the enhancement of their job. However, Gaff *et al.* (1978:8) noted much earlier already that professional development needed to change its focus from mere in-service training, where the focus falls on knowledge acquisition, to development that includes activities that improve instruction and career development, enhance relationships with the institution, as well as foster personal development. Professional development can occur in any area of professionalism

(Panda, 2004:63), but this current study focused solely on the professional development of teachers in particular and thus the remainder of this dissertation focuses on professional development of teachers.

The Michigan Report (Michigan State Department of Education, 1977:12) states that in education, professional development is –

“a planned effort to provide teachers and other educational workers with the knowledge and skills necessary to facilitate improved student learning and performance.”

Effective teachers' professional development is professional development that brings about change in teachers' instructional practice (Blazer, 2005:1). The report of the ministerial committee on teacher education (Department of Education, 2005:9) mentions that various contributions can be made to professional development of teachers. These include once-off interventions, short training programmes and courses linked to formal qualifications. Avalos (2010:10), Hendricks (2004:16), Murtaza (2010:123) and Iheanacho (2007:19) all agree that professional development of teachers can be executed by means of various methods, like workshops, where teachers' knowledge, skills and attitudes are developed, though not all interventions are equally effective (Department of Education, 2005:9). When considering these various methods, learning approaches in professional development should be considered as a guideline. Subsequently, two learning approaches in professional development will be discussed.

## **2.3. LEARNING APPROACHES IN PROFESSIONAL DEVELOPMENT**

As professional development is defined as an ongoing process executed by means of various methods, it is important to establish which paradigm or approach is best suited for the programme in order to develop teachers' knowledge, skills and attitudes. Two approaches to learning in professional development are investigated, namely behaviourism and constructivism.

### **2.3.1. Behaviourism as an approach to professional development**

Charlesworth (2004:73) describes the behaviourist approach as an approach that rests on the following principles: people are taught to behave in a certain way, people teach other people, to learn is to change, and teachers are people who change learners. Though behaviourism does not allow people to construct their own knowledge, it has been set aside as the theory of learning most commonly used in schools and formal contexts (Pritchard & Woollard, 2006:4). MacLellan (2005:137) argues that behaviourism is the most predominantly used teaching-

learning method, where a passive-reception view of learning is followed. He further states that educationalists expect curriculum changes to be “transmitted” to heads of departments who then have the task to cascade it to personnel. When following the behaviourist approach to teaching and learning, teaching is seen as the provision of knowledge, whereas the constructivist approach views teaching as the facilitation of knowledge construction (Boghossian, 2006:714).

Professional development of teachers, as mentioned previously (see 2.2.) entails more than just merely giving knowledge to teachers; it concerns the development of teachers in order for them to better themselves in all aspects of life. Thus, by definition, behaviourism is less viable than what other approaches may be. Subsequently, constructivism will be discussed in order to determine whether it is a better approach to professional development than behaviourism.

### **2.3.2. Constructivism as an approach to professional development**

Although some educationalists still hold on to the theories of behaviourism, the teaching-learning theory of importance in modern society is constructivism (Boghossian, 2006:713). The constructivist approach to learning assumes that learning is the responsibility of the individual, where individuals create their own meaning by incorporating prior knowledge with ideas and knowledge with which they come into contact (MacLellan, 2005:139; Resnick, 1989:2). This links directly to the cognitivist approach to learning, which is concerned with how knowledge is constructed in the mind. The main concept of constructivism is however that knowledge is not an absolute, and therefore each individual needs to have the opportunity to create his or her own knowledge in his or her own space and time (Boghossian, 2006:714).

Kimble *et al.* (2006:318) found that making use of a constructivist-based professional development programme allows for sustainable professional development and fosters the use of constructivist teaching approaches by teachers. Furthermore, Powell and Kalina (2009:241) argue that constructivism is the best method for teaching and learning as it is based on more than just observable behaviour. Professional development, as implanted recently within a constructivist approach, has been proved to be more successful as teachers are actively involved in their learning and are challenged to develop holistically (Richardson, 2007:13). Apart from logistical challenges faced by teachers (in not being able to attend professional development sessions, see 1.2), teachers in South Africa are required to teach in a constructivist manner, thus implying that they need to receive professional development in a constructivist environment (Hendricks, 2004:18). Professional development programmes should meet teachers’ individual needs and varying levels of content knowledge and skills (Desimone

*et al.*, 2006:206; Penuel *et al.*, 2007:943), thereby implying that one cannot accept that teachers sitting in a classroom at a once-off training session are all benefiting as each individual's needs and definitions of knowledge differ.

Taking into consideration the two above-mentioned approaches to professional development, it is clear that the constructivist approach serves teachers' needs best. Even though the approach to learning is important in professional development, the model, which is followed, also plays an important role. The following section focuses on the different models found in professional development programmes.

## **2.4. DIFFERENT MODELS OF PROFESSIONAL DEVELOPMENT**

A professional development model is defined as a plan that can be followed when designing a professional development programme (Bantwini, 2009:170). Thus the first step in developing a professional development programme is an investigation into various professional development models to ensure that the most appropriate model is followed. If this is not done, the professional development programme, like various others in South Africa, will fail as a result of inappropriate models (Maistry, 2008:127).

### **2.4.1. Training model**

Traditional in-service training generally follows the training model, where one or more facilitators act as the experts; teaching participants what they need to know (Maldonado & Victoreen, 2002:3) and teachers are required to attend a workshop. In this model, it is possible for the training to accommodate various aspects including content knowledge and pedagogical skills, which have the potential to enhance teachers' professional development. Teachers are however described as passive participants as the model mostly makes use of the direct teaching strategy (Sandholtz, 2002:816).

Limitations of this model have been identified. Ryan (2007:47) notes that what teachers learn at these workshops or training model-based professional development seldom gets implemented into the teachers' classes. McKenzie (2001:4) states that the training model too often focuses on "marching through a series of skills lessons", which does not allow for personal preference and needs of teachers to be met. According to Garet *et al.* (2001:920), workshops are one of the most criticised methods of professional development.

In South Africa, this model of professional development is often provided by the Department of Education, where teachers are required to attend workshops presented by Department representatives. These training sessions normally rest on the behaviourist approach to learning, which does not promote individual learning or allow people to construct their own knowledge (Pritchard & Woollard, 2006:4).

#### **2.4.2. Award-bearing model**

The award-bearing model can include any form of professional development but will most likely be in accordance with the requirements of the higher education institution that endorses the professional development programme (Kennedy, 2005:238). As this model grants teachers the opportunity to receive a qualification or certificate recognising their participation and performance, teachers are more likely to participate in this type of professional development. Often higher education institutions will collaborate with either the school or the Department in order to create a professional development programme giving teachers the opportunity to further their education and in doing so increasing their qualifications (Frost, 2000:21). Poulter (2003:1) mentions three reasons why award-bearing professional development is beneficial: it is seen as recognised training, it is seen as further professional development and it allows teachers to gain a recognised qualification. Poulter (2003:1) however expresses concern that those teachers attending the professional development programmes might not attend for the right reasons and that the knowledge and skills learnt will not be sustainable or implemented. He further illustrates how some teachers are not bothered about professional development but only want to obtain a recognised qualification (Poulter, 2003:1).

In the South African context, the award-bearing model is encouraged by the South African Council for Educators (SACE) as they suggest that teachers should be granted professional development points after successfully completing an accredited professional development programme (Department of Education, 2006:18). This model of professional development however does not state which programmes need to be attended, therefore teachers might choose programmes bearing the most beneficial award, not seeking the programme that addresses their needs most adequately.

#### **2.4.3. Deficit model**

Teachers are often regarded as lacking certain knowledge and skills. The deficit model specifically addresses these perceived deficits that teachers may experience (Kennedy, 2005:239; Tantranont, 2009:61). Professional development following the deficit model is

therefore not guided by the needed professional development of the day, but by what teachers are perceived of lacking. On the other hand, teachers do not merely learn what is expected of them, but their needs are taken into consideration. Bantwini (2009:170) argues that, in professional development a certain level of the programme should be devoted to addressing teachers' needs and decreasing the deficit they might experience in their knowledge and pedagogical skills. Focusing solely on the supposed deficits will cause some valuable additional information to be lost (Bantwini, 2009:170). This model is criticised throughout literature as some teachers' needs are met while other teachers, not experiencing the same needs, have to endure the session until their needs are addressed (Clarke & Hollingsworth, 2002:948). In South Africa, many teachers have not received adequate pre-service training, which leads many professional development authors to make use of the deficit model (Bopape, 2009:49).

#### **2.4.4. Cascade model**

In the cascade model, one or two people in the school, for instance, are expected to attend a professional development programme and on completion, return to school and pass their knowledge on to their colleagues (Du Plessis, 2010:157; Hooker, 2006:4).

Some disadvantages of the cascade model are that teachers feel that they miss out from not having experienced the development first-hand and that they do not receive adequate information. Selected personnel often do not want to attend and reluctantly report back to their subordinates (Hayes, 2000:138). Shezi (2008:101) found in his study that the cascade model is most commonly used in South Africa, but that it de-professionalises teachers due to its lack of sustainability and the mass scale of implementation. However, this model still proves to be more cost- and time-efficient (Wilkinson & Billig, 2006:22). Having only one or two staff members disrupting their work, many schools have welcomed it. As indicated in the body of scholarly work, it is beneficial to have people learn together: a principle that is fostered in the cascade model (Shezi, 2008:66).

When outcomes-based education was introduced in South Africa, the Department of Education made use of the cascade model, selecting some individuals from a school to cascade the information to their colleagues (Ono & Ferreira, 2010:60). Ono and Ferreira (2010:61) reported that teachers complained that even the trainers themselves did not understand the work fully.

#### **2.4.5. Standards-based model**

The professional development that is executed in this model is determined by the general standards that are expected, after which teachers are required to reach these standards through professional development (Beyer, 2002:243). According to Kennedy (2005:237), this model of professional development is often controlled by a central entity, ensuring the quality of the programme. She however continues to note that this view is not based on the individual needs of teachers and therefore the standards-based model often falls short (Kennedy, 2005:237). With the implementation of the standards-based professional development model, a competitive feeling could be fostered as teachers often feel inferior when they cannot reach the set standards (Ingvarson, 1998:138).

Though it has the potential to force teachers to reach greater heights (Kennedy, 2005:241), as the standard might be higher than their average expectancy, Beyer (2002:240) criticises the standards-based model of professional development as not focusing adequately on the purpose of teaching.

One major advantage of the standards-based model of professional development is the fact that it gives teachers the opportunity to have a common ground enabling them to partake in conversations and collectively support each other (Kennedy, 2005:242).

#### **2.4.6. Coaching/mentoring model**

Assigning a coach to each teacher to allow for professional development forms the basis of the coaching/mentoring model (Kennedy, 2005:242). This model has proved to have many benefits such as teachers receiving professional development in their context as well as one-on-one support received from the coach (Onchwari & Keengwe, 2008:20). Tugel (2004:23) supports the coaching/mentoring model as he notes that it allows professional development to be sustainable. In this model, the teacher may become dependent on the coach, not relying on his or her own ability to further his or her own development (Russo, 2004:3). However Rhodes and Beneicke (2002:1) emphasise the advantage that this model holds in terms of communication and interpersonal skills and therefore iterate that it is a viable option.

#### **2.4.7. Community of practice model**

The community of practice model requires several participants as well as an expert of the professional development programme to form a cluster where they are able to share knowledge

and skills (Wenger *et al.*, 2002:4). Each of the participants has the responsibility of bringing a certain set of skills and knowledge to the cluster so they can assist each other in their development (Tantranont, 2009:62). With the community of practice model of professional development, participants have the opportunity to cooperatively partake in their professional development (Cochrane, 2007:36).

The community of practice model could confront teachers with the problem of scheduling cluster meetings which could negatively influence the progress of their professional development (Ferguson, 2011:101). Furthermore, a possibility exists that teachers may not experience professional learning due to a lack of mutual accountability (Kennedy, 2005:245; Wenger, 1999:81). Jenkins and Lonsdale (2007:443) are of the opinion that participants will reap fruits and gain from the professional development programme if a community of practice is established correctly.

#### **2.4.8. Action research model**

Professional development, according to the action research model, sees the teacher as being a researcher in his or her own context (Kennedy, 2005:246). According to Rock and Levin (2002:8), inquiry, problem solving and reflection skills are enhanced when this approach to professional development is followed. Teachers develop their research skills as they are required to use the above-mentioned skills in the action research model of professional development. Teachers are responsible for their own progress in their professional development because they need to implement research techniques and in doing so continuously revise their teaching-learning strategies (Zeichner, 2002:302).

Even though this model has benefits, some disadvantages may also occur. As teachers generally approach this endeavour individually, they may overlook certain key aspects that are in need of revision, slowing down their professional development (Kennedy, 2005:245).

#### **2.4.9. Transformative model**

The transformative model gives participants the opportunity to transform their knowledge, skills and attitudes as it integrates aspects of various professional development models (Bélisle, 2008:10; Kennedy, 2005:246). The transformative model is often seen as a response to traditional in-service training where knowledge and skills are transmitted from the facilitator to the participant (Silverman & Thompson, 2008:7). Cummings and Williams (2005:125) argue that the transformative model was established in order to transform educational systems and the

society. This model of professional development is strongly embedded in the constructivist perspective of learning as teachers are required to construct their own knowledge rather than memorising what is taught, with emphasis on how to implement this knowledge in a practical way (Dickerson *et al.*, 2007:371). Elements of the behaviourist learning approach is also visible in the transformative model where the advantages of the training model are incorporated. One of the main focuses of the transformative model is that of critical reflection (Wang, 2010:2). Although the transformative model of professional development emphasises that pedagogical-content knowledge should be on the foreground in professional development, and Prestridge (2007:1) argues that professional development cannot solely be focused on this type of knowledge, this model has been proved to be sufficient for successful professional development as it focuses on bringing about transformation (Prestridge, 2007:1).

The transformative model is not without fault and still has room for improvement (Kennedy, 2005:246). In South Africa, several professional development programmes aim at being transformative in nature, thus incorporating aspects of different models of professional development to insure teacher change. Although professional development programmes sometimes make use of the transformative model, the training model still remains the leading model for professional development in South Africa.

## **2.5. TEACHERS' NEEDS: A COMPASS FOR PROFESSIONAL DEVELOPMENT**

Teachers in South Africa express several needs that they require to be met when participating in professional development programmes. These needs have to be used as a compass when developing professional development programmes.

Grant (2008:86) argues that any professional development programme for teachers needs to promote leadership skills, where leadership is defined as “the process that brings about change in an organisation”. Grayson *et al.* (2001:5) argue that professional attitudes need to be addressed in a professional development programme. Theory cannot overshadow practice and thus it is important that the professional development programme take on a school-based form, bearing in mind the implementation of theory and not only theory itself (Probyn & Van der Mescht, 2001:2). Researchers like Du Preez and Roux (2008:83) and Korthagen (2004:5) note that professional development cannot be successful if there is no room for reflection, implying that teachers need to be given the opportunity as well as the skills to reflect critically. Mentoring, where teachers are assigned a mentor assisting them in their professional development process, is considered vital by researchers like Barnes and Verwey (2008:12). Ingvarson *et al.* (2005:11)

emphasises the importance of continual contact between the facilitator of the professional development programme and the teachers.

## **2.6. FACTORS INFLUENCING THE SUCCESS OF A PROFESSIONAL DEVELOPMENT PROGRAMME**

There are several factors that should be taken into account when measuring the success of a professional development programme. Researchers like Reeves (2010:22), Smith and Gillespie (2007:206) and Desimone *et al.* (2002:110) argue that the success of a professional development programme is measured by students' achievement. This is not always the case, as professional development has as its aim holistic development of the teacher and not merely enforcing better student achievement. The effect of a successful professional development programme is therefore not necessarily evident in the increase in student marks (Dede *et al.*, 2005:5). It could however be one indicator of the success of a professional development programme due to the teacher being trained more adequately for the job at hand and, if possible, having a better attitude toward learning (Galvis, 2004:38). It is however important to remember that students' achievements are influenced by various factors (Alvaera *et al.*, 2009:57) and uncontrollable variables and thus judging the efficacy of a professional development programme solely on changes in student achievement will not prove to be reliable (Kelly & Williamson, 2002:423). Villegas-Reimers (2003:19) agrees that student achievement can be a factor in measuring the success of professional development, but also mentions that it is not the only factor by which success should be measured. Borko (2004:10) notes that the facilitator plays a role in the success of a professional development programme, and Garet *et al.* (2001:917) mention that the fostering of ongoing collaboration, alternative ideas on teaching, focus on student thinking, content knowledge and pedagogy addressed also influence the efficacy of professional development. As illustrated above, various criteria exist for measuring the success of a professional development programme. For the purpose of this study, a combination of the criteria suggested by Borko (2004:10) and Garet *et al.* (2001:917) will be discussed in the next section.

The facilitator, especially in a face-to-face professional development programme, is responsible for guiding teachers in the process where they are constructing new knowledge and acquiring new skills (Borko, 2004:4). Teachers often complain that the professional development programme they attended was unsatisfactory due to an inadequate facilitator (Engelbrecht *et al.*, 2007:591). The facilitator of a professional development programme could determine the success or failure of the programme and thus needs to be trained well him/herself and be able to facilitate the programme in a competent way (Klinger, 2004:254).

Furthermore, facilitators of these programmes should promote a teaching-learning environment where teachers feel comfortable to ask questions, interact with each other and have their personal needs met. Thus it is deduced that the efficacy of a professional development programme can be measured by how well the facilitator guided the process of learning as well as how the participants of the programme experienced the facilitator, for example whether they felt the facilitator was adequate (Conco, 2004:28).

As mentioned earlier, it is clear that traditional in-service training programmes focused on assisting teachers in acquiring a steady body of content knowledge, omitting other facets of teacher development that also needed to be addressed (Chisholm, 2000:3). Content knowledge is of the utmost importance and teachers should be able to increase their content knowledge of whatever topic is at hand in a successful professional development programme (Eylon & Bagno, 2006:2). Mere acquisition of knowledge is not enough. Instead of focusing solely on teaching teachers some content, each section of content should be accompanied by pedagogical principles so that the teacher will be able to apply the content knowledge learnt adequately and effectively. Pedagogical skills are skills used in any educational endeavour (Hinchliffe, 2001:34). The way teachers teach is a clear indication of their pedagogical skills; thus, if they lack the necessary pedagogical skills, learners will more often than not struggle to grasp the concepts at hand (Entz, 2006:2). During previous professional development programmes, teachers noted that they sometimes lacked the pedagogical skills needed, as they were never taught what the best teaching approach would be (Conco, 2004:28). A successful professional development programme will allow teachers to gain not only content knowledge, but also pedagogical skills (Garet *et al.*, 2001:923; Martin *et al.*, 2002:1). This implies that different teaching-learning strategies need to be introduced as well as showing teachers how these strategies can be implemented effectively. Assessing teachers' pedagogical skills after completion of a professional development programme is therefore necessary (Haslam, 2010:5). If teachers can indicate that they have acquired content knowledge and relevant pedagogical skills and thus know how to teach the content learnt in the professional development programme, it is possible to conclude that this specific aspect of the professional development programme is successful.

It has been proved many times before that isolated learning often falls short as it does not allow the learner or, in this case, the teacher to reinforce what he or she has learnt through discussion and collaboration (Cordingley *et al.*, 2005:3; Fitzgerald *et al.*, 2010:305). Collaboration in a successful professional development programme does not necessarily entail that teachers should complete the programme in a collaborative setting but rather that collaboration should take place continuously during and after the programme (Ingvarson *et al.*, 2005:11).

Collaboration within a professional development programme can take various forms including communities of practice (where more than two teachers form a cluster and learn from each other) (Kennedy, 2005:244) and mentoring (where one teacher mentors another and assists him/her in the professional development process) (Collinson *et al.*, 2009:6). When measuring the success of a professional development programme, it is important to establish whether the programme supports collaborative learning in such a way that teachers will be enthusiastic to share what they have learned with others. If the professional development programme succeeds in executing the above-mentioned criteria, it has succeeded in one of the different areas of professional development.

Bearing in mind the above-mentioned criteria, it is also necessary to make mention of different modes of delivery as this also influences the success of the professional development programme.

## **2.7. DIFFERENT MODES OF DELIVERY**

Various modes of delivery in professional development are suggested in the literature. The following section will subsequently discuss the most prevalent modes used in professional development.

### **2.7.1. Face-to-face mode of delivery**

The face-to-face mode of delivery includes courses and conferences, workshops and other one-on-one meetings with teachers (White & Tutty, 2005:125). Smith and Kritsonis (2006:72) are of opinion that the face-to-face mode of delivery is of a conventional nature as one or two people run a professional development programme by arranging a day of training. When presenting a professional development programme by means of the face-to-face mode of delivery participants may feel more connected than in large workshops as they can get personal attention from an instructor or facilitator. Furthermore participants have the opportunity to learn from each other in a face-to-face setting, allowing them to ask questions and learn collaboratively. One of the disadvantages, described by the SchoolNet Africa report (2004:31) is that a professional development programme by means of a face-to-face mode of delivery can only be as good as its instructor, indicating that the instructor could be responsible for letting the programme fail. Another major disadvantage of the face-to-face mode of delivery is that it is not accessible to all teachers due to a lack of funding, travel challenges as well as time consumption, thus the distance mode of delivery has been suggested.

## **2.7.2. Distance mode of delivery**

Defining the distance mode of delivery proves to be difficult as many definitions are found. The most common form of distance mode of delivery is that of online professional development where teachers join online discussions and receive professional development courses over the Internet (using video and other resources) (Johnson & Steven, 2003:1; Wang & Sun, 2000:168).

When implementing professional development by means of the distance mode of delivery, participants are able to partake in the programme at any given time and in a setting that is comfortable to them. Furthermore, the distance mode of delivery often costs less than the face-to-face mode of delivery. In South Africa, one of the biggest concerns regarding professional development of teachers is the inaccessibility of professional development due to travelling challenges, time constraints and funding. If the distance mode of delivery is used, these challenges can easily be overcome.

One of the disadvantages of the distance mode of delivery is that of inaccessibility due to financial strains. This disadvantage can be overcome by making use of more cost effective strategies and thus making it accessible to all. Developers of professional development programmes need to ensure that participants can access the material and courseware prescribed. If, for instance, the professional development programme is presented online, participants need to have adequate hardware and software to access the material (Evans *et al.*, 2007:64). Another disadvantage that can exist is that of costs to participants (Valentine, 2002). If participants are required to print material themselves and carry these costs, the professional development programme might be too expensive and participants will not be able to benefit.

The distance mode of delivery can be executed through the internet, CD/DVD ROM or DVD and this will subsequently be discussed.

### **2.7.2.1. Internet as tool for distance mode of delivery**

One of the most generally recognisable tools in the distance mode of delivery is that of the internet. When making use of such a tool, content of the professional development programme is posted on a website. Participants then have the responsibility to download the different documents, view lectures or partake in conversations over the internet. In South Africa, this tool is not a viable option as many teachers do not have access to the internet, or if they do cannot

afford to download various documents. Furthermore, sophisticated hardware and software are required in order to benefit fully from this tool for the distance mode of delivery (Koul, 2002:66).

#### 2.7.2.2. CD/DVD ROM as tool for distance mode of delivery

Another tool for distance mode of delivery is CD/DVD ROMs and other discs containing data that can be read on a computer (Syed *et al.*, 2004:73). The benefit of these tools is that they are accessible to teachers; however, it can only be assumed that it will be accessible to them during school hours as not all teachers have access to computers at home. Furthermore, teachers will need specific software to run content on the CD/DVD ROM which, if not featured on their computer, may include additional costs.

#### 2.7.2.3. DVD as tool for distance mode of delivery

Stemming from the above-mentioned two tools that can be used in the distance mode of delivery, the last suggested tool is DVD-based. This implies that the professional development programme is subdivided into ‘chapters’, allowing the user to choose which section he/she would like to attend to. The DVD is distinguished from the CD/DVD ROM in that it can be viewed at home and the costs are noticeably lower. If a teacher does not have access to a computer (for instance, if they have to complete the programme via CD/DVD ROM) the cost of a computer would be too high to provide. In the case of a DVD, the teacher can be equipped with a portable DVD player for costs lower than R250 (De Sousa, 2008:76). Subsequently, the use of a DVD to execute professional development will be discussed.

### 2.8. DVD-BASED PROFESSIONAL DEVELOPMENT

When developing a professional development programme executed by means of a DVD, one needs to focus on two main areas specifically: firstly, the design of the programme and secondly, the content. However it is necessary to focus on the use of multimedia first.

#### 2.8.1. Designing a DVD-based professional development programme

One of the major advantages of the use of DVDs for the implementation of professional development is the component of multimedia. Therefore it is important to discuss multimedia in depth in order to illustrate the advantage of DVDs.

### 2.8.1.1. The role of multimedia in DVD-based professional development

Multimedia can be defined in various ways (Mayer, 2001:2). Sherin (2007:23) defines multimedia as a system in which various media are used. Chan (2003:7) emphasises that multimedia does not necessarily only entail the use of videos but also narrated photos, animations, or other combinations of media. Chrichton and Kopp (2002:1) are in agreement with Chan (2003:7) as they define multimedia projects as those projects that combine text, graphics, videos, animations and sound to convey information. For the purpose of this study, multimedia will subsequently be defined as any system making use of various technologies like videos, audio tapes, animations, narrations, text and graphics on any given medium.

Knowing what multimedia is all about bring us to the definition of multimedia learning in the context of professional development.

Voogt and Knezevic (2008:30) define multimedia learning as learning that occurs in an environment that incorporates a mix of audio and video technologies. Even though Mayer (2001:3) agrees that multimedia learning is learning from words and pictures, he suggests that multimedia learning occurs through multimedia instruction, a presentation involving pictures (e.g. static and dynamic graphics) and words (speech and printed) intended to foster learning. Cook (2009:35) reiterates by saying that multimedia learning and multimedia instruction are used interchangeably and that it involves conveying content through multiple media.

#### 2.8.1.1.1. Advantages and disadvantages when using multimedia

Making use of multimedia as a tool for fostering learning holds many advantages. The following brief advantages are visible on review of relevant literature:

- Scheduling for learning activities is made easier as the multimedia tool is accessible at any time (Shihong *et al.*, 2008:1).
- Students actively engage in the learning activities and also construct their own knowledge (Thibeault, 2004:263).
- If multimedia is used effectively, it improves pedagogy and learning (Bbuyes, 2008:2).
- It has the potential of enhancing and expanding learning opportunities (Tearle & Dillon, 2001:16).
- Different learning styles can be accommodated (Allison, 2007:21).
- It allows for training/learning to be made accessible to professionals situated in rural areas (Cable and Dinkel, 2002:364).

- It saves on costs incurred by schools for professional development of their teachers (Fisher *et al.*, 2010:302).

In the light of the above-mentioned advantages of using multimedia to foster learning it can once again be asked why it could also be a viable option for professional development of Information Technology teachers in South Africa.

Although a vast number of advantages for using multimedia to foster learning can be found in the literature, one cannot omit the fact that there are also disadvantages:

- Bbuyes (2008:5) mentions that the development of multimedia systems can be very costly.
- Users, teachers in the case of this study, may not have access to multimedia-capable machines (Bin Ismail, 2005:9).
- Lack of face-to-face interaction (Posey *et al.*, 2010:4)

Disadvantages in using multimedia to foster learning should not be seen as a discouragement but rather as a hazard as to which pitfalls may be prevalent if multimedia are not designed and implemented correctly.

#### 2.8.1.1.2. Contrasting views of multimedia learning

Mayer (2001:12-15) notes that a clear distinction should be made between the two contrasting views of multimedia learning: multimedia learning as information acquisition and multimedia learning as knowledge construction, as the way learning is understood influences how a multimedia tool will be developed. Clark and Mayer (2008:24) contend that three metaphors to learning exist, namely response strengthening, information acquisition and knowledge construction.

Table 2.1 illustrates Clark and Mayer's (2008:34) view on the three metaphors of learning, indicating the learner's role as well as the instructor's role. Furthermore, it indicates how learning is defined within these metaphors. Subsequently, each of the three metaphors will be discussed briefly.

**Table 2.1 Three metaphors of learning**

Metaphor of learning	Learning is:	Learner is:	Instructor is:
Response strengthening	Strengthening or weakening of association	Passive recipient of rewards and punishment	Dispenser of rewards and punishments
Information acquisition	Adding information to memory	Passive recipient of information	Dispenser of information
Knowledge construction	Building a mental representation	Active sense maker	Cognitive guide

(Clark &amp; Mayer, 2008:34)

### ***Multimedia learning as response strengthening***

When referring to multimedia learning as response strengthening, the general assumption is that learning occurs when a correct response is rewarded and an incorrect response is punished (Clark & Mayer, 2008:34). Response strengthening is viewed as one of the traditional approaches to learning, but has been noted to be incomplete as it does not portray the cognitive process of learning properly (Clark & Mayer, 2008:34).

### ***Multimedia learning as information acquisition***

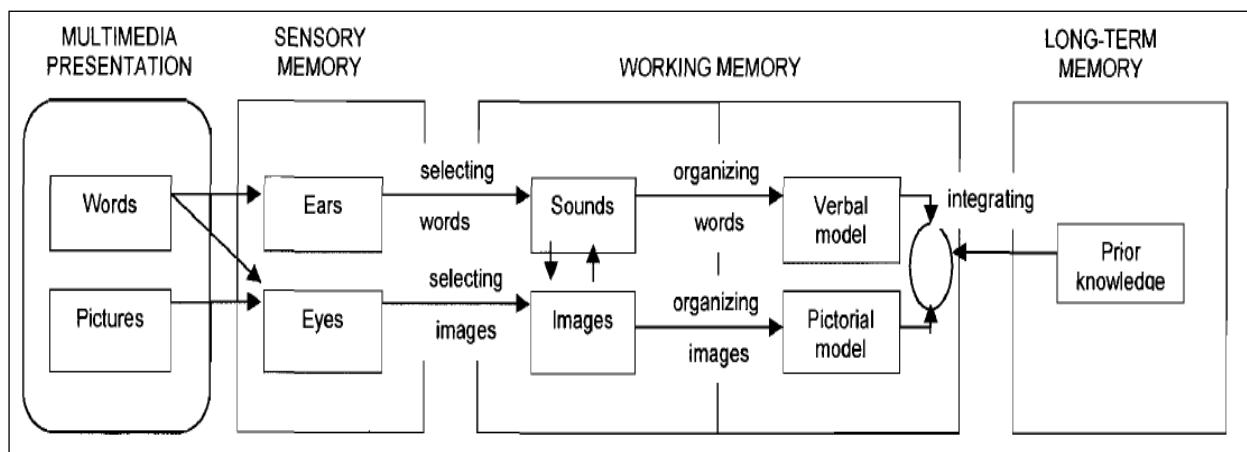
Learning by means of information acquisition entails adding information to the memory, reproducing the information and/or retrieving the information (Barzilia & Zohar, 2008:38; Mayer, 2001:12). This approach is most prominent in the cognitive sciences (Paavola *et al.*, 2004:558). Viewing learning from this perspective holds many disadvantages as it has been proved that learners do not comprehend what they learn as the main focus is on merely memorising the work. If this approach to learning is taken, multimedia hold fewer advantages as more information can be conveyed through purely printed works than multimedia-based works.

### ***Multimedia learning as knowledge construction***

Knowledge construction is an approach to learning that emphasises that learning occurs when various different stimuli are incorporated in order to build coherent mental representations of information conveyed (Mayer, 2001:13). This view of how learning occurs has become more prevalent in literature as cognitive psychology progressed and has shown the vast number of activities happening inside the brain when learning occurs.

In Figure 2.1, the cognitive theory of multimedia learning is illustrated. This indicates how information is perceived, processed and then stored. When an individual is confronted with a multimedia presentation, be it words or pictures, data is perceived by and stored in the sensory memory. Selected elements are retained and sent to the working memory where the organisation of these elements occurs. In the working memory, prior knowledge (retrieved from the long-term memory) is integrated with the new perceived elements. By integrating the newly perceived elements with prior knowledge, new knowledge is constructed (Mayer, 2001:44).

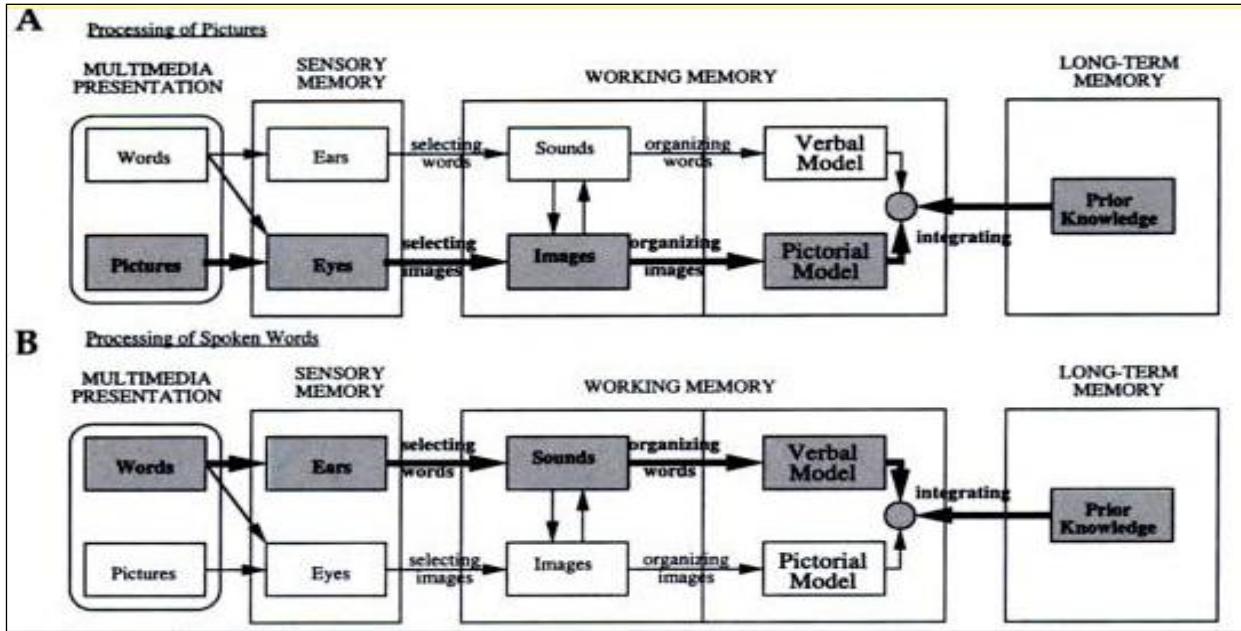
The cognitive theory of multimedia learning is based on three assumptions, namely dual-channel assumption, limited-capacity assumption and active-processing assumption (Clark & Mayer, 2008:36; Mayer, 2001:44). Subsequently, each of these three assumptions will be described.



**Figure 2.1 The cognitive theory of multimedia learning (Mayer, 2001:44)**

#### *Dual-channel assumption*

The dual-channel assumption as illustrated in Figure 2.2 indicates that people have separate channels for processing visual/pictorial material (illustrated in frame A) and auditory/verbal material (illustrated in frame B) (Clark & Mayer, 2008:36). When processing visual/pictorial material, the eyes are stimulated after which selected images are sent to the working memory. In the working memory, images are stored in the pictorial model after organisation. When processing auditory/verbal material, the eyes and ears can be stimulated after which selected words are sent to the working memory. In the working memory, sounds or images are stored in the verbal model after organisation. Lastly, prior knowledge as well as data from the verbal and pictorial models is integrated to form a new concept or to make meaning of stimuli. Taking into consideration the assumption of dual-channels, multimedia tools should incorporate and stimulate both channels present in the process of learning.



**Figure 2.2 (A) The auditory/verbal channel (top frame) and (B) visual/pictorial channel (bottom frame) in a cognitive theory of multimedia learning (Mayer, 2001:47)**

#### *Limited-capacity assumption*

The limited-capacity assumption describes how people can only process a small amount of information in each channel at one time (Clark & Mayer, 2008:36; Mayer, 2001:44). Three demands on cognitive processing capacity are described by Clark and Mayer (2008:36), namely:

- extraneous processing, occurring when instructional objectives are not met due to poor instructional layout;
- essential processing, which describes processing that is aimed at mentally representing the salient material when complex material is presented; and
- generative processing, occurring when deeper understanding is attempted as a result of the motivation of the learner to make sense of material.

In order to create an effective learning experience, extraneous processing should be minimised, essential processing should be managed and generative processing should be cultivated (Clark & Mayer, 2008:37).

#### *Active-processing assumption*

Humans are actively involved in processing material to construct a representation of their experience (Mayer, 2001:50). The active-processing assumption is closely related to the

constructivist learning theory (Dori, 2008:48), indicating its close relation to the epistemology of this study. Mayer (2001:50) emphasises that, according to this assumption, the presented material should be structured coherently and learners should be guided in building their own structure. This assumption of multimedia learning encourages learners to be actively involved in their own learning (Clark & Mayer, 2008:57).

The aforementioned three assumptions to learning should be kept in mind throughout the design of multimedia instructions (Asanok *et al.*, 2008:4; Schroeder, 2006:17).

### 2.8.1.2. Design principles of multimedia DVD-based professional development

Following multiple studies on the design of multimedia, Mayer (2001:184) compiled seven research-based principles for the design of multimedia presentations. These principles will be used to lead the following discussion.

#### 2.8.1.2.1. Dual-channel principle

The multimedia principle refers to the question as to whether learners (in teacher professional development, teachers) learn better when confronted with words and pictures used together than when they are confronted with words alone (Fletcher & Tobias, 2005:117; Mayer, 2001:63). Using as many sensors as possible increases the chances of learning occurring successfully and having a lasting effect; thus, if words (written or printed) are used solely, learners have a less likely chance of learning. Students who learn with words alone, produce less creative answers than students who learn with words and pictures (Mayer, 2001:76). Thus, when making use of multimedia presentations, it is more beneficial to incorporate words and pictures simultaneously than using words only. Clark and Mayer (2008:58) describe various graphics that can be used to enhance learning in support of the multimedia design principle. These graphics include the types described below.

#### ***Decorative graphics***

Decorative graphics are graphics that serve little purpose in enhancing the message of the lesson and should be kept to a minimum (Clark & Mayer, 2008:58). Clark and Lyons (2010:15) also mention that decorative graphics add aesthetic appeal to the lesson, however Koumi (2006:9) warns that too much appeal could cause cognitive overload.

### ***Representational graphics***

Representational graphics are graphics that illustrate a single element accompanied by a caption describing the element (Clark & Mayer, 2008:58). Rieber (2009:2) notes that exposing learners to an accurate representation of something (like an actual photo) may not always be the best approach to learning as learners with limited prior knowledge about the topic at hand may get confused.

### ***Relational graphics***

Graphics portraying a relation between two or more variables are described as relational graphics (Clark & Mayer, 2008:58). One example of relational graphics is the use of graphs (Francis & Slawski, 2010:2), most commonly used to assist learners in understanding the relationship between various elements.

### ***Organisational graphics***

When a learner is presented with information in the form of a table, matrix or diagram it falls under organisational graphics (Clark & Mayer, 2008:58). Organisational graphics are especially useful when learners have to learn concepts or facts that relate to each other (Clark & Mayer, 2008:61).

### ***Transformational graphics***

In the case of graphics necessary to illustrate how an element changes over time, transformational graphics (depicting these changes) are used (Clark & Mayer, 2008:58). Transformational graphics may include videos, animations or line drawings with movement indicators (Clark & Lyons, 2010:22). In order to facilitate process, procedure and/or principle content, Clark and Mayer (2008:61) suggest using transformational graphics.

### ***Interpretive graphics***

Illustrating invisible relationships, such as animations to show movement, is described as interpretive graphics (Clark & Mayer, 2008:58). Clark and Mayer (2008:61) further describes that interpretive graphics prove helpful when content of learning either consists of concepts, procedures or principles.

Another design principle reported by Mayer (2001:184) is the spatial contiguity design principle. This principle will be discussed in the next paragraph.

#### 2.8.1.2.2. Spatial contiguity design principle

Noting that students learn better when words and pictures that relate to each other are displayed closely together on one page denotes the spatial contiguity principle (Mayer, 2001:81). Holsanova *et al.* (2008:3) state that when learners are confronted with words and pictures, several cognitive activities have to take place: learners have to read the text and scan the illustrations, process it and connect it to previous knowledge. Two strategies can be applied when referring to the spatial contiguity principle: separation strategy (where words and pictures are kept in separate spaces on one page or screen) and integration strategy (where words and pictures form one unit on a page or screen) (Mayer, 2001:85). The spatial contiguity principle addresses the issue of cognitive overload as it reduces the load (Lam, 2007:3). It is important to determine which strategy will be used before designing a multimedia presentation.

The third design principle, as reported by Mayer (2001:184) is the temporal contiguity design principle.

#### 2.8.1.2.3. Temporal contiguity design principle

According to Mayer (2001:96), the temporal contiguity principle refers to whether students learn better when words and pictures are shown simultaneously rather than successively. As learners possess two different channels to memory, visual and verbal, both can be stimulated simultaneously, improving the representation of the information in the memory of the learners. If words and pictures are not displayed simultaneously, a gap could form leading to the learner's memory confusing pictures and words. As with the spatial contiguity principle, the temporal contiguity principle also needs to be decided on before designing the multimedia presentation.

Another design principle described by Mayer (2001:184) is the coherence design principle.

#### 2.8.1.2.4. Coherence design principle

Overloading students with irrelevant material could counteract learning, and thus the coherence principle looks at how a student's learning can be damaged by including irrelevant words and pictures in the multimedia presentation (Mayer, 2001:113). When designing a multimedia presentation, designers often make the mistake of wanting to mesmerise their audience rather than considering which use or omission of words and text will foster learning best. Mayer (2001:113) describes how the principle of coherence can be divided into three subcategories.

These categories add to the guidelines used for designing this study's multimedia presentation and reflect the following:

- a student's learning is curbed when irrelevant words and pictures are added to the presentation;
- adding irrelevant sound to the presentation will discourage learning; and
- keeping text as short and to the point as possible enhances learning.

#### 2.8.1.2.5. Modality design principle

The modality design principle refers to whether animation should be used in conjunction with on-screen text or narration (Mayer, 2001:134). Animations stimulate the visual channel and thus it is argued that adding on-screen text to the animation will overload the visual channel. As mentioned before, stimulating more than one sense at a time enhances learning; therefore, stimulating the visual and the auditory channels simultaneously, by using animation in conjunction with narration, will promote learning.

#### 2.8.1.2.6. Redundancy design principle

Mayer (2001:147) describes the redundancy design principle as the principle that tests whether students learn better from animation and narration combined than from a combination of animation, narration and on-screen text combined. Students have different learning styles and even though on-screen text might be discussed as accommodating learners with a preference to visual learning styles, the on-screen text is likely to repeat the narrated text, so redundancy occurs, resulting in learning being discouraged.

#### 2.8.1.2.7. Individual differences design principle

Taking into account the fact that learners differ, Mayer (2001:161), in his individual differences design principle, states that low-level knowledge learners are more affected by design principles than higher-level knowledge learners. This does not imply that higher-level knowledge learners are not affected by design principles, but rather that they are able to focus beyond the ill-designed multimedia presentation, focusing their attention on the more important concepts.

#### 2.8.1.3. The use of different media in DVD-based professional development

With the above-mentioned seven principles of multimedia design in mind, it is worth discussing the effect different media has on the learner. Media is categorised as visual and auditory. In this study, visual media include video, text (printed or on-screen) and animation, whereas auditory media include sound and narration. The following section describes how each of the above-mentioned media affect learning.

### 2.8.1.3.1. Visual media

#### **Video**

Video is defined by the Oxford Dictionary (2011f) as the recording, reproducing or broadcasting of moving visual images. Video allows students to see behaviour as opposed to only reading it. It therefore allows students to visualise complex phenomena and, in fascinating the viewer it could capture his or her attention for longer (Koumi, 2006:117-118).

#### **Text**

The Oxford Dictionary (2011e) defines text as a piece of written or printed material regarded as conveying the authentic or primary form of a particular work. Mayer (2001:61) makes use of the term ‘printed words’ to describe text. He warns that making use of text could lead to an overload of the visual channel used for processing information (Mayer, 2001:139). Koumi (2006:73) notes that, although a learning task could benefit from using video, it could be presented better in printed text.

#### **Animation**

Animation can be defined as the technique of photographing successive drawings or models to create an illusion of movement when the film is shown as a sequence (Oxford Dictionary, 2011a). De Sousa (2008:26) notes that learners are only able to hold a few images in their short-term memory when presented with animation. She further claims that animation is beneficial to high prior-knowledge learners when they learn descriptive facts (De Sousa, 2008:54).

### 2.8.1.3.2. Auditory media

#### **Sound**

The Oxford Dictionary (2011d) defines sound as vibrations that travel through the air or another medium, which can be heard when they reach a person’s ear. According to Mayer (2001:123), adding irrelevant sound to a multimedia presentation can have a negative influence on learner’s learning. As Koumi (2006:117) noted, a multimedia presentation should capture the attention of the viewer, but Mayer (2001:124) argues that adding interesting sounds to a multimedia presentation could result in poorer learning. Thus making use of sound in a multimedia presentation is useful, but should be considered carefully.

### **Narration**

Narration is defined as a commentary delivered to accompany a film (Oxford Dictionary, 2011b). Koumi (2006:209) encourages narrators to make use of such a style of audio that the student feels that he/she has a personal tutor. Mayer (2001:26) emphasises that narration is best applied when accompanied by animation. Furthermore, Mayer (2001:142) found that narration proved to improve students' retention of information more than on-screen text does.

### **2.8.2. Content**

As described above, the content of a multimedia disc should include visual as well as auditory media applicable to the professional development programme in order to enhance learning. In Chapter 3, the specific content of the multimedia-based professional development programme is discussed.

### **2.9. SUMMARY**

In the South African contexts, it has been suggested that teachers find it hard to attend group professional development sessions due to logistical challenges. An alternative to professional development where teachers can participate in professional development sessions without having to disrupt their teaching time or go to great financial strain to attend workshops is needed.

Investigating various models of professional development leads to the conclusion that professional development needs to be transformative in nature, and in doing so development should include as many participants as possible. The best suited mode of delivery found for including more teachers in professional development programmes than previous attempts is that of distance education (allowing teachers to work through programmes in their own time). When referring to the distance mode of delivery, several possibilities arise; however, in South Africa, the most viable option is that of DVD-based professional development. This allows teachers to view content included in the professional development programme anywhere and anytime with very little costs incurred. Furthermore, the use of multimedia on a DVD supports the constructivist approach to professional development. Traditional professional development workshops have been proved to fall short as they rely too heavily on the behaviourist approach causing teachers to be 'silent stones' in their own professional development. Thus, approaching professional development from a constructivist point of view, where each individual (IT teacher)

has the opportunity to construct his or her own knowledge in his or her own time seems to be viable.

A multimedia-based professional development programme by medium of a DVD can be viable in addressing the challenges faced by the Department of Basic Education. More teachers can be reached in this way and therefore more teachers can be professionally developed.

## CHAPTER 3

### MULTIMEDIA-BASED PROFESSIONAL DEVELOPMENT: SCRATCH PROGRAMMING

#### **3.1. INTRODUCTION**

In Chapter 2, professional development of teachers was described and discussed. It was noted that making use of multimedia in professional development proved to be a viable option.

The aim of the current study was to determine how a selected group of teachers experienced multimedia-based professional development. In order to reach this aim, a need arose to describe how the DVD (the multimedia tool) was developed, focusing on content as well as design. This chapter will therefore focus on the content of the professional development presented to Information Technology teachers by means of a digital versatile disc (DVD) as well as the accompanying user manual. Furthermore, the chapter reports on how the multimedia principles, as described in the previous chapter, were addressed with the specific content at hand.

#### **3.2. SCRATCH: THE NEW PRESCRIBED PROGRAMMING LANGUAGE**

Scratch, a computer programming language with a graphical drag-and-drop user interface (Giganti, 2010:1; Harvey & Mönig, 2010:1), was designed in 2003 and launched in 2007 at the Massachusetts Institute of Technology (Maloney *et al.*, 2010:2). The objective of Scratch is to introduce programming concepts to individuals unfamiliar with computer programming environments (Maloney *et al.*, 2010:3).

Research in the implementation of Scratch as an introductory programming language has shown various advantages. Adams (2010:360) found that children attending their after-school computer programming camps enjoyed Scratch as they were able to create their own characters and games. It proved to be a viable option for the introduction of young people to programming (Sivilotti & Laugel, 2008:1). Although Scratch has been implemented mostly in classes for younger learners, Malan and Leitner (2007:1) experienced great success when implementing Scratch in their higher education classes, thus implying that the programming language is not bound to serve children only but young adults too (Giganti, 2010:1). Scratch programs can be shared among the Scratch online community fostering collaborative learning between learners (Grippin, 2010:3). Idlibi (2009:18) noticed that a greater emphasis is placed on the concept of programming than on meticulous programming syntax. Lewis (2010:346) agrees, and claims that, due to Scratch programming blocks only fitting in syntactically valid ways,

errors that occur are always semantic errors and not negligent typing errors. This saves time for learners as less time has to be spent on correcting faulty typing and syntax errors. With Scratch being a visual programming environment, software development can be done in a way that is non-threatening (therefore it does not demotivate learners as other programming languages often do) and fun (Meerbaum-Salant *et al.*, 2010:69). Utting *et al.* (2010:3) is of the opinion that Scratch attracts a broad range of students to computer science.

As with all good things, Scratch also holds some disadvantages. Some researchers like Harvey and Mönig (2010:2) note that object-oriented programming skills are not addressed in Scratch, which might result in difficulty when moving to programming languages like Java. Furthermore, Scratch does not support the use of classes and inheritance (Utting *et al.*, 2010:5). Sophisticated programmers might find the graphical interface frustrating as some programming code can be expressed clearer in a text-based programming language (Begel, 1996:8). Heise and Joyner (2004:8) argue that the codes of visual programming languages are not as easily readable as text-based programming languages. The three above-mentioned disadvantages are the only disadvantages that were found in the attempt to search the literature on Scratch and visual programming languages. Even though these disadvantages are important enough to be noted it is clear that they focus on advance programming principles and skills and that they are therefore not necessarily applicable to novice programmers, learning the basic principles of programming. Scratch holds many more advantages than disadvantages clarifying why the South African Department of Basic Education proposed it as the introductory programming language to be used in the new Curriculum and Assessment Policy Statement (CAPS) (Department of Basic Education, 2012:11).

In the South African context, in IT as a school subject, software development makes up 60% of the syllabus (Department of Basic Education, 2012:8). Learners in Grade 10 are therefore required to be able to acquire software development skills. For the purpose of this study, where teachers were faced with the challenge of implementing a new programming language (Scratch) as prescribed by the CAPS, the content to be covered on this DVD focused on basic principles of Scratch, including some pedagogical content knowledge as well. It is obvious that teachers are required to know more about the programming language, but teachers in this context have ample knowledge about programming in general and therefore need to be helped with the implementation of this knowledge in the Scratch programming environment. Furthermore, the CAPS addresses the majority of concepts found in the Scratch programming language and therefore is a thorough resource to use as guideline for the content to be covered on the professional development DVD.

### **3.3. DEVELOPING A SCRATCH DVD**

Developing a DVD to train IT teachers in Scratch consists of two main focus areas: the content (describing the content which can be found on the DVD) and the design (describing how the multimedia principles are addressed with the specific content in mind). Furthermore it is important to note that a user manual was included in the professional development programme as an additional resource and aspect of multimedia. This user manual (see Addendum A) served as a synopsis of the DVD, addressing each section as it was on the DVD. It allowed participants to take notes whilst completing each section of the DVD. The manual also gave participants the opportunity to complete activities after completing each section in order to reinforce their knowledge and skills gained from watching the DVD. Participants were asked to also complete the reflection sheets found at the end of each section and the researcher and participants came to an agreement that answers to the various activities will be provided once the reflection sheets have been received. The user manual contributed to the content of the DVD but a further discussion on the DVD's content will follow.

#### **3.3.1. Theoretical underpinning of the content of the digital versatile disc**

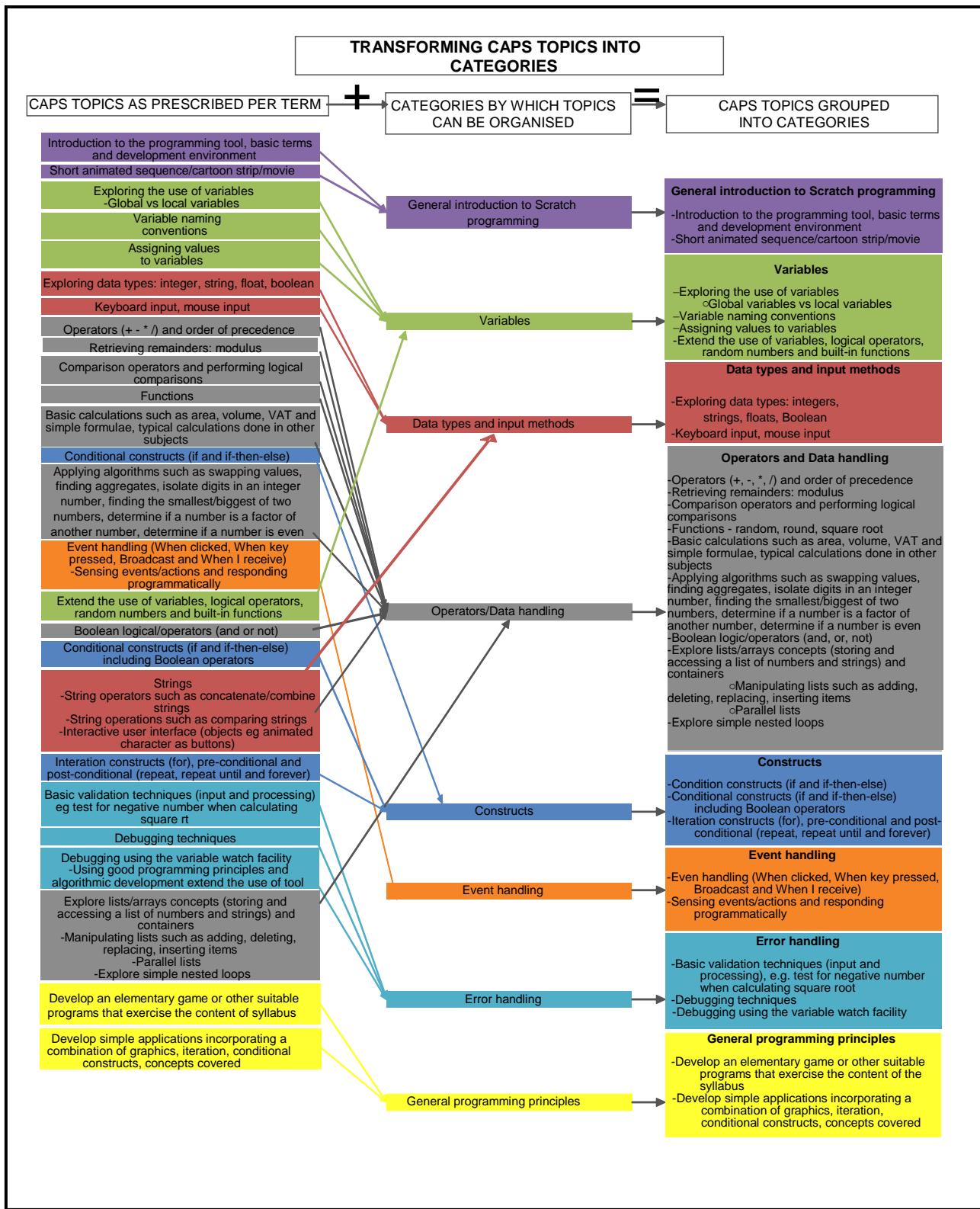
In order to successfully implement a Scratch training DVD, the content of the DVD should be considered carefully. Borko (2004:5) states that teachers should obtain rich knowledge about the content students or learners are required to learn. Even though Borko's statement rings true, the context of the teachers in this study differed. The IT teachers in the study group had already been teaching programming (or had been trained in programming) and therefore possessed knowledge and skills of a higher-level programming language as well as in teaching programming. It was therefore not necessary to include in-depth explanations on basic programming principles or teaching methodologies.

##### **3.3.1.1. The Curriculum and Assessment Policy Statement (CAPS)**

The CAPS document forms the basis of the minimum outcomes and standards of learner achievement in public and independent schools in South Africa (Department of Basic Education, 2012:4). With the recent changes in the South African curriculum in mind (Department of Basic Education, 2012:11) and on account of the findings of Garet *et al.* (2001:935) which indicated that teaching specific subject matter enhances sustained teaching-learning knowledge and skills, it was therefore decided to use the content of the CAPS to develop the content of the DVD (see Figure 3.1).

The CAPS document introduces different elements of different topics per term and not necessarily together as a unit; therefore, it was decided to group these topics together in order to work logically through each section respectively. Figure 3.1 indicates how the content of the CAPS is categorised and then grouped together in order to form logical sections that are used in the training of the IT teachers participating in this professional development programme. It is illustrated by an addition sign (+) thus implying that the topics in the CAPS added to the categories equal the grouped content. In the first section, the CAPS topics (in the order and structure set out by the Department of Basic Education (2012:19-28)) are found. These topics are then connected to categories (illustrated with arrows) which are found in the middle section of the figure. In the right section of the figure, topics, as categorised in column two, are grouped together to serve as the content guideline to be used on the Scratch training DVD. However, the content will still be transformed into sections in order to make the completion of the professional development more structured.

In order to teach the topics set out in CAPS successfully, bearing in mind the level of the IT teachers for whom the DVD is developed, guidelines were necessary to focus the pedagogical structure of each topic at hand. Pedagogical guidelines (in the form of various taxonomies) which were considered in the following section were the ACM/IEEE-CS Joint Task Force Steering Committee's guidelines (2012:1), Krathwohl's (2002:212) revision of Bloom's taxonomy and Johnson and Fuller's revision of Krathwohl's taxonomy (2006:121).



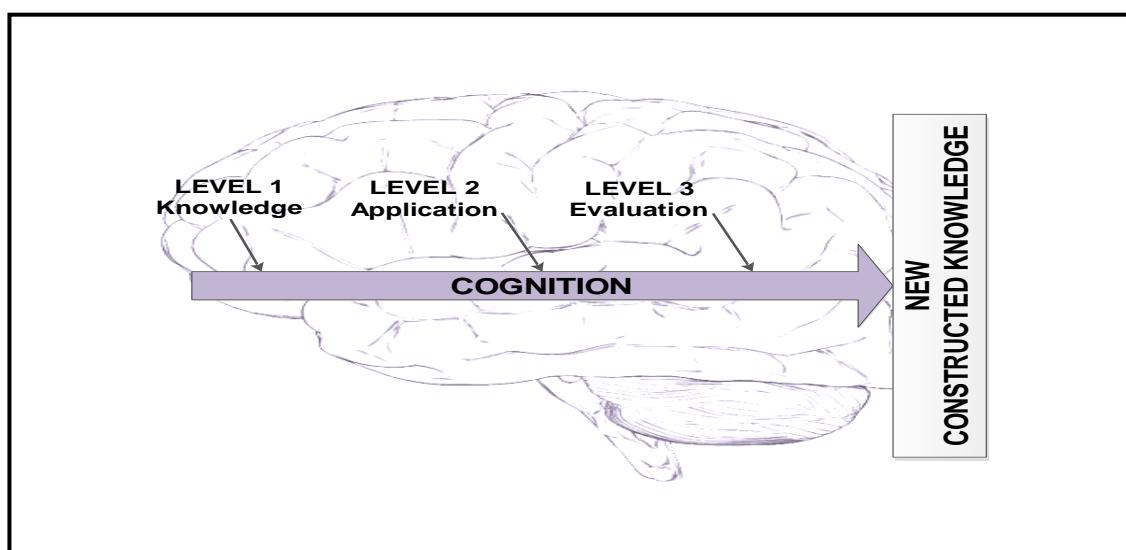
**Figure 3.1 Schematic illustration to show CAPS content transformed into categories**

### 3.3.1.2. Teaching Computer Science Education concepts

The ACM/IEEE-CS Joint Task Force Steering Committee (2012:1), a committee internationally accepted as the authoritative body regarding Computer Science Education, compiled a document on the curriculum set for Computer Science. This document builds on previous guidelines set in 2001 and 2008 (ACM/IEEE-CS Joint Task Force Steering Committee, 2012:1). It sets out three principles to be adhered to when measuring whether participants have mastered set learning outcomes in the Computer Science curriculum. These three principles can be seen as a type of taxonomy as they set the standard for what is expected from students to learn as a result of instruction (Krathwohl, 2002:212). Each principle can be defined as follows:

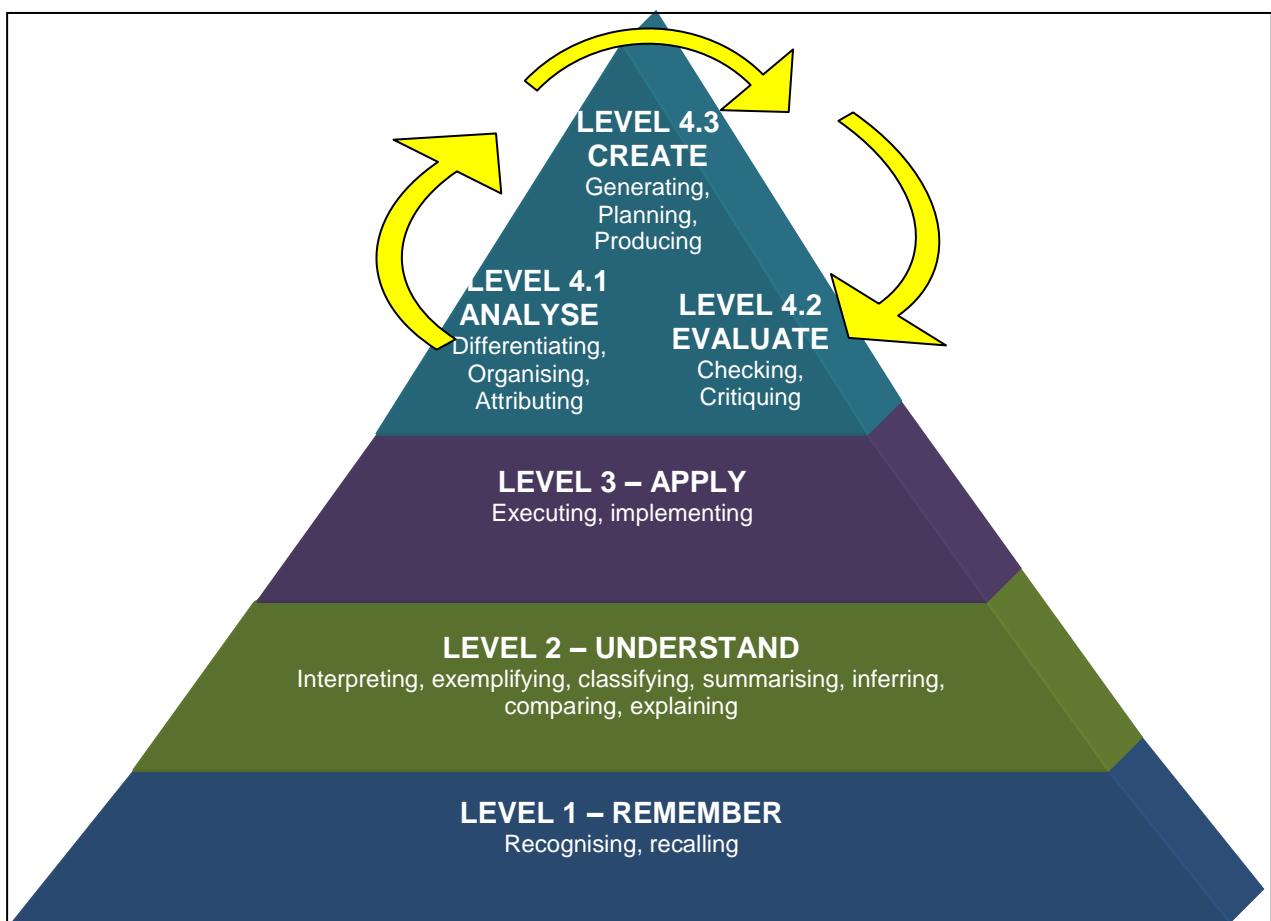
- knowledge (does the participant understand what the concept is or what it means);
- application (does the participant possess the skills to apply the concept in a viable way); and
- evaluation (can the participant view the concept from various perspectives and/or justify his or her chosen approach).

In Figure 3.2, a representation of the taxonomy is illustrated. The sketch of the brain illustrates the individual's brain where cognition takes place. Cognition occurs at level 1 (where knowledge is broadcasted), followed by level 2 (where knowledge is applied), and lastly level 3 (where applied knowledge is evaluated). The arrows indicate that each of the three levels feed into the cognition process as it occurs in the brain. Once all three levels have been addressed, new knowledge is constructed.



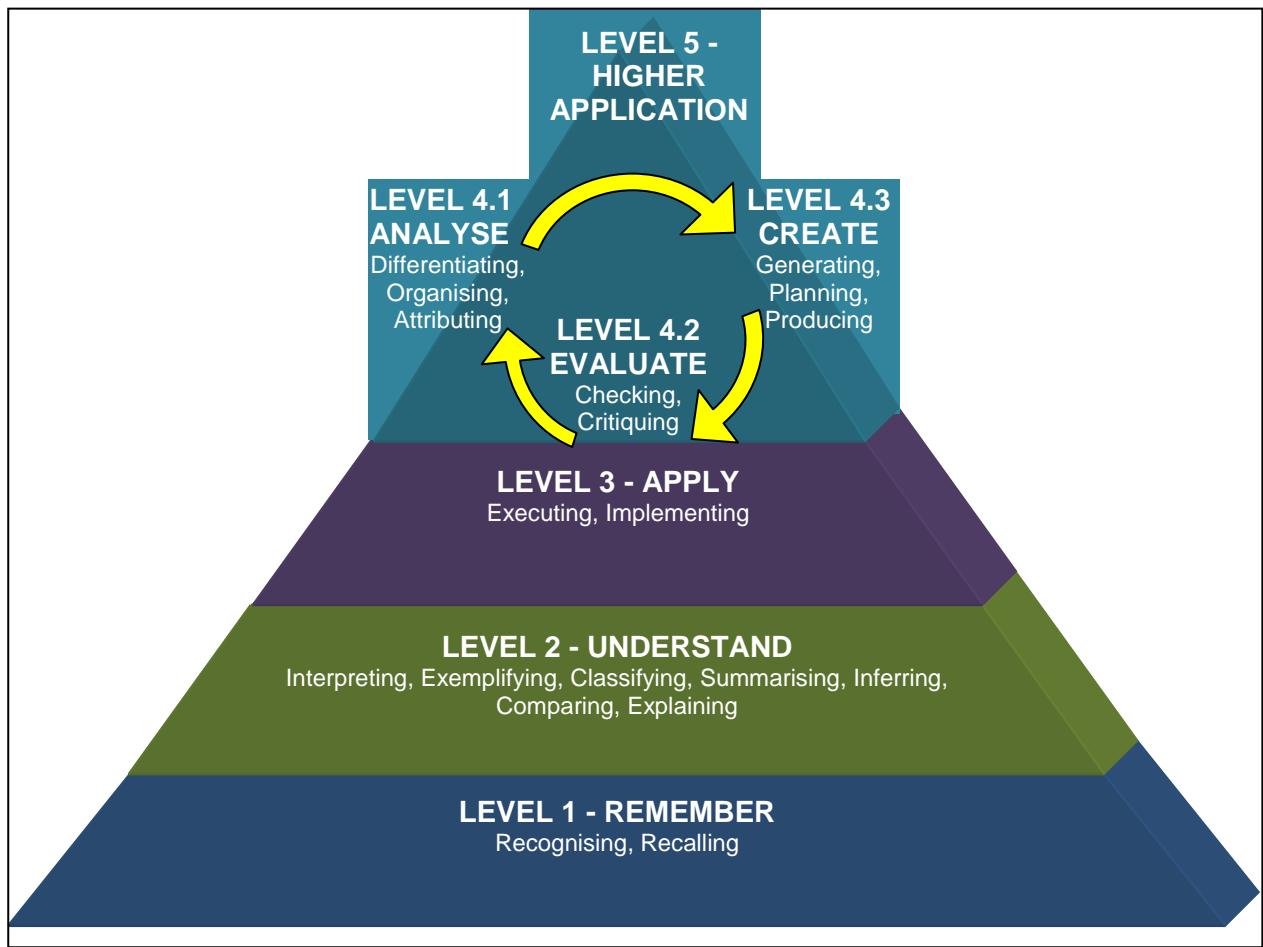
**Figure 3.2 Representation of taxonomy adapted from ACM/IEEE Joint Task Force Steering Committee (2012:1)**

The modified Bloom's taxonomy closely connects to the above-mentioned taxonomy and is another taxonomy that can be considered when developing content. Krathwohl (in Johnson and Fuller, 2006:121) describes that the analysis, evaluation and creation levels (as originally depicted in the revised taxonomy of Bloom) are not superior or inferior to one another and thus occurs side by side. Figure 3.3 attempts to illustrate the Krathwohl's notion visually, by keeping to the original triangular depiction of Bloom's taxonomy. The triangle illustrates that the cognition at the lowest level (which has a broadest area) is easier and more commonly addressed whereas, moving upward in the levels of cognition, it gets harder and is less commonly addressed. The top level of the triangle illustrates that analysis, evaluation and creation happen interchangeably but that all three require a higher form of cognition than the other three levels.



**Figure 3.3 Structure of the cognitive process of the revised taxonomy adapted from Krathwohl (2002:215) and Johnson and Fuller (2006:121)**

Johnson and Fuller (2006:121) specifically look at the relevance of the revised taxonomy in Computer Science and note that another level should be added when applying Bloom's revised taxonomy in Computer Science, namely higher application, whereby an individual is able to criticise the created knowledge on a higher level (see Figure 3.4).

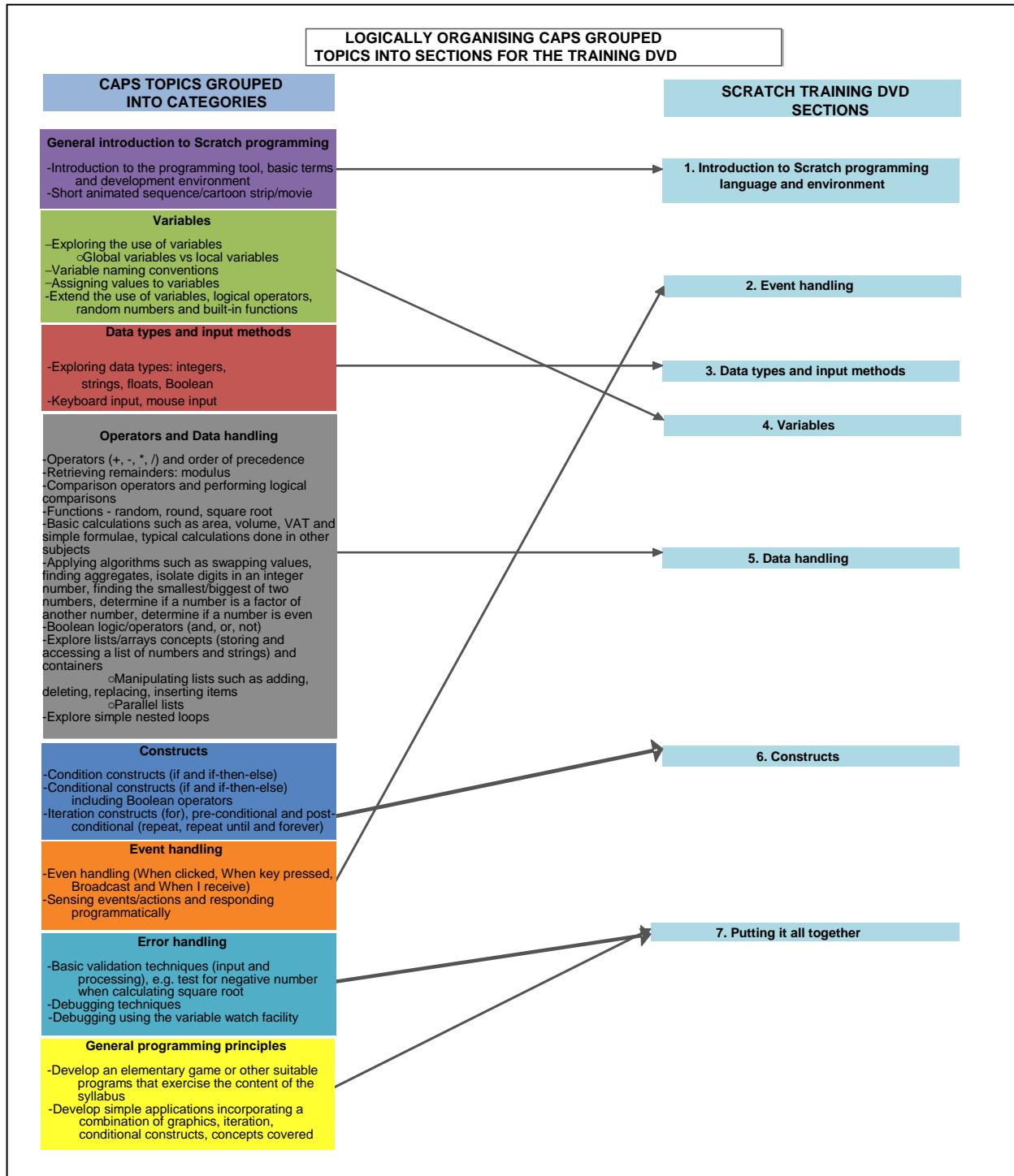


**Figure 3.4 Bloom's revised taxonomy in Computer Science adapted from Johnson and Fuller (2006:121)**

Taking into consideration the three above-mentioned taxonomies (ACM/IEEE, Bloom's revised taxonomy by Krathwohl, and Krathwohl's revised taxonomy by Johnson and Fuller) one can derive that Johnson and Fuller's taxonomy provides the most comprehensive coverage, especially within Computer Science and programming (Fuller *et al.*, 2007:166) and was therefore selected to guide the development of the Scratch multimedia DVD.

### 3.3.2. The content of the Scratch DVD

The content prescribed by the Department of Basic Education should be instructed in such a way that IT teachers are guided through each level of the selected taxonomy. The categories identified in Figure 3.1 are transformed into sections on the DVD (see Figure 3.5).



**Figure 3.5 Transforming categories into sections**

Figure 3.5 shows that each category, consisting of the content prescribed in the CAPS relates to a certain section on the DVD. This is illustrated by the use of arrows. The sections of the Scratch training DVD were chosen in such a way that participants would not be challenged by certain topics for which efficient foundations had not been laid. In this light, for instance, the section on event handling is placed before the other sections (apart from the introduction) as the Scratch programming language rests on its ability to make use of event handling, and other concepts cannot be addressed appropriately without the knowledge of event handling.

With Figure 3.5 in mind, it is sensible to note that each section of the DVD addresses one or more levels of the taxonomy. Subsequently, each section of the DVD will be discussed, focusing on the detailed content, as applied on the Scratch training DVD, as well as the way the taxonomy was infused in the section. Narration on the DVD is illustrated by means of a purple speech bubble and additional comments to clarify the screenshot will be illustrated in an orange block.

### 3.3.2.1. Introduction to professional development programme

As with any good programme, it is necessary to lead the participants subtly into the professional development programme so as to inform them how they would go about completing the programme as well as what they can expect from the programme (Todorova & Osburg, 2010:61). In the multimedia-based disc developed for this study, the general introduction introduces participants to the facilitator (see Screenshot 3.1), the structure of the DVD and the way each section is divided (see Screenshot 3.2). This introductory section is only a general introduction to the professional development programme and does not form part of the Scratch content described previously.



Screenshot 3.1 An introduction to the facilitator before starting professional development programme



**Screenshot 3.2 illustrating the structure of the DVD to participants**

### 3.3.2.2. Introduction to the Scratch programming language

The multimedia-based DVD gives a brief overview of where Scratch originated and why it was developed. Furthermore, the advantages and disadvantages of the Scratch programming language are highlighted in order to inform the teacher why Scratch is a viable option for programming in Grade 10 (see Screenshot 3.3. and Screenshot 3.4.). This section only addresses the first level of the taxonomy which is the 'Remember' level. Cognitively this level requires participants to recall previous knowledge, if they have any, and to recognise the new knowledge with which they are confronted.

## ADVANTAGES OF SCRATCH (1)

- Viable option for the introduction to programming for young people
- Great success when implementing Scratch in their higher education
- Scratch programs can be shared on the Scratch online community fostering collaborative learning between learners



Screenshot 3.3 Illustrations of advantages, presented to introduce teachers to Scratch

## DISADVANTAGES OF SCRATCH

- Object-oriented programming skills are not addressed in Scratch
- Sophisticated programmers might find the graphical interface too frustrating
- Visual programming languages' codes are not as easily readable

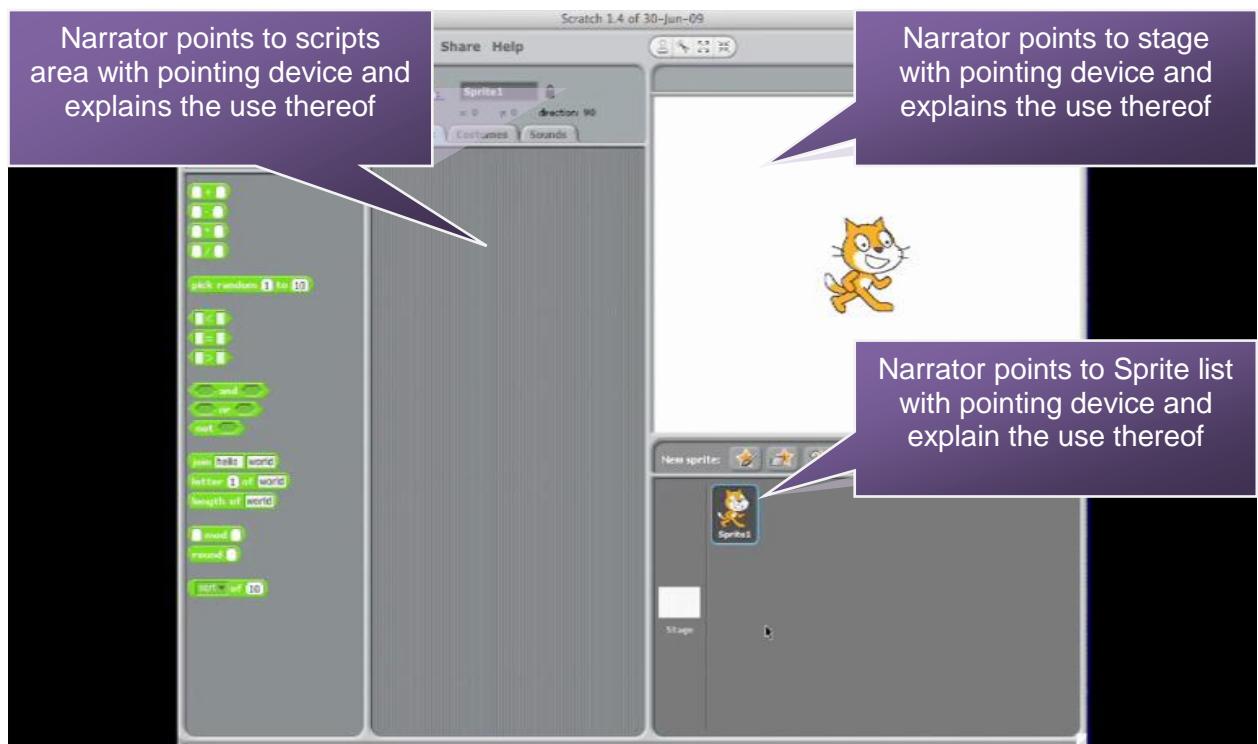


Screenshot 3.4 Illustrations of disadvantages, presented to introduce teachers to Scratch

### 3.3.2.3. Scratch programming language environment

The CAPS prescribes that an introduction to the terms of the programming language as well as the programming language environment be discussed (Department of Basic Education,

2012:21). Knowledge of the Scratch programming environment is not needed before programming can start (Maloney *et al.*, 2010:10) however rather than have teachers explore the environment on their own account, it saves time to introduce them to the environment at the onset of the DVD. This implies that all components in the Scratch environment be discussed focusing on their function and where it would be appropriate to use these components. The components in the Scratch environment include the Stage, the Scripts area, the Sprite list and the programming blocks. As this section also does not focus too heavily on application, it addresses the ‘Remember’ level of the taxonomy. It does however also touch on some of the other levels like level two (Understand) and level three (Apply) as teachers have to grasp the knowledge of the programming environment and they should know how to apply this knowledge in order to reach success. Screenshot 3.5 illustrates how teachers are introduced to the programming language environment by means of a pointing device and narration.

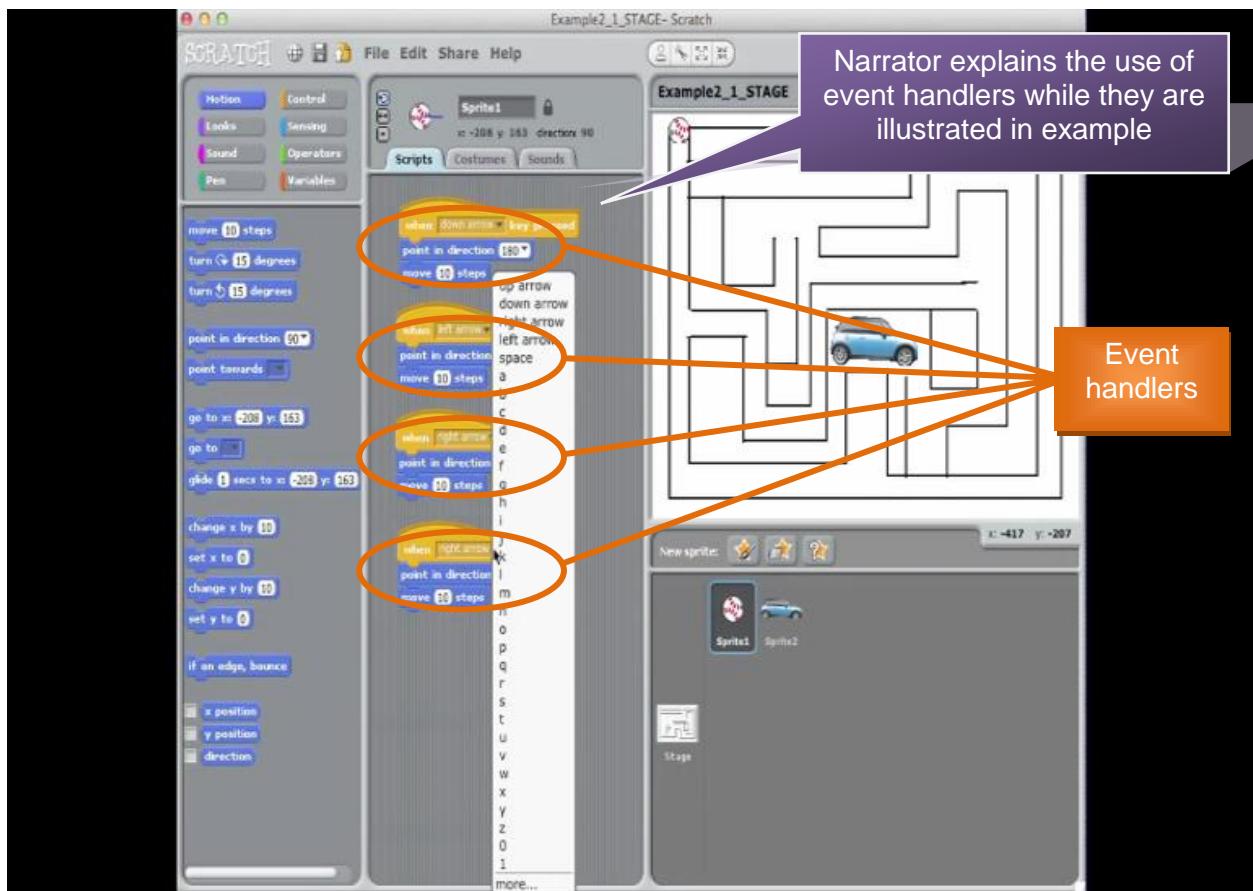


**Screenshot 3.5 The programming language environment introduced**

### 3.3.2.4. Event handling in Scratch

Event handling or event-driven programming is a style of programming so called as the program responds to events triggered by the user (Barrow *et al.*, 2005:16). It is also one of the advantages of Scratch in that students have the opportunity to graphically control events that are triggered by the user, making Scratch the interactive programming language that it is. Teachers are firstly introduced to the concept of event handling as well as the components in Scratch supporting event handling; hence, addressing the first level of the taxonomy. The

second and third levels of the taxonomy (Understand and Apply) are more prominently addressed in this section as teachers are required to not only 'Remember' but also to apply knowledge by means of examples that they have to complete. Screenshot 3.6 shows an example of event handling illustrated on the Scratch DVD.

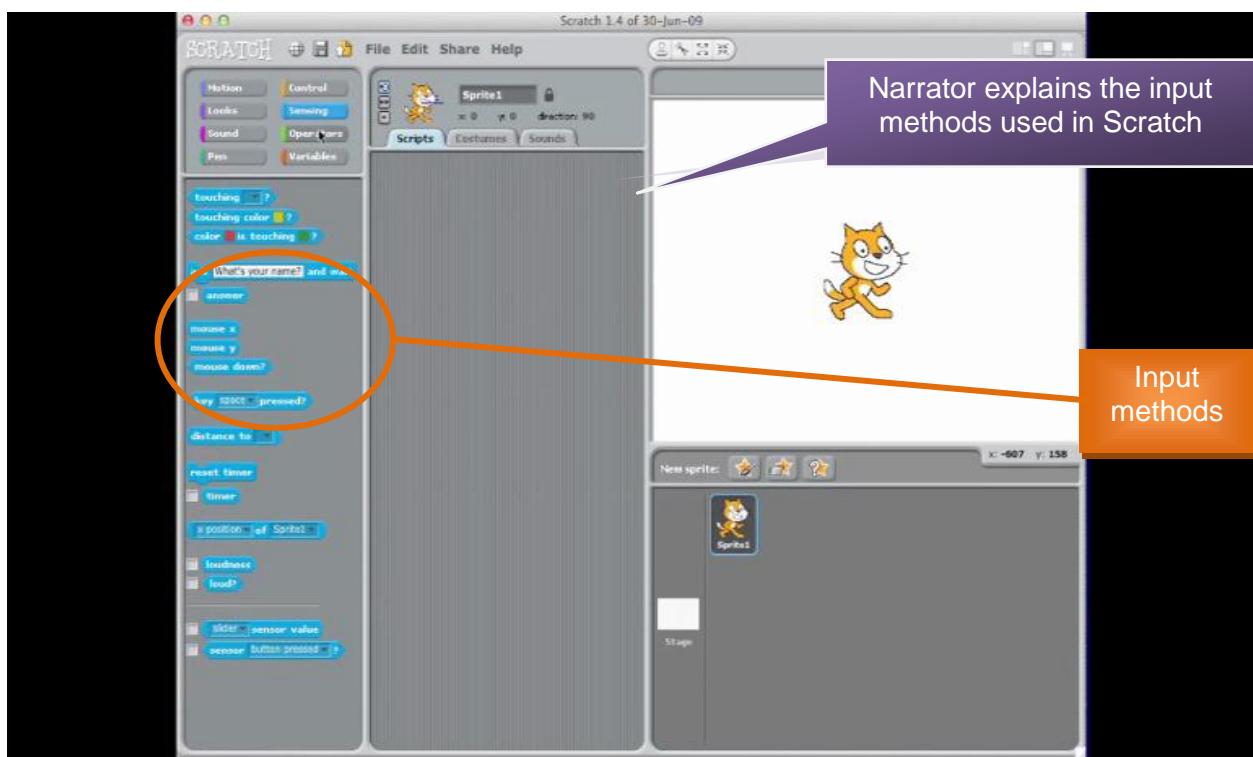


**Screenshot 3.6 An illustrated example on the Scratch DVD assisting teachers in understanding and applying knowledge gained**

### 3.3.2.5. Data types and input methods

Scratch consists of three different data types, namely Boolean, Integer and String (Maloney et al., 2010:9). Brady (2005:2) emphasises the importance of data types in programming, therefore it is not surprising that it is one of the stated concepts in the CAPS document (Department of Basic Education, 2012:20). In order to address this issue in the professional development programme, teachers need to be informed that Scratch only allows for certain data types to be used (Maloney et al., 2010:9). Apart from data types that are allowed in Scratch, limited input methods are available, namely mouse and keyboard input.

Making mention of information on mouse and keyboard input may seem futile, but this information prominently addresses the first level of the taxonomy. Teachers, however have the opportunity to complete examples and activities featured in the professional development programme, addressing some of the other levels on the taxonomy. Screenshot 3.7 illustrates how teachers are informed about the programming blocks used when input is required from the user (this addresses the first, second and third levels of the taxonomy).

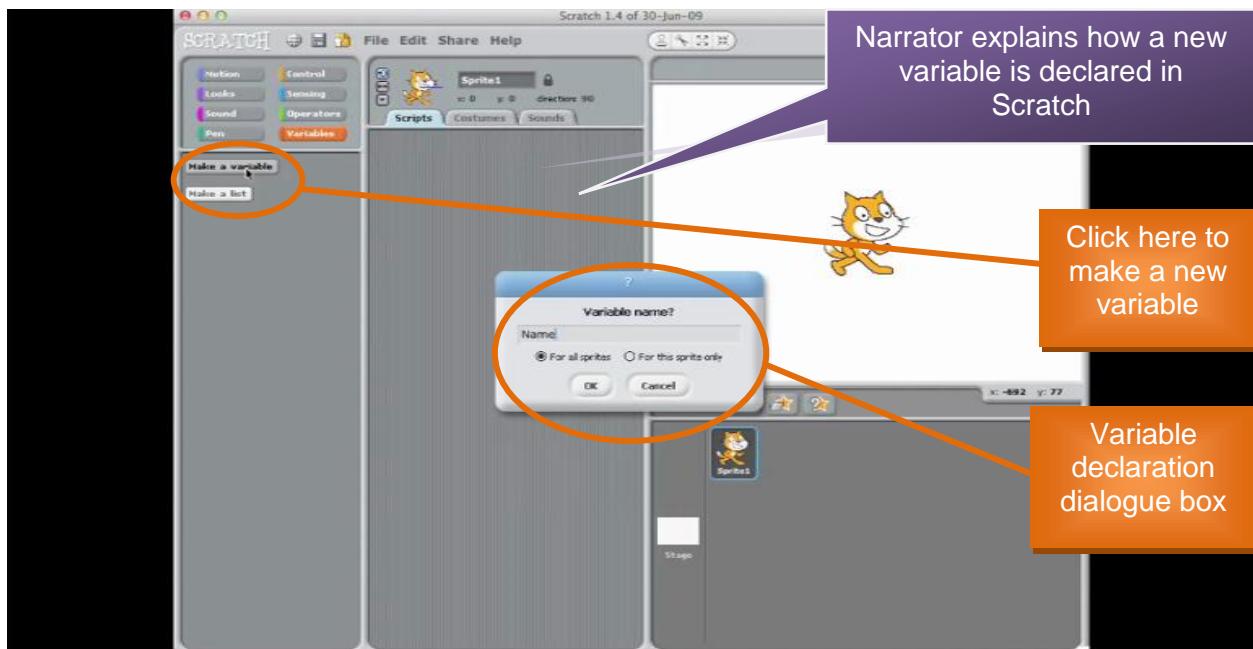


**Screenshot 3.7 Programming blocks used for input illustrated**

### 3.3.2.6. Variables

The concept of variables is often quite difficult to grasp (Kuittinen & Sajaniemi, 2004:57). Variables are memory blocks that are created in order to store data. A variable block has to be declared and a value is assigned to it (Meerbaum-Salant *et al.*, 2010:74). The CAPS (Department of Basic Education, 2012:20) requires that learners explore different uses of variables (e.g. global and local) as well as manipulate variables by assigning values to it and making use of the different functions in Scratch. This implies that teachers too need to be guided in the use of variables giving them the opportunity to acquire specific knowledge of variables in the Scratch programming language. When learning variables, previously constructed knowledge is predominantly used as it makes up a large part of the understanding of variables. Teachers have been introduced to introductory concepts of Scratch, focusing more on the first level of the taxonomy, therefore the section on variables moves to the higher levels. This section does not, for instance, look into the theoretical underpinnings of what variables are

and how they are used (which would address the lower levels of the taxonomy), instead it focuses on how variables are applied in Scratch as well as how this can be used to solve programming problems (addressing levels two and further of the taxonomy). Screenshot 3.8 illustrates the application of variables in Scratch.



**Screenshot 3.8 Applying knowledge of variables in Scratch**

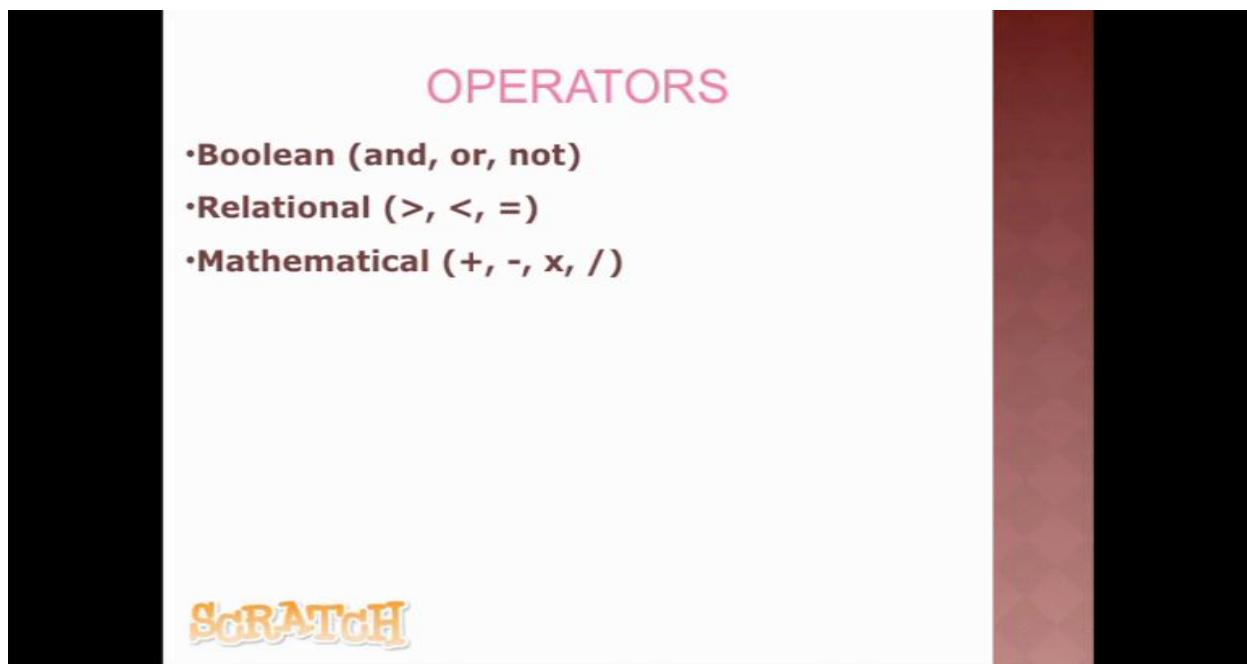
Furthermore, two activities are given to teachers (in their manual which accompanies the DVD) to guide them cognitively to the three higher levels of the taxonomy (analyse, evaluate and create) as they are confronted with a programming problem that they have to relate to the knowledge constructed. This knowledge has to be analysed (to connect the right knowledge to each other), evaluated (to evaluate new knowledge gained) and created (to be able to apply this knowledge in such a way that new knowledge is formed and a new artefact is created).

### 3.3.2.7. Data handling

Data handling implies that one sets out certain methods in order to manage data effectively. In order to establish this, Scratch makes use of three components, namely operators, functions and arrays (Department of Basic Education, 2012:20). Each of these components is discussed separately on the Scratch training DVD in order to equip teachers more effectively in the teaching thereof.

### 3.3.2.7.1. Operators

In Scratch, mathematical operators as well as String operators are evident. Mathematical operators are operators that are used in equations of integers but they can also be used in String manipulation. Furthermore, String operators like concatenate are also possible in Scratch. In order to address both these operators, a section on these operators is available on the DVD, where teachers are introduced to the operators. This section touches on the first, second and third levels of the taxonomy as teachers are introduced to the concepts (see Screenshot 3.9) and an example is illustrated (see Screenshot 3.10) in order to assist understanding and application of knowledge acquired.



Screenshot 3.9 Introduction of operators

The example illustrated in this section is shown to teachers on the DVD after which they are required to complete an activity on the topic of operators. This activity ensures that the first three levels of the taxonomy have been reached, but once again allows teachers to move onto the fourth level.

## EXAMPLE

Learners today do not know when a number is greater or smaller than another number. They often confuse these two concepts and thus it is necessary to illustrate the difference to them. Write a Scratch program illustrating whether 2 numbers are greater, smaller or equal to each other.

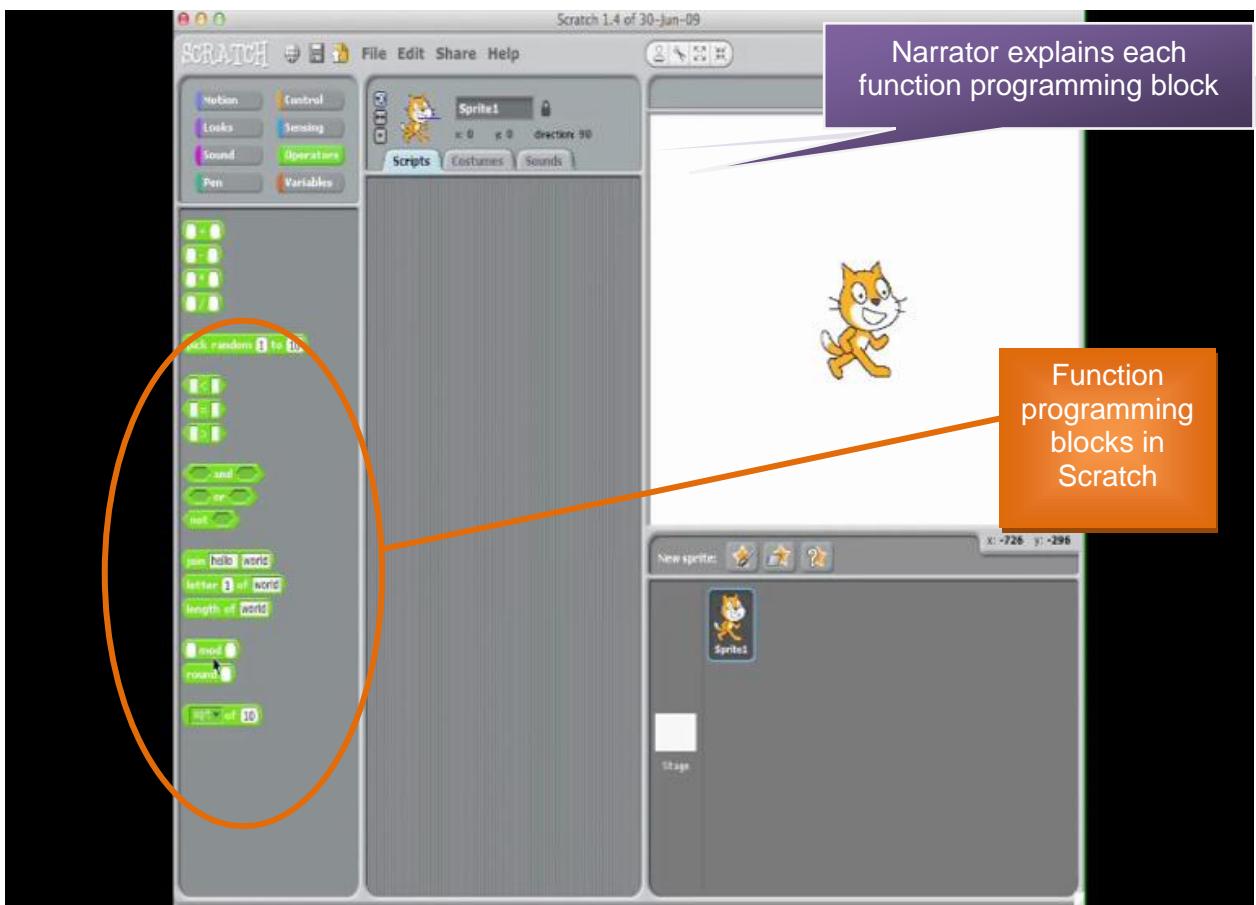


Screenshot 3.10 An example to assist application of knowledge on operators

### 3.3.2.7.2. Functions

Functions are pre-coded instructions that assist with the programming process, especially in arithmetic and mathematical operations (Barrow *et al.*, 2005:335). These instructions save the programmer time in that they already contain the necessary code needed to execute certain tasks. In Scratch, three main functions that are used are 'random' (for randomly calculating a number), 'round' (for rounding a decimal number) and 'square root' (for calculating the square root of a number).

On the Scratch DVD, these functions are described and explained (Screenshot 3.11). Although this section addresses the first and the second levels of the taxonomy (when superficially introducing functions), the third level of the taxonomy is most predominantly addressed as teachers are guided in the process of how to apply functions in Scratch and therefore the focus is not on remembering and understanding as such.

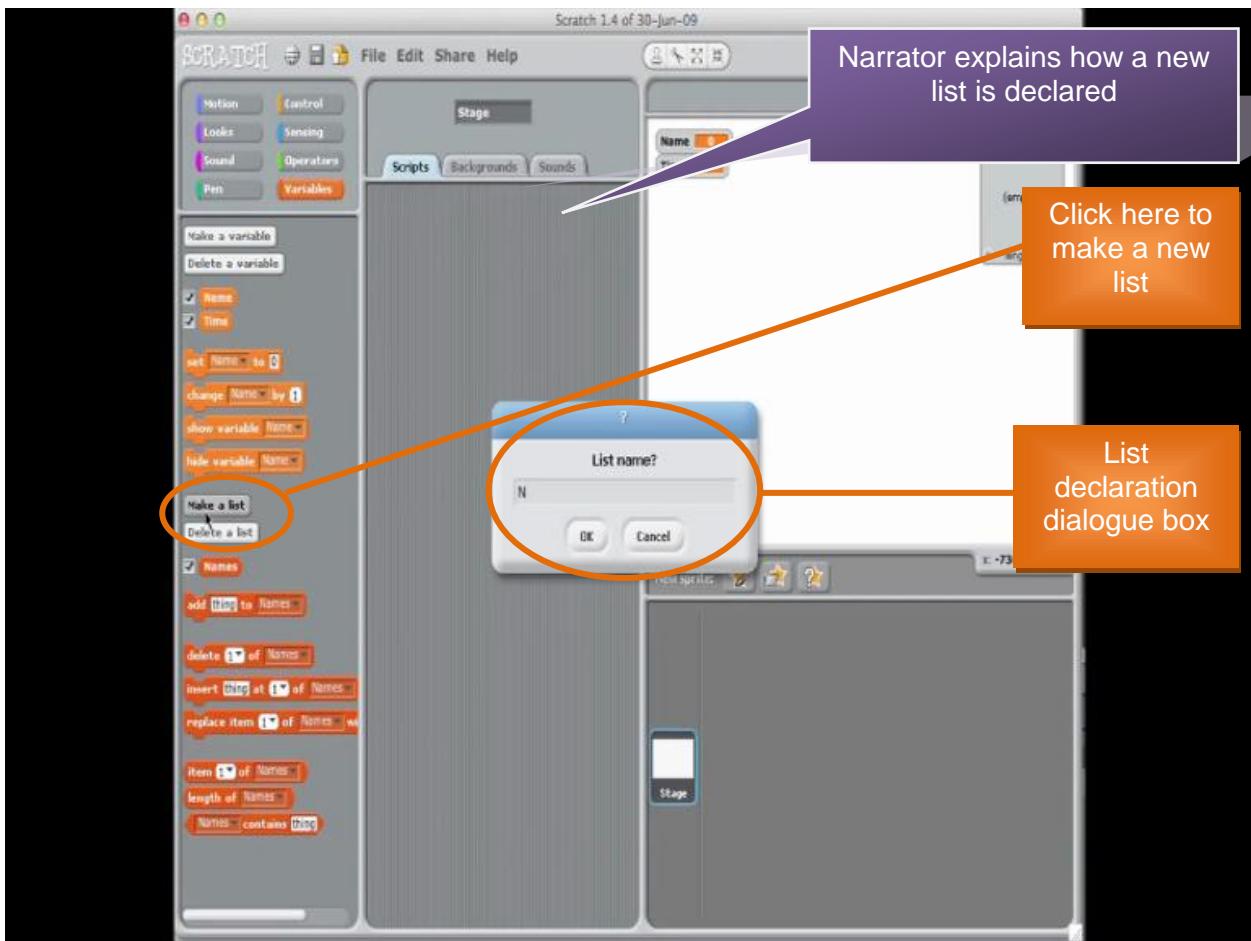


**Screenshot 3.11 Explaining functions on the DVD**

### 3.3.2.7.3. Arrays

Reserving memory ‘banks’ for data (several variables) to be inserted is done by means of arrays. When using arrays, reference to a specific memory ‘bank’ can be assigned, assisting the process of data handling as data can easily be manipulated, recalled, deleted or replaced. In Scratch, the use of arrays are possible; however, within the Scratch environment, it is referred to as ‘lists’ although the same functionality is achieved (Maloney *et al.*, 2010:9).

The Scratch DVD introduces knowledge of arrays and emphasises the use of lists through the illustration of how lists are created and deleted as well as how they can easily be employed in a Scratch program (see Screenshot 3.12).



**Screenshot 3.12 Explaining how to create a new list**

With the basic explanation of the use of lists, the first three levels of the taxonomy are addressed. Screenshot 3.13 illustrates the example shown to teachers in order to guide their cognition and to allow them to apply the knowledge acquired.

Once teachers have completed the example, they are required to complete an activity on arrays. This ensures that they have the opportunity to move toward the fourth level of the taxonomy as they are granted the opportunity to analyse, evaluate and create knowledge from the knowledge constructed whilst completing the section.

## EXAMPLE

The principle asks you to keep score of the local athletics tournament. Write a program for the 100m sprints, where each participant and their time is added in a list. Ask the teacher to enter the athlete's name when clicking on 1 button and randomly calculate the time when clicking on another button. Show the list of names and times.



Screenshot 3.13 An example used to illustrate the use of arrays (lists) in Scratch

### 3.3.2.8. Constructs

Specific programming code, joined together to perform specific tasks is grouped together and forms a construct. Two types of constructs can be found in the Scratch programming environment. These are conditional constructs and iteration constructs, each serving its own purpose. Addressing level one of the taxonomy, teachers are introduced to the types of constructs (see Screenshot 3.14), after which each type of construct is discussed on the DVD.

## 2 TYPES OF CONSTRUCTS

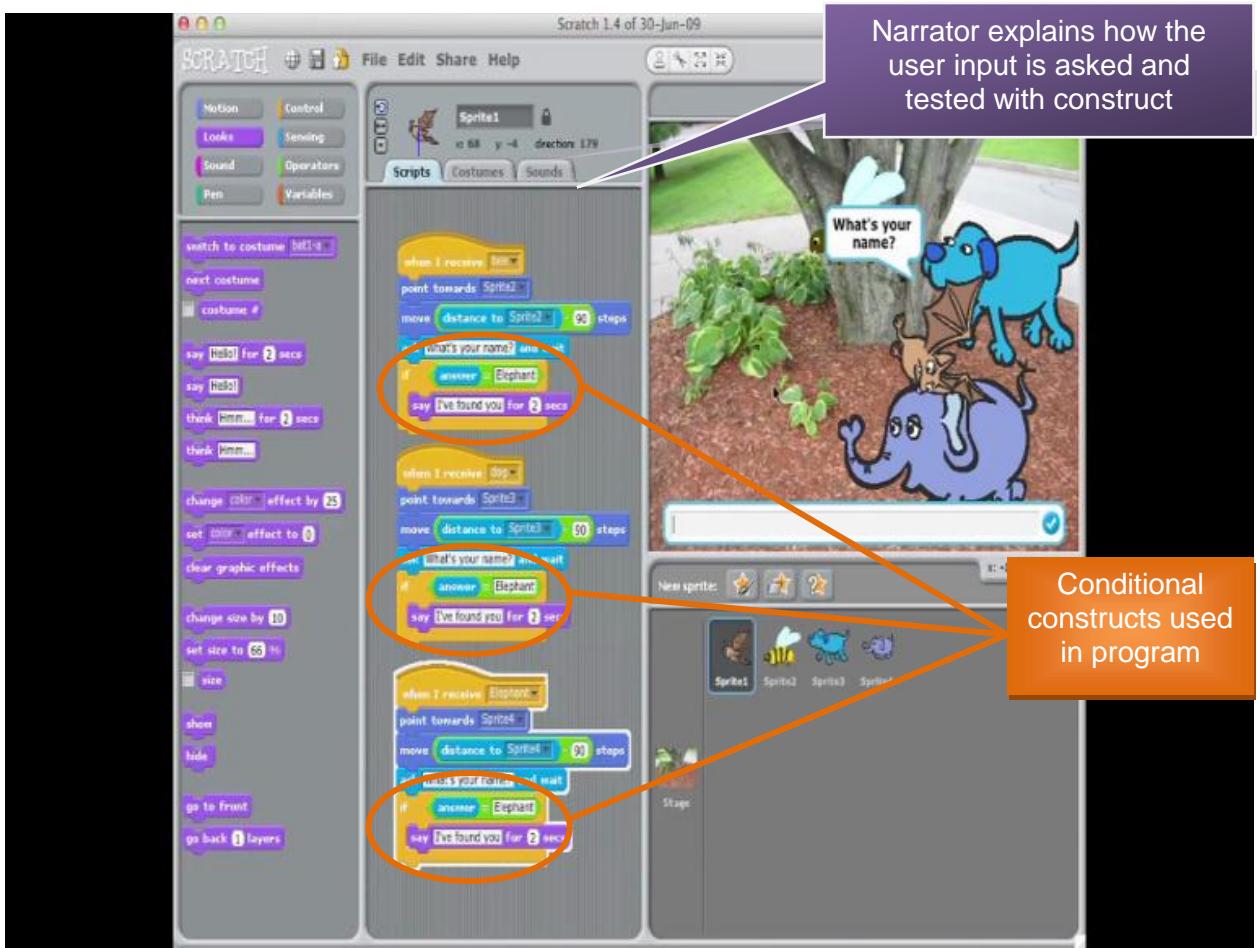
- Conditional constructs
  - (if and if-then-else)
- Iteration constructs
  - (forever, forever-if, repeat and repeat-until)



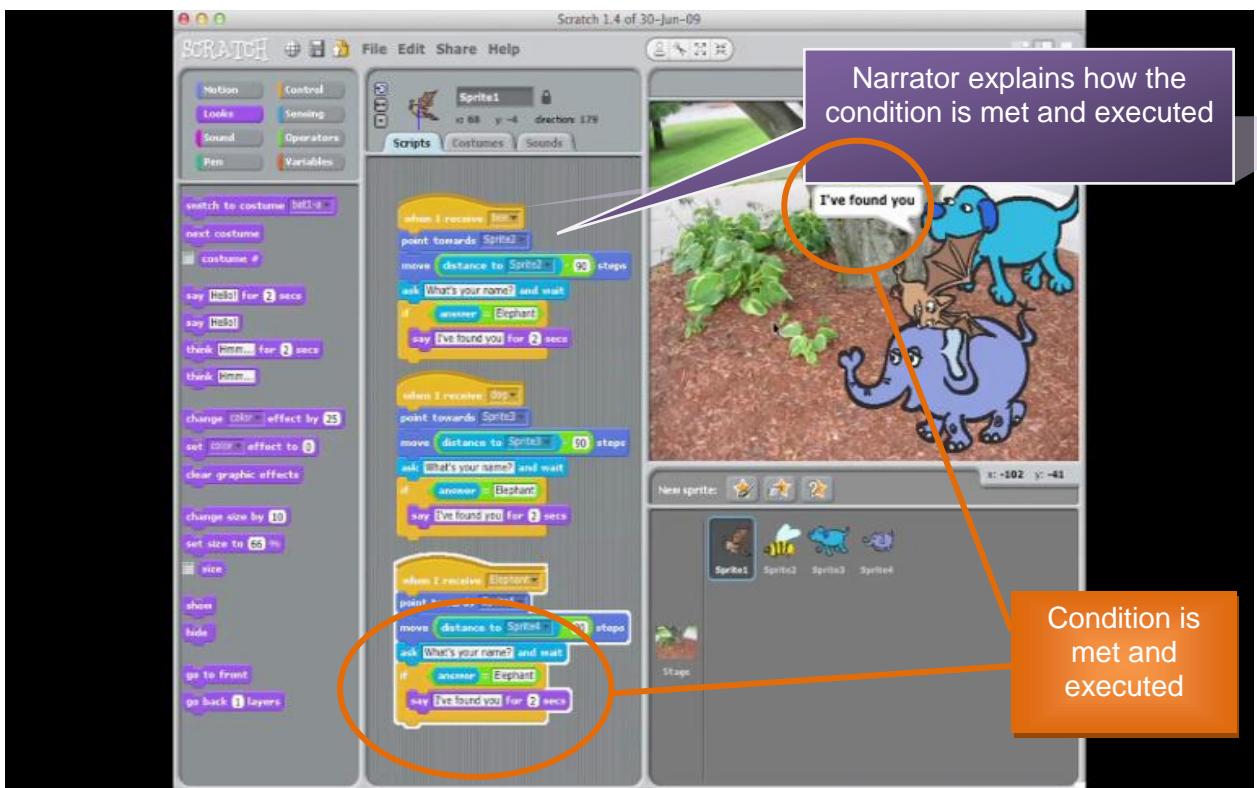
**Screenshot 3.14 Screenshot illustrating the introduction of two types of constructs**

### 3.3.2.8.1. Conditional constructs

Conditional constructs test certain conditions, and if the condition is satisfied, certain tasks are executed. In order to establish the use of these constructs an example is illustrated on the DVD. The example is one of a bat searching for his friend with a specific name (condition) (see Screenshot 3.15), and once the condition has been met (he finds his friend), a specific task is executed (see Screenshot 3.16). Should the scenario fail to satisfy the condition, another specific task is executed (he goes to the next animal). Teachers are encouraged to complete the example together with the facilitator in order to give them the opportunity to apply the knowledge acquired, hence addressing the third level of the taxonomy. Furthermore, as with many of the previous sections, an activity is given to focus the cognition of the teachers on level four as they analyse, evaluate and create whilst completing the activity.



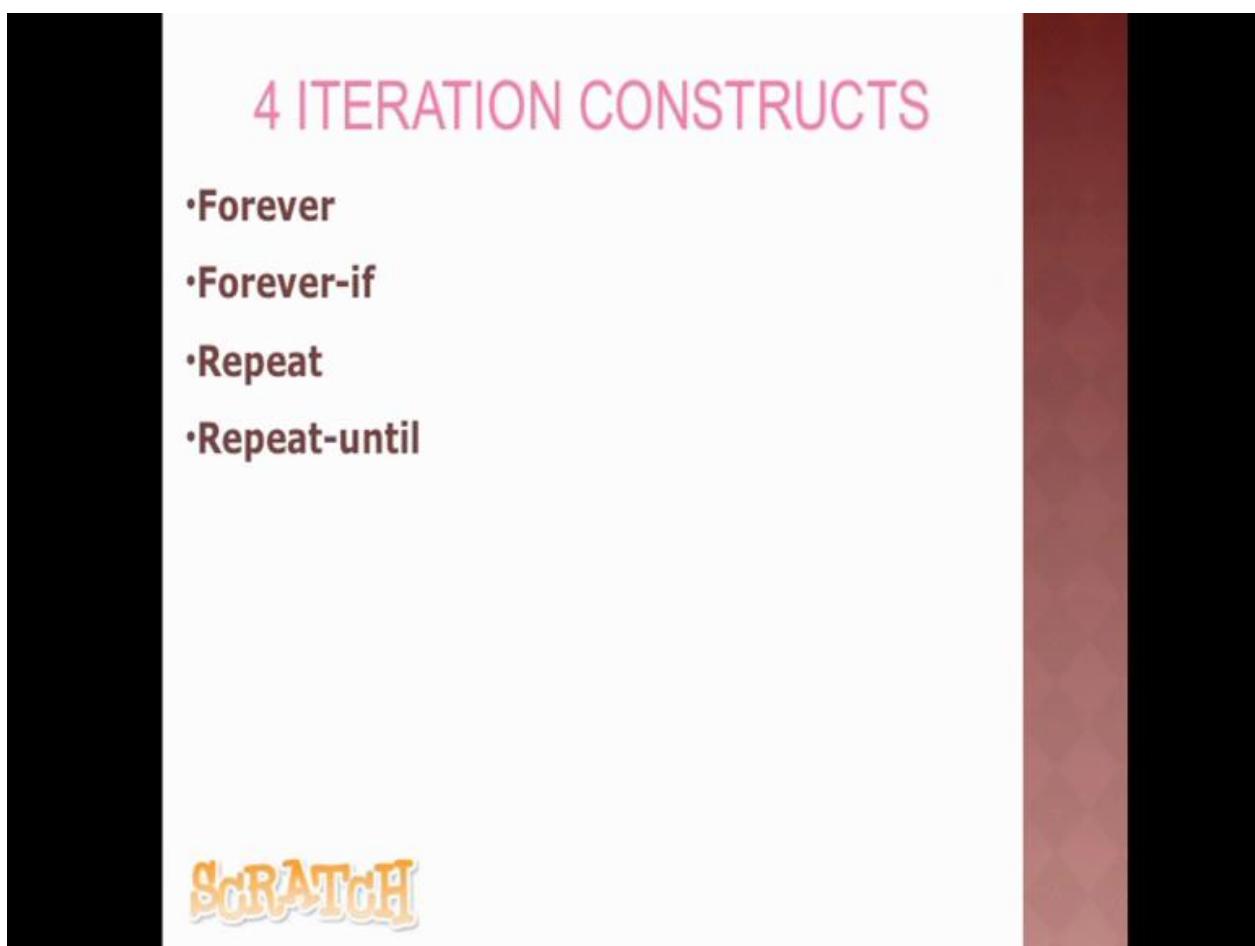
Screenshot 3.15 Programme testing a condition



Screenshot 3.16 Programme executing a task as condition is met

### 3.3.2.8.2. Iteration constructs

Iteration is synonymous with repetition (Merriam-Webster Dictionary, 2012). Scratch allows for four separate iteration constructs, each with its own functionality and appropriate use (Department of Basic Education, 2012:22). Teachers are introduced to the four iteration constructs on the DVD in order to refresh their memory of these constructs, and in doing so levels one (refreshing their knowledge of constructs) and two (refreshing their understanding of constructs) are addressed. Screenshot 3.17 shows a screenshot of how teachers are introduced to the four iteration constructs. Furthermore, these four iteration constructs are grouped together on the DVD as each set of two connects closely to the other. Each group is discussed separately.

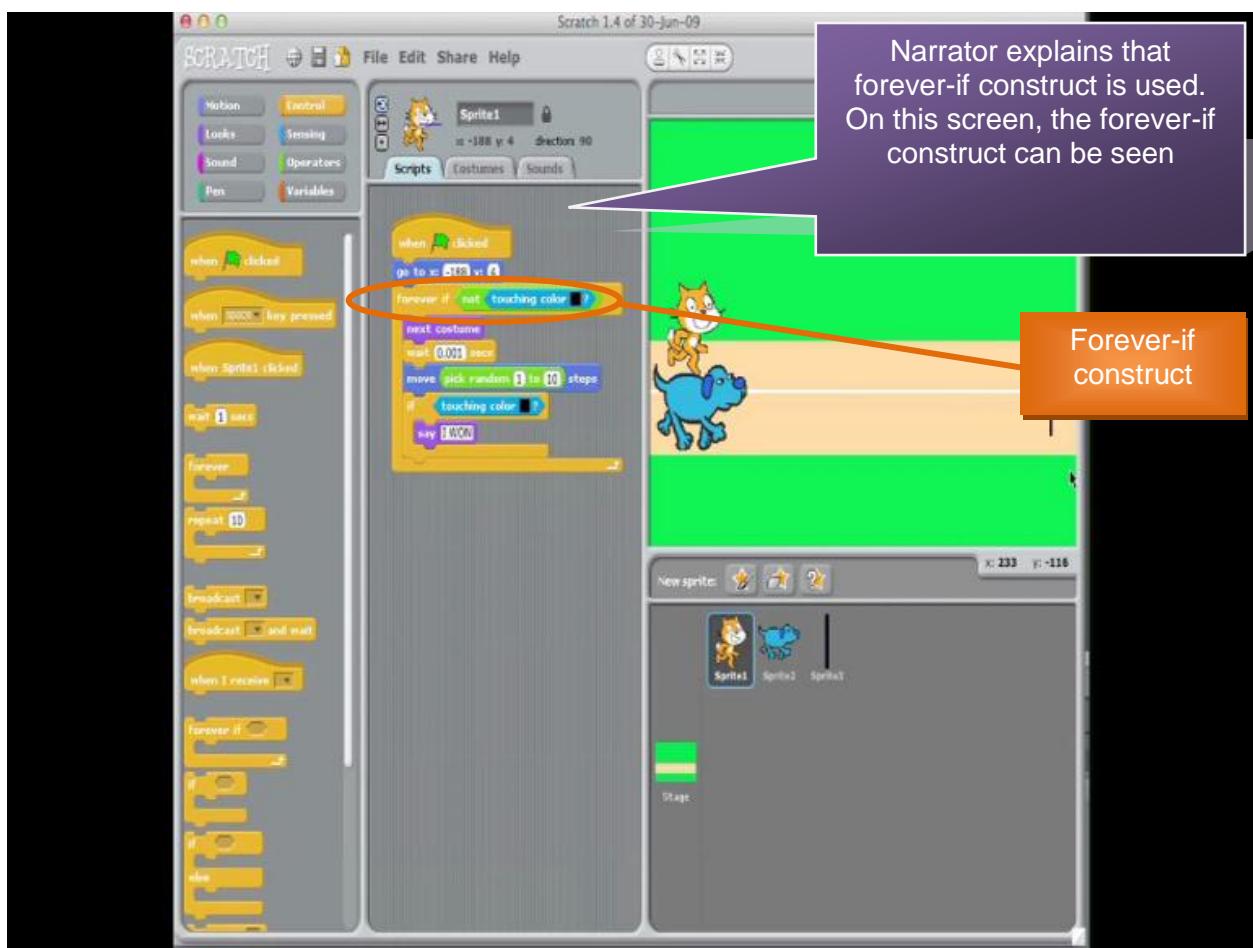


Screenshot 3.17 Screenshot of the introduction to iteration constructs

#### ***Forever and forever-if***

Forever and forever-if statements are iteration constructs allowing the program to run an undefined number of times. The difference in the two is that the forever statement repeats

continuously until the program stops whereas the forever-if statement continues while a certain condition is satisfied (Maloney *et al.*, 2010:9). Both these iteration constructs are mentioned on the DVD, giving the teacher an introduction to when the forever and forever-if constructs are used. This is focused on the first level of the taxonomy as new knowledge is presented to the teachers which they (if they had not known it before) have to remember. Teachers are asked to look at an example illustrating the use of both the ‘forever’ and ‘forever-if’ constructs, which leads them to move from level one of the taxonomy to levels two and three. Screenshot 3.18 shows the programming code illustrated to enhance the understanding of both the constructs.



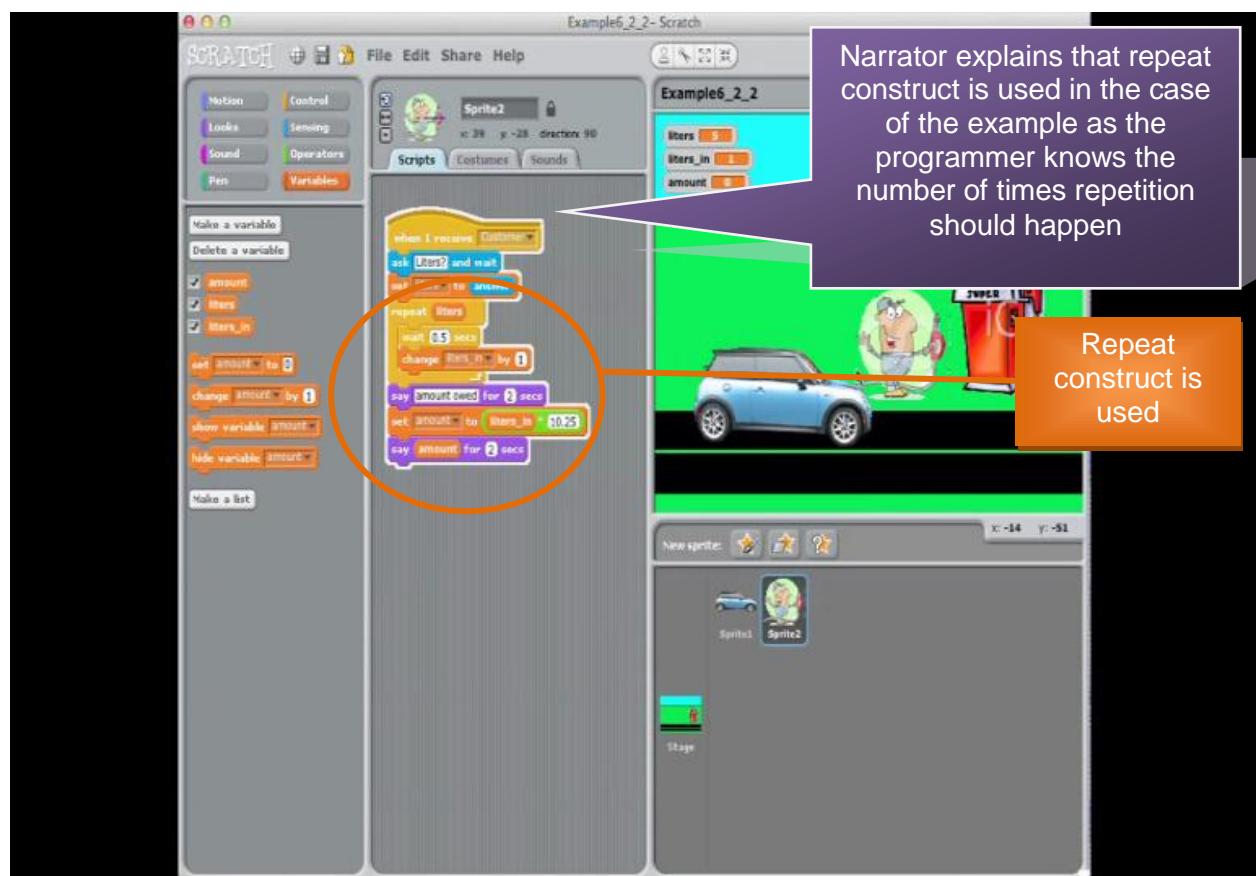
**Screenshot 3.18 Screenshot of a program incorporating the forever-if construct**

In order to address not only the lower levels of the taxonomy but also the higher ones, teachers are required to complete an activity (as in previous sections) to ensure that cognition moves to a higher level.

## **Repeat and repeat-until**

As mentioned in the previous section, iteration is synonymous with repetition. Although the forever and forever-if statements can be used when a need for repetition arises, repeat and repeat-until are often more appropriate. The repeat and repeat-until statements allow the programmer to state specifically how many times a certain set of programming code need to be repeated (Maloney *et al.*, 2010:9). For instance, if the program requires the user to insert five numbers, it is unnecessary to make use of the forever or forever-if statements as the specific number of repetitions are known and therefore the repeat statement is more appropriate. The repeat-until statement allows the programmer to set a boundary for the repetitions and in doing so allows the program to test the condition and have the coding repeat until the condition is met. Teachers are given a brief overview of the repeat and repeat-until in order to enhance their knowledge of the concept thus addressing the first and second levels of the taxonomy more predominantly.

An example of the repeat statement is given on the Scratch DVD to allow teachers to briefly distinguish between the forever and forever-if constructs and the repeat constructs (see Screenshot 3.19 for a screenshot of the programming blocks used in the example).



**Screenshot 3.19 Screenshot of program making use of repeat construct**

Teachers have completed various sections up to this point and thus content on the DVD cannot only be focused on levels one to three. As with the other sections, the main aim of this section is to lead teachers to be able to move to at least level four of the taxonomy once the section is completed. This is done by giving an activity in which teachers are required to analyse the knowledge acquired, to evaluate it and to create a new programme in order to accomplish the requirements of the activity.

### 3.3.2.9. Putting it all together

Apart from the above-mentioned topics, several other topics like debugging, validation techniques, solution development and animation are mentioned in the CAPS (Department of Basic Education, 2012:20-23). Addressing these topics is still important as this is prescribed by the CAPS. Though many of the set topics are not addressed in detail on the DVD, they are mentioned either in the last section on the DVD or throughout portions of the DVD as teachers are knowledgeable in higher-level programming skills, for instance debugging. Teachers are required to assist learners in forming a holistic view of the Scratch programming environment. This includes making use of all the different sub-sections and concepts as well as the non-programmable aspects like debugging and development. Should teachers be able to take all the knowledge acquired from completing the professional development programme up to this point, they will automatically be able to move to the last level of the taxonomy where higher application is required. Teaching what one has learnt assists in the transformation from level four to level five of the taxonomy.

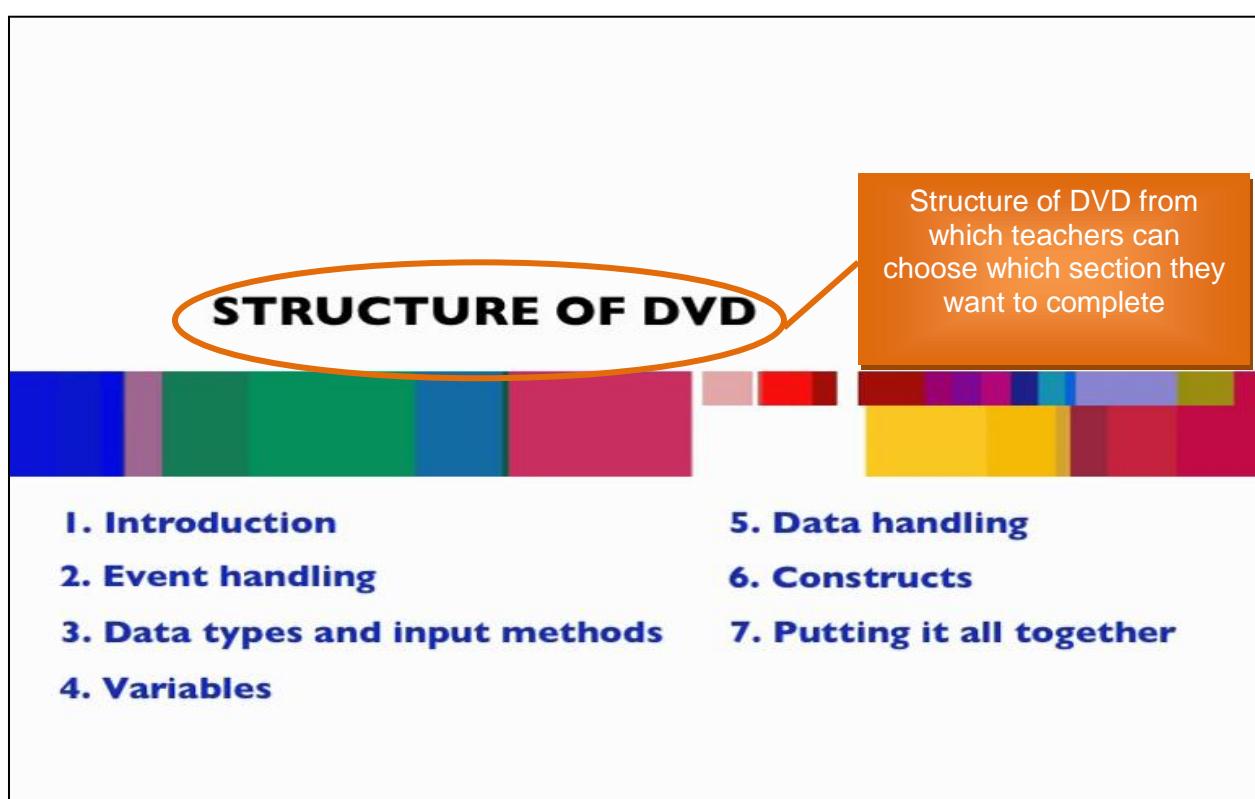
Apart from the example shown to teachers while watching the DVD, they are required to complete three activities (in their user manual) to ensure their comprehension of Scratch in totality. It is impossible to criticise knowledge acquired and to convey it to learners if sufficient knowledge is not attained; therefore, activities given to teachers are challenging and require all five levels of cognition to be addressed in order for teachers to complete such activities successfully.

In the next section, the design principles determined in Chapter 2 and how they are addressed on the DVD will be discussed.

### 3.3.3. Addressing design principles on the Scratch DVD

Referring to paragraph 2.8.1 where the design of a multimedia-based DVD is discussed at length, this section illustrates how these aspects are evident on the DVD developed for Information Technology teachers in their endeavour to learn Scratch as part of their professional development.

From the onset of the DVD, it is evident that the view of multimedia learning as knowledge construction is supported (see 2.8.1.1.2) as teachers are expected to journey through their own cognitive processes in order to make meaning of the content described. This is done by structuring the DVD in such a way that teachers can choose the sections on which they want to focus (see Screenshot 3.20 for the menu used on the DVD).

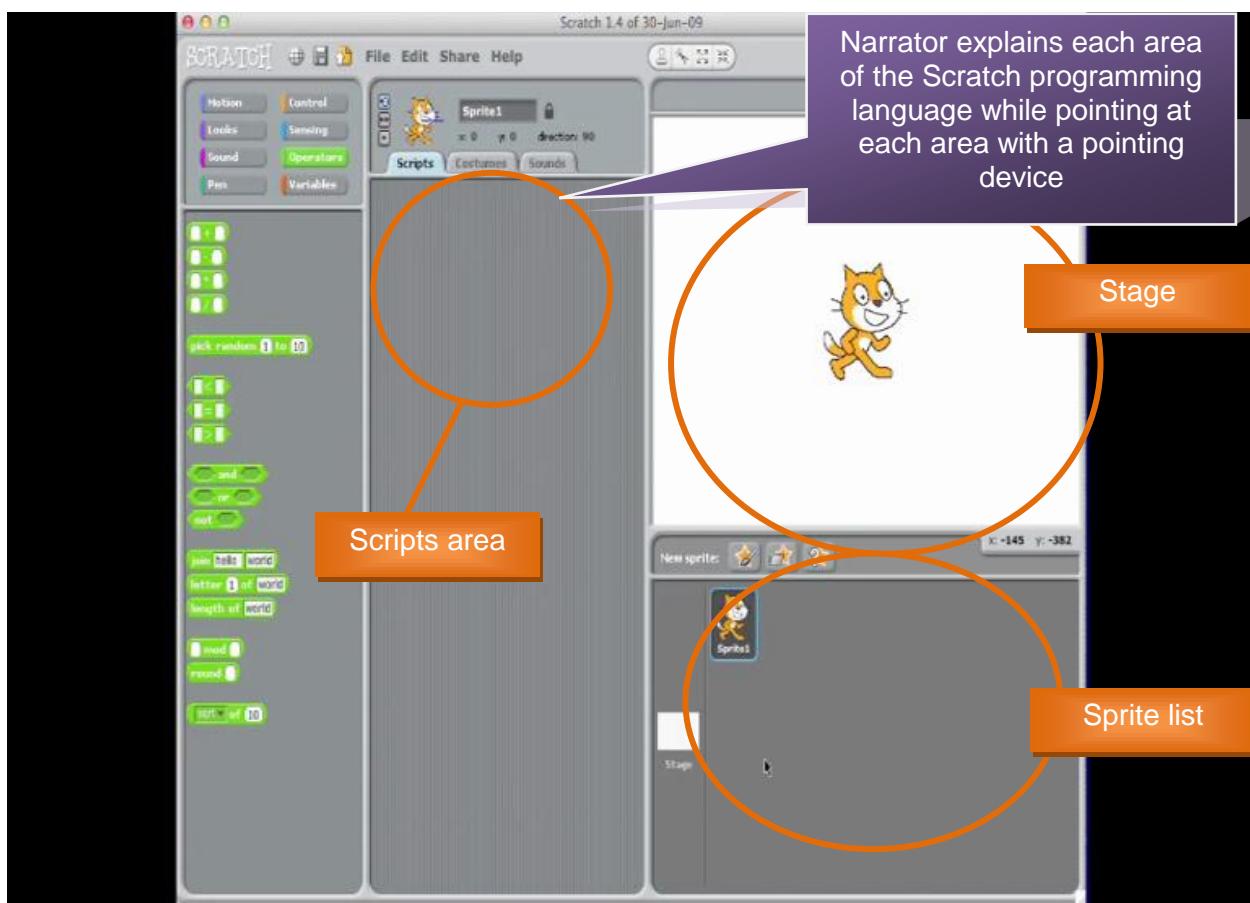


Screenshot 3.20 The DVD menu allowing teachers to choose any topic

Furthermore, different senses are stimulated in order to foster learning (hearing and seeing). In the next paragraph, application of the design principles (see Chapter 2) will be discussed.

### 3.3.3.1. Dual-channel principle

The dual-channel principle emphasises that it is more beneficial to incorporate words and pictures simultaneously when making use of multimedia presentations, than when using words alone (see 2.8.1.2.1). On the Scratch DVD, words (text or sound) and pictures (illustrations) are used together as much as possible. When, for instance, illustrating an example of the Scratch programming environment, the teachers can see the environment as well as accompanying words to illustrate the different parts of the environment. While the teachers see the environment (see Screenshot 3.21) the facilitator is narrating which area it is and pointing to the specific area with the mouse pointer.

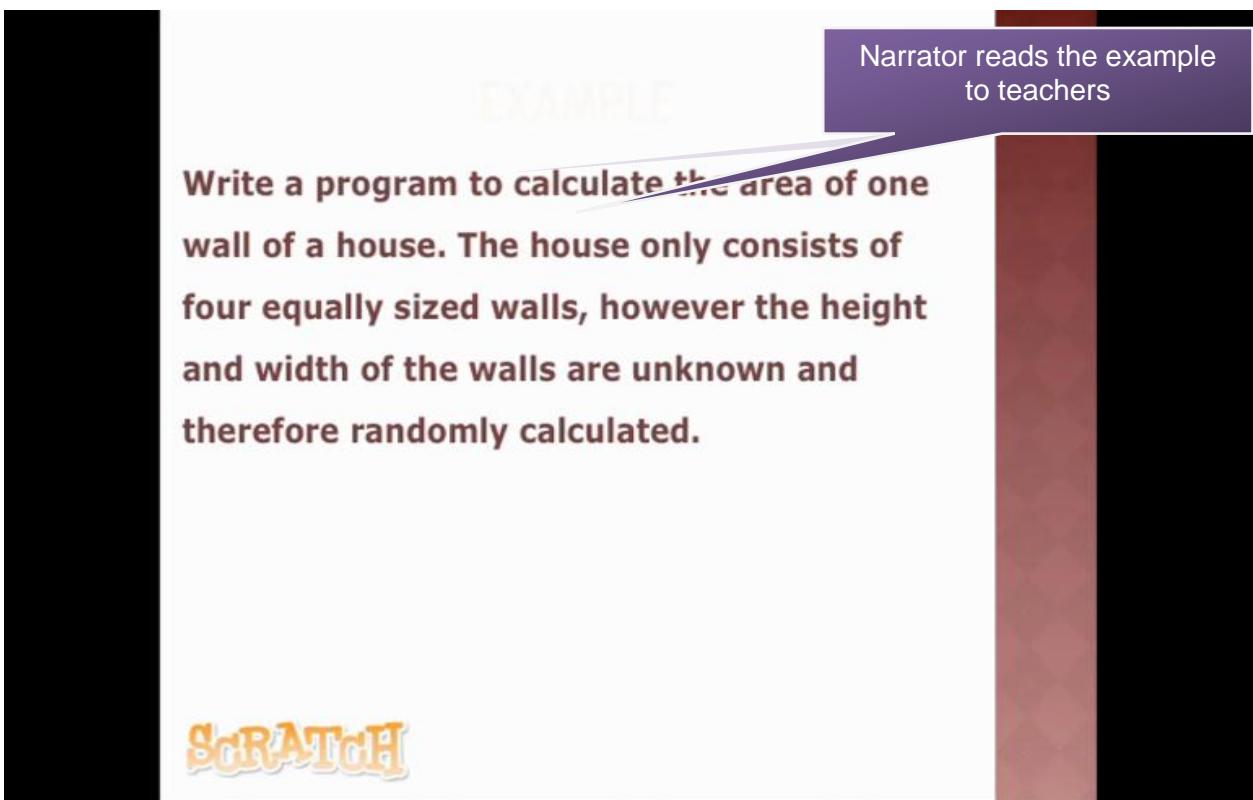


**Screenshot 3.21 Illustration of the dual-channel design principle being adhered to**

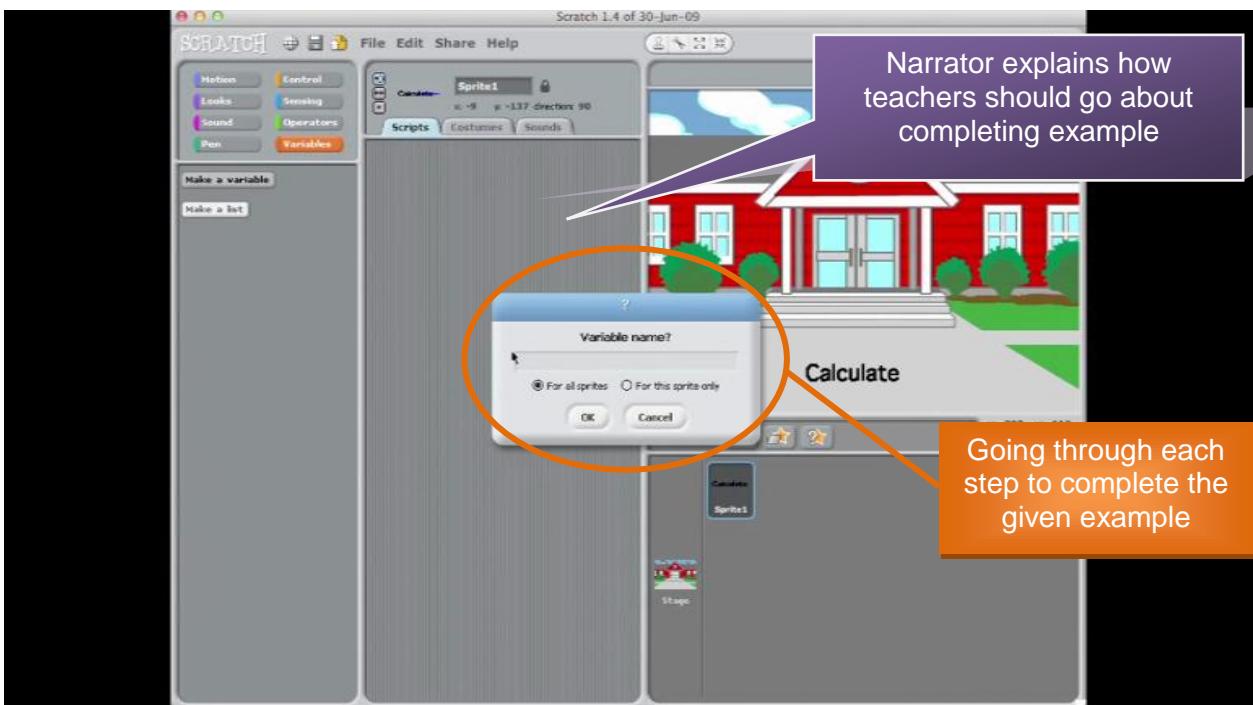
### 3.3.3.2. Spatial contiguity design principle

It is important to incorporate the spatial contiguity design principle that notes that individuals learn better when words and pictures that relate to each other are displayed closely together on one page or individually on separate pages (see 2.8.1.2.2). On the DVD, these principles are adhered to by ensuring that illustrations and examples are shown in separate screenshots but one after the other. Screenshot 3.22 and 3.23 illustrate that the examples given to teachers are

shown on one screen, followed by the explanation of the example in the Scratch programming environment on another screen.



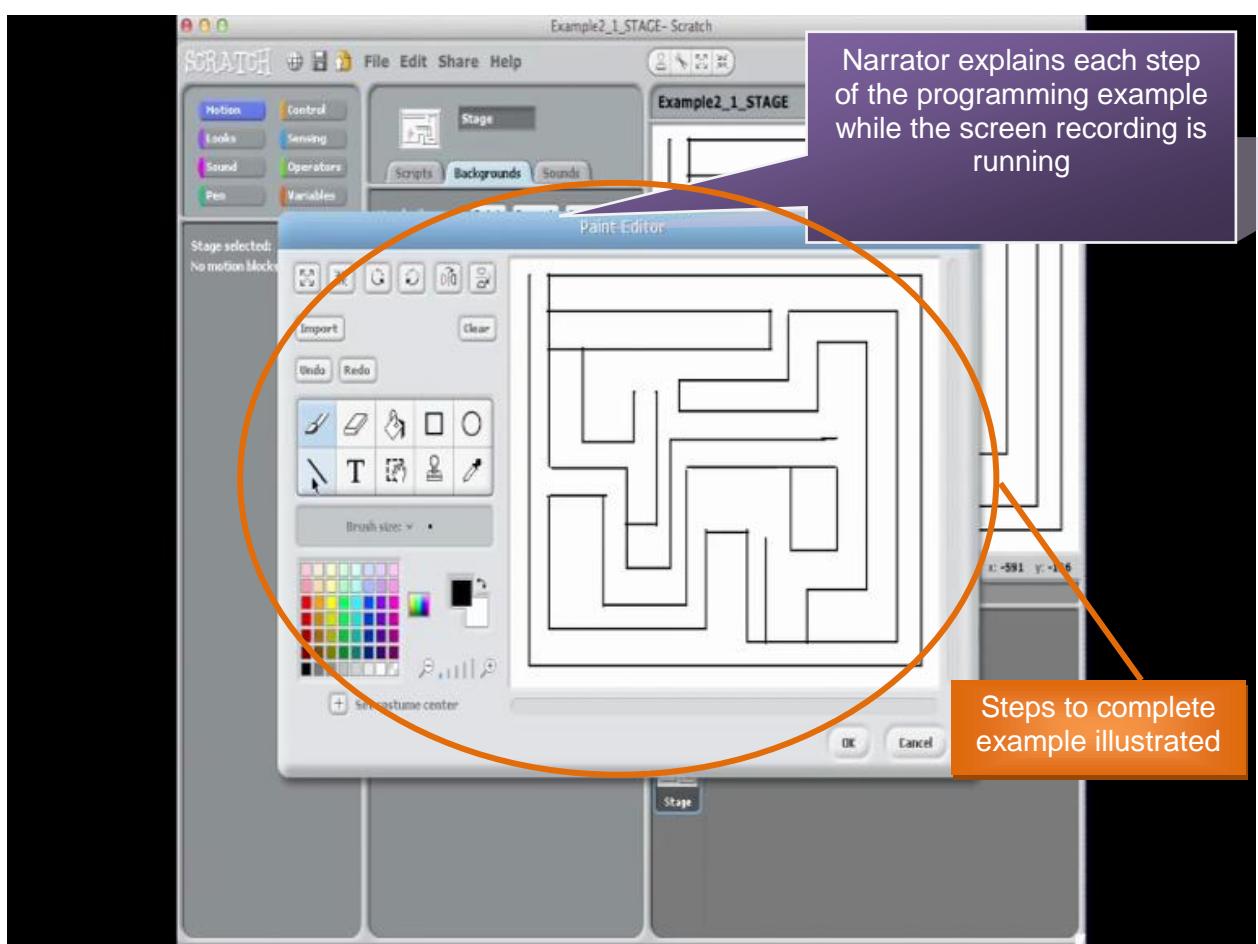
Screenshot 3.22 The example is given on one screen



Screenshot 3.23 The example explained on another screen

### 3.3.3.3. Temporal contiguity design principle

The temporal contiguity design principle emphasises that when words and pictures are not displayed simultaneously, a gap could form leading to the learner's memory confusing pictures and words (see 2.8.1.2.3). In order to address this principle on the DVD, words (narration) and pictures (screen recordings) of the DVD are displayed simultaneously. This is done by showing the text of an example, for instance, accompanied by a narrator reading the example. Furthermore, examples are illustrated by means of pictures or animations and accompanied by narrations to describe what the pictures are illustrating. Screenshot 3.24 shows an illustrated example accompanied by narration.

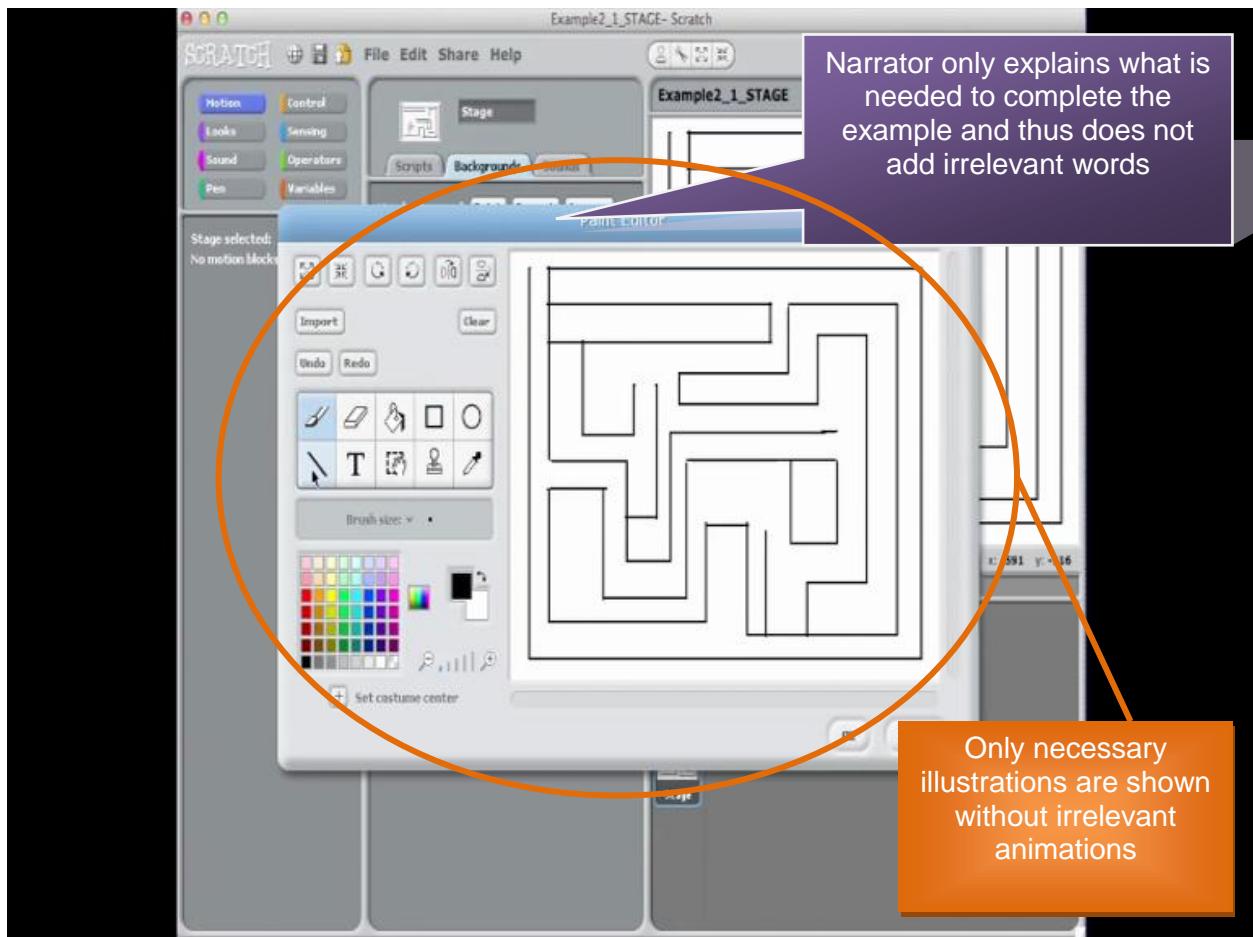


**Screenshot 3.24 Example of how the temporal contiguity design principle is adhered to**

### 3.3.3.4. Coherence design principle

The coherence design principle states that adding irrelevant pictures and words counteracts learning (see 2.8.1.2.4). The DVD adheres to the design principles and therefore makes use of animation and narration. When explaining a certain topic, it is unnecessary to have too much

animation or too many illustrations. The DVD should rather focus on the content and the best way to teach it than to mesmerise the teachers watching the DVD. In Screenshot 3.25, it is illustrated that an example is shown plainly in the Scratch programming environment, without adding additional animations.



**Screenshot 3.25 Screenshot of an example being illustrated without additional animation**

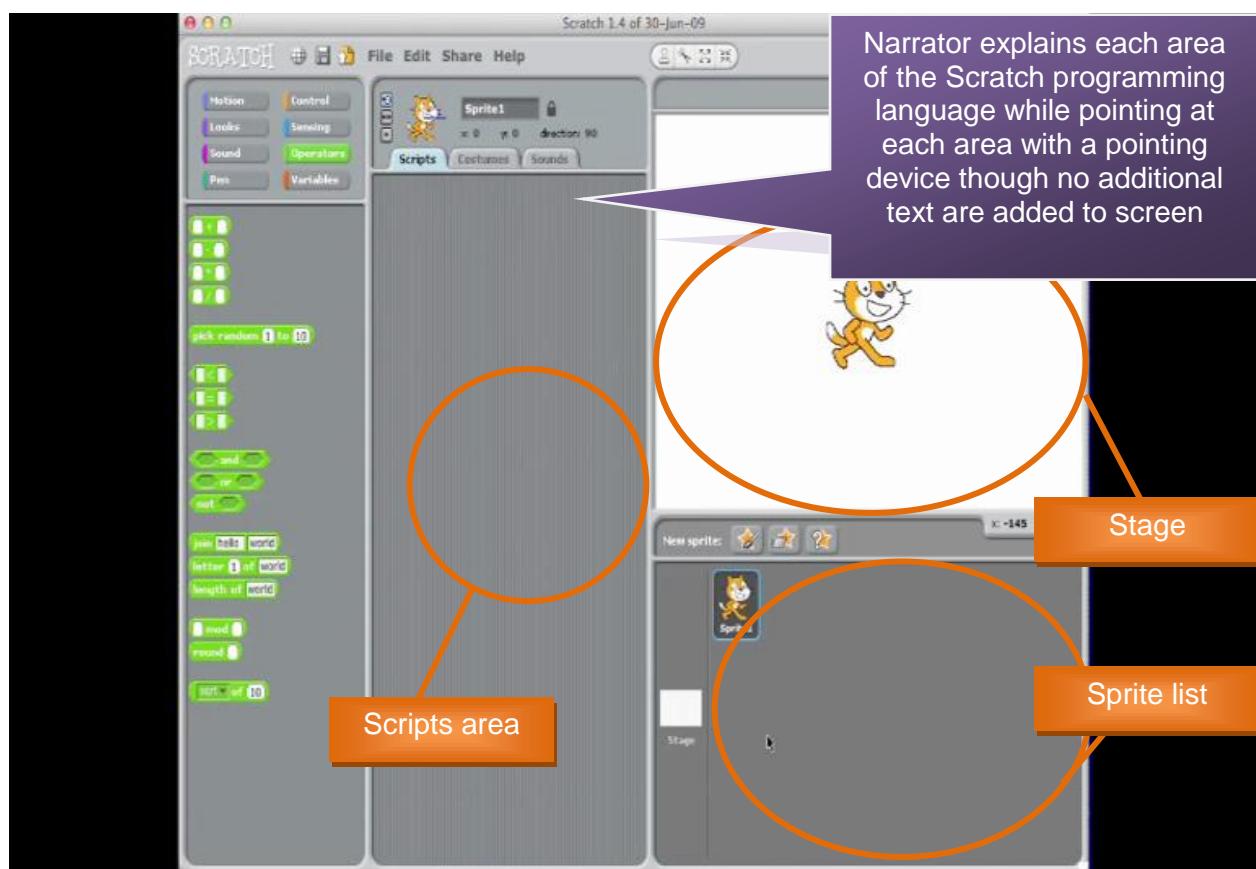
### 3.3.3.5. Modality design principle

The modality principle explains how the use of animation and text should be combined (see 2.8.1.2.5). As described in the previous section, animation may be used to illustrate examples, as this will be beneficial. Joining narration and animation will enhance learning through illustrations and this is therefore used on the DVD. However, one should be mindful of cognitive overload and therefore the narration should directly contribute to the animation. When an animation is used without combining it with narration, the viewer will find it difficult to know why certain actions are done in a certain way (especially when illustrating an example program), therefore the DVD should use animations and narrations in conjunction with each other, but not

overload the cognition of the individual. Screenshot 3.24 and 3.25 illustrate that the DVD uses animation and narration in conjunction with one another.

### 3.3.3.6. Redundancy design principle

The redundancy principle and modality principle are closely related. However, the redundancy principle notes that narration, animation and on-screen text should not be combined if the on-screen text repeats what is narrated (see 2.8.1.2.6). When designing the Scratch DVD, on-screen text does not repeat what is narrated unless it is not accompanied by animation. Thus, if an example is illustrated by means of animation (showing a screen recording of a program) narrating what the programmer is doing will be sufficient. Screenshot 3.26 illustrates the example of the programming environment where it would have been possible to include text to illustrate the three programming areas. However, in order to adhere to the redundancy design principle, no additional text was added.



Screenshot 3.26 Adhering to the redundancy design principle

### 3.3.3.7. Individual differences design principle

Low-level knowledge individuals (in the case of this DVD, knowledge of programming) are more affected by design principles (see 2.8.1.7). As the Scratch DVD is developed for IT teachers

who have sound knowledge of intricate programming, the above-mentioned design principles will not influence their learning as such. However, correct use of these design principles will enhance their learning greatly and should therefore be adhered to as far as possible.

### **3.4. CHALLENGES WHEN DEVELOPING A DVD**

The researcher decided to do all the programming, facilitating, creation and development of the DVD herself as it would connect her more closely to the study and the DVD. It therefore required additional work and research from the researcher, other than what would have been the case had she used professional videographers to develop the whole DVD. The fact that the researcher was actively involved in the whole process of development provided her with the opportunity of learning first-hand from the process. During the development of the Scratch training DVD, certain challenges arose. These challenges are described in the next section.

#### **3.4.1. Software**

In order to develop a DVD of high quality, specialised software was required. Although professional videographers widely possess the software required for developing a DVD, it is not commonly found on an everyday computer. The researcher went through great trouble to obtain this software, which included Final Cut Pro and DVD Studio as well as QuickTime for screen recordings. This software is compatible with Apple Mac computers, which are also the most commonly used computers in the industry of videography.

#### **3.4.2. Equipment**

As mentioned in the previous section, a specialised computer was needed in order to run the software used successfully. Apple Macs have become more popular although they are still regarded as the elite computer range as most households in South Africa possess Microsoft computers. The researcher made use of an Apple Mac – a computer which she had never used before, and therefore she had to acquire the necessary skills for working on the system.

For the parts on the DVD where the facilitator was shown on screen, the researcher needed a good camera to ensure that teachers would be able to see clearly what was going on. An HD video camera was therefore used to assist in this regard.

Where narration accompanies screen recordings, a voice recorder of higher quality than a standard computer microphone was needed. The researcher obtained a high-quality voice

recorder with noise cut functions to ensure that teachers would be able to follow the narrations on the DVD.

### **3.4.3. Time**

Ample time needed to be set aside to develop the screen recording, examples and assignments for each section of the DVD. It was also time-consuming to record all the screen recordings. Each time the narration was not correct, the whole screen recording had to be recorded again.

### **3.4.4. Skills**

As mentioned, the researcher was confronted with software and equipment she had not worked with before. However, as her need to be directly involved with the development of the DVD was strong enough, she took it upon herself to learn the necessary skills. These skills included:

- working with the software as mentioned;
- learning to write scripts and narratives; and
- learning to face audiences on camera (as the researcher placed herself in front of the camera and did not make use of any actors).

### **3.4.5. Scratch programming language environment**

As the Scratch programming language environment is not graphically sophisticated, it posed a challenge when screen recordings were made. Although the researcher made use of highly technical software and hardware – which allowed for higher quality screen recordings – the font of the programming blocks as well as the other components in Scratch still remained of a lower quality due to the programming language's lower resolution.

These challenges were tough to overcome, but the researcher managed within limits to do so. When making use of professional services like videographers, many of these challenges are irrelevant. Due to the need for direct involvement, the researcher maintained that it was better to take on the development herself, and this proved to be a viable option in this case.

## **3.5. SUMMARY**

With the implementation of the new CAPS document, teachers have been forced to deal with the new content prescribed, among many a new programming language – Scratch. Scratch (a

graphical programming language) not only has many advantages but disadvantages too. This implies that learners need to be guided through the learning process as it can pose challenges to them. Apart from the CAPS training received from the South African Department of Basic Education, teachers are left to master the knowledge needed to teach Scratch themselves. In order to assist teachers in this endeavour, a multimedia-based DVD disc has been suggested.

Content, as described in the CAPS and other literature, has been discussed with particular reference to how this needs to be addressed on the DVD. Each section of the content is addressed, with adequate examples on the DVD as well as giving teachers the opportunity to consider different possibilities when teaching Scratch. This addresses some levels described in Bloom's revised taxonomy by Johnson and Fuller. In order to implement a DVD of this type successfully an indication of how the multimedia principles, as described in Chapter 2 was also discussed.

Chapter 4 will focus on the research design and empirical processes of the study in order to describe how the experience of IT teachers using the proposed DVD was determined.

## CHAPTER 4

### RESEARCH METHODOLOGY AND EMPIRICAL STUDY

#### **4.1. INTRODUCTION**

In Chapters 2 and 3, the scholarly body of work in the form of a literature review was investigated. The main areas that were addressed in Chapter 2 were professional development of teachers as well as multimedia as a tool for implementing professional development. In Chapter 3, the content of a multimedia-based professional development Digital Versatile Disc (DVD) was described, focusing specifically on how this was incorporated to implement such a multimedia-based professional development DVD successfully.

In this chapter, specific focus is placed on the research methodology and design of the study, including a detailed discussion on the empirical study conducted. The results of the study are also discussed.

#### **4.2. AIM OF THE RESEARCH**

The aim of the research was to propose a multimedia-based method of professional development of IT teachers in Scratch, which was addressed in Chapters 2 and 3. A further aim was to determine how teachers experienced this particular proposed method, which will be addressed in this chapter.

#### **4.3. RESEARCH QUESTION**

In the study, several research questions were addressed; however, with the empirical study the research question addressed was:

- How do teachers experience a multimedia-based professional development programme in the form of a DVD when learning Scratch?

#### **4.4. RESEARCH PARADIGM**

Nieuwenhuis (2009:57) and Denzin and Lincoln (2005:183) mention (among others) two paradigms that are generally used in qualitative research designs: critical theory and constructivism. In order to determine which of the two paradigms will be best suited for this study, a brief description is given of each.

- Critical theory seeks to rid society of oppression by empowering individuals to move beyond their circumstances (Lichtman, 2009:128).
- The (social) constructivist paradigm focuses on how individuals seek to understand the world they live in. In research, this entails that the researcher tries to understand and thus interprets the context of the participants, recognising the participants' background against the researcher's own backdrop (Creswell, 2007:21).

As the researcher aimed at understanding the participants' lived experience from within their context notwithstanding the researcher's own experiences and background, the research will be directed by the constructivist paradigm. When discussing a paradigm, five assumptions should be stated (Creswell, 2007:17). Table 4.1 illustrates the implications the constructivist paradigm entails for the five assumptions that are needed.

**Table 4.1 Implications of the constructivist paradigm illustrated by Creswell (2007:17)**

Assumption	Question	Characteristics of the constructivist paradigm	Implications for practice of the constructivist paradigm
Ontological	"What is the nature of reality?"	Reality is subjective and multiple as seen by participants in the study	Researcher uses quotes and themes in words of participants and provides evidence of different perspectives
Epistemological	"What is the relationship between the researcher and that which is being researched?"	Researcher attempts to lessen distance between himself or herself and that which is being researched	Researcher collaborates, spends time in the field with participants, and becomes an "insider"
Axiological	"What is the role of values?"	Researcher acknowledges that research is value-laden and that biases are present	Researcher openly discusses values that shape the narrative and includes his or her own interpretation in conjunction with the interpretations of participants

**Table 4.1 Implications of the constructivist paradigm illustrated by Creswell (2007:17)**  
**(continued)**

Rhetorical	"What is the language of research?"	Researcher writes in a literary, informal style using the personal voice and uses qualitative terms and limited definitions	Researcher uses an engaging style of narrative, and employs the language of qualitative research
Methodological	"What is the process of research?"	Researcher uses inductive logic, studies the topic within its context, and uses an emerging design	Researcher works with particulars (details) before generalisations, describes in detail the context of the study and continually revises questions from experiences in the field

From Table 4.1 it is evident that the five assumptions need to be addressed to fully engage in the chosen paradigm. Subsequently, each assumption will be described as pertaining to this study.

#### **4.4.1. Ontological assumption**

"What is the nature of reality?"

According to Denzin and Lincoln (2005:193), the ontological assumption from within the constructivist paradigm is of a relative nature. Bearing in mind the nature of the study where teachers' experience of multimedia-based professional development was investigated, it is reasonable to say that the ontological assumption is in fact of a relative nature. Experiences of individuals cannot be seen of absolute nature as each individual brings his or her own background and context to the table and therefore contributes to the relativity of the nature of knowledge.

#### **4.4.2. Epistemological assumption**

"What is the relationship between the researcher and that being researched?"

In this study, the relationship between the researcher and that which was being researched were of subjective nature. This subjective nature was the result of the researcher bringing an inevitable sense of bias to the research endeavour. A constructivist researcher rejects the notion that there is an objective reality that can be known and takes the stance that the researcher's goal is to understand the multiple social constructions of meaning and knowledge (Mertens, 2010:18).

#### **4.4.3. Axiological assumption**

“What is the role of values?”

The researcher, by means of several additional measures, tries to keep biases to a minimum (see 4.5.5). It is, however, inevitable that both the participants as well as the researcher bring to the study their own values and interpretations.

#### **4.4.4. Rhetorical assumption**

“What is the language of research?”

The language used in the research is that of a literal nature as it formally describes the various aspects of the holistic research endeavour. In order to distance herself, the researcher tried at all times to take on a role of the third person and therefore also writes in this person.

#### **4.4.5. Methodological assumption**

“What is the process of research?”

In coherence with the constructivist paradigm, which surmises that knowledge and reality is socially constructed through interaction between the researcher and the participants, the researcher selected a phenomenological qualitative research design and this will be discussed next.

### **4.5. RESEARCH DESIGN AND METHODOLOGY**

Based on the above-mentioned discussion on the constructivist paradigm, a specific research design and methodology were used.

#### **4.5.1. Research design**

The choice of a research design plays a vital role in the way data is collected. The research design is guided by the questions the researcher aims to answer as well as the way the researcher goes about answering the questions (Flick *et al.*, 2007:36; Nieuwenhuis, 2009:70;). Creswell (2009:5) describes the research design of a study as the “plan” comprising of the philosophy behind the study (research paradigm, see 4.2), the strategies used for inquiry (methodology, see 4.4.1.2) and the research methods used (see 4.4.3.1).

In this study, a qualitative research design was used in order to determine how the teachers participating in the study individually experienced multimedia-based professional development. The qualitative research design, as chosen design, is discussed in the next section.

##### **4.5.1.1. Qualitative research design**

Qualitative research describes how individuals view certain aspects in their world as it is focused on individual encounters and descriptions rather than on general assumptions (Creswell, 2009:4). Krauss (2005:763) and Babbie *et al.* (2008:270) explain that qualitative research is concerned with meaning-making, as individuals are responsible for forming their own meaning of their world. A qualitative research design, generally, according to Babbie *et al.* (2008:279) shares certain features. The features addressed in the study are discussed below.

###### **4.5.1.1.1. A detailed encounter with the participant is prevalent**

Participants were visited twice during the time of the study; however, the researcher openly invited participants to contact her at any time if questions or other matters arose. Encounters with participants also included informal discussions regarding matters of the study as well as general matters not specifically focused on in the study in order to build trust relationships between the researcher and the participants.

###### **4.5.1.1.2. A small number of participant are selected**

In order to give thorough attention to participants and due to the fact that one round trip to three participants already totalled 1 000+ kilometres, the researcher was only able to select three participants. This proved to be advantageous as the researcher was able to visit the participants twice and could focus on understanding these three participants’ contexts well.

#### 4.5.1.1.3. An understanding that data may have multiple sources is obtained

The researcher made use of two data collection methods, namely semi-structured interviews and reflection sheets. This was resulted from the fact that data may have multiple sources thereby allowing participants to be free to express their opinions in various forms (whichever may be comfortable to them). Furthermore, the two methods served as a confirmation of each other as data could be verified by referring to similar sections in both the semi-structured interview and the reflection sheets.

From the above-mentioned discussion, it can be surmised that the qualitative research design served the purpose of this study. A discussion regarding the methodology follows.

#### 4.5.1.2. Methodology

Bearing in mind the main research question of the study (to determine teachers' experience of multimedia-based professional development), a phenomenological research methodology was used. Phenomenology is a methodology focused on the human experience of a specific phenomenon (Creswell, 2009:13). This methodology falls under the qualitative research design, where emphasis is placed on studying the participant's perspective on a certain phenomena while in his or her natural setting (Babbie *et al.*, 2008:278).

#### 4.5.2. Study participants

This study formed part of a larger SANPAD project on the empowerment of IT teachers in the North West province ( $n=23$ ). From these 23 teachers, 10 teachers were identified by the IT subject coordinator in order to comply with aims set out in the research project (within which the study falls). These schools were identified, taking into account which schools could benefit from support granted by the research project. Of the 10 teachers, a purposeful sample of three were selected for teaching-learning support strategies, three for communities of practice support, and three for this study on professional development in Scratch programming. The three teachers for this study were purposefully selected to include teachers from diverse contexts and backgrounds. A teacher from a metropolitan area, a teacher from a farming community far from any metropolitan area and a teacher in a deep rural area were selected in this regard.

### **4.5.3. Data collection**

#### **4.5.3.1. Methods**

Bearing in mind the research question which guided the empirical study, a semi-structured interview was conducted with each participant. This interview focused on three main aspects, namely the content of the DVD, the design of the DVD and the participant's overall experience of the DVD. Participants also received a user manual with additional activities (Addendum A) as well as a reflection sheet (Addendum A). The reflection sheets gave participants the opportunity to reflect on each section after completion and to comment on the helpful and unnecessary aspects of the DVD as well as the design of each section on the DVD. With the reflection sheets, participants who might have been too shy to raise their opinions in the semi-structured interview had the opportunity to write their experiences of the different facets. The reflection sheets also ensured that the participants did not forget important aspects of their experiences of the DVD (during the semi-structured interview) and therefore allowed them to express their impression immediately on completion of each section of the DVD. For those participants who might not have enjoyed expressing their experiences by means of writing, the semi-structured interview served as the more explicit data collection method.

Two visits to each participant were arranged at times which suited them the best. During the first visit, the ethical procedures were dealt with (see 4.5.6) after which the researcher thanked participants for their willingness to participate in the research. She continued to explain to them the structure of the multimedia-based professional development DVD as well as the accompanying user manual (consisting of activities and reflection sheets). This visit was done a week before the school holidays started, giving teachers the opportunity to work through the DVD during the holiday, at their own pace and in the comfort of their own homes.

A second visit was arranged after the holidays, again at a time that suited each participant. During this visit, the semi-structured interview was conducted and the reflection sheets handed out to participants were collected.

#### **4.5.3.2. Semi-structured interview**

During the second visit, the semi-structured interview was conducted. The questions which guided the interview were the following:

- What was your experience of the DVD with regard to the content?
- What was your experience of the DVD with regard to the design of the DVD?

- Describe your overall experience of the DVD as a professional development tool.

In conclusion, the researcher also asked the participants to describe their view on whether the DVD would be a viable option for training IT teachers in Scratch.

Although several follow-up questions were also asked in order to obtain a clear picture of each participant's experience of the multimedia-based professional development programme, the above-mentioned questions were the main questions guiding the interview. These questions were selected as they directed the semi-structured interview in such a direction that the researcher would be able to gather participants' experience of the DVD.

Question 1: "What was your experience of the DVD with regard to the content?" gave participants the opportunity to elaborate on the content covered on the DVD. Chapter 3 focused solely on the content of the DVD and reported on why certain topics were addressed and others only mentioned. Though the content was explicitly chosen with a specific purpose in mind, it was still important to give participants the opportunity to voice their opinion on the content covered, as this could have influenced their experience of the DVD.

Question 2: "What was your experience of the DVD with regard to the design of the DVD?" gave participants the opportunity to discuss which design facets of the DVD were hindering and which facets of the design they welcomed. In Chapter 3, the design principles implemented on the DVD were discussed. These design principles were selected in order to assist the learning process of the professional development programme but, as the individual preference design principle states, each individual prefers the incorporation of different principles therefore posing the need to ask participants what their experience of the design was. The design of the DVD, just like the content, played an important role and could have influenced participants' experience of the professional development programme, therefore it was necessary to include this question.

Question 3: "Describe your overall experience of the DVD as a professional development tool" gave participants the opportunity to comment on any other facets that they considered important and noteworthy and which could also have influenced their experience of the DVD. With this question, advantages and disadvantages regarding the DVD in its holistic form could be brought to the foreground, giving the researcher a view on participants' overall experience of the DVD.

Question 4: "Describe your view on whether the DVD is a viable option for training IT teachers in Scratch" allowed participants to voice their opinions on whether the proposed DVD as

multimedia-based professional development tool would be viable for training other IT teachers in the Scratch programming language. One could surmise that, if the teachers experienced the DVD positively, they would advocate that it could be a viable option for other IT teachers as well. Furthermore, with this question, participants had the opportunity to give reasons as to why they would say it could be viable or not, giving the researcher the opportunity to gather information regarding improvements that need to be made.

#### 4.5.3.3. Reflection sheets

The semi-structured interview served as the primary data collection instrument; however, the reflection sheets also served an important role. Teachers needed to reflect on the following questions, addressing basically the same concerns as the interview:

- Which areas of this section proved to be helpful?
- Which areas of this section seem to be unnecessary?
- General comments on the DVD (refer to the design, the presentation and the content).

With each section reflected on individually, the researcher got a more detailed picture of what participant's experience of each section was.

Analysis of the semi-structured interviews as well as the reflection sheets were executed separately and will be addressed in the following section.

#### 4.5.4. Data analysis

Qualitative data analysis may occur in various forms (Babbie *et al.*, 2008:489). For this study, the following research procedure was used in order to analyse data gathered:

##### 4.5.4.1. Transcribing data

After the semi-structured interviews had been conducted and reflection sheets had been gathered, the researcher transcribed the recorded interviews. The comments regarding each section of the DVD written on the reflection sheets were transcribed by placing all three participants' comments about each question in one table with their specific comments.

#### 4.5.4.2. Transcripts were organised

Each participant's interview and reflection sheet were grouped together and analysed as a whole instead of discussing the data from the two instruments separately. This was done because the researcher believed that the journal entries of each participant could help to clarify and understand the data from the interviews.

#### 4.5.4.3. Coding of transcripts was executed

Coding entails perusal of transcripts followed by segmentation to allow meaning-making (Creswell, 2009:186). Each data set (interview and reflection sheet transcripts) was perused in detail several times. While perusal occurred, the researcher marked any quotes that could indicate a relevance to the phenomenon being investigated. These quotes were also given a code name to represent its relevance. Creswell (2009:186) advises that the researcher bear four types of codes in mind whilst coding transcripts, namely:

- Codes on topics

These codes were used where participants addressed topics referred to in the investigation of the body of scholarly work like professional development, multimedia and teacher training.

- Codes that were surprising

In this regard, it could be any other topic or areas that were not anticipated for in the research. In this study, it was not anticipated that participants would comment on software issues and relevance to learners and therefore quotes pertaining to these unanticipated areas were coded.

- Codes that were unusual

During the coding of the transcripts, the researcher did not detect any codes that were unusual and therefore no codes of this type were used.

- Codes that addressed a larger theoretical perspective

Codes pertaining to general multimedia-based professional development by means of a DVD were addressed in this regard.

#### 4.5.4.4. Each code was noted with relevant quotes supporting it

Once all transcripts were marked with different codes, the researcher made a list of all the codes found. These codes were written down together with each supporting quote from the

different participants. With this technique, the researcher was able to see which codes occurred more frequently than others and which codes were visible in all three participants' data.

#### 4.5.4.5. Themes emerged from codes

Codes in themselves often relate to one another and therefore can be classified into different themes. Once all codes had been classified in a theme, interpretation of data started taking place.

#### 4.5.4.6. The phenomenon being researched was described

The researcher was able to draw on the themes which emerged from the data. These themes addressed the phenomenon investigated in this study, which was to find out how teachers experience multimedia-based professional development. From the themes, negative and positive experiences could be identified as well as some other relating concerns and comments.

### 4.5.5. Trustworthiness

Babbie *et al.* (2008:276) note that there are four elements that need to be adhered to in order to ensure trustworthiness of data. These principles are discussed below.

#### 4.5.5.1. Credibility

Peer debriefing (Babbie *et al.*, 2008:277), where a peer (from outside the context) checks the credibility of actions taken and notions made, was used to ensure the credibility of the study was appropriated.

The researcher asked a peer (who possessed adequate knowledge of qualitative research methods) to take a transcript of one of the participants and also to code it. Once she had done this, the researcher and the peer debriefer discussed the codes of both of their transcripts. Where discrepancies occurred discussions took place and revision of codes were made if necessary until both parties were comfortable with the result. Once this process was completed, the peer debriefer took yet another transcript and coded it. The process of discussion and revision was executed again and both the peer debriefer and researcher agreed on the chosen codes.

#### 4.5.5.2. Transferability

Purposive sampling in order to enhance the transferability of the study was used. The three participants were selected in such a way that their backgrounds as well as their current contexts differed vastly.

#### 4.5.5.3. Dependability

Dependability measures whether data and interpretations can be seen as reliable. Babbie *et al.* (2008:277) note that, if credibility is established, it can most probably be deduced that dependability would also be attained. In the current study, credibility was attained (see 4.5.5.1). As the participants' own experiences were transcribed and their written responses captured and reported in Addenda B and C it further strengthened the dependability principle.

#### 4.5.5.4. Confirmability

Confirmability in qualitative research is reached, some argue, by ensuring neutrality of the researcher (Babbie *et al.*, 2008:277). The researcher was involved in designing the DVD (intervention artefact) as well as distributing it and conducting interviews. It may therefore be surmised that the researcher could not be unbiased or neutral. However, it might also be possible to deduce that the researcher was able to remain neutral during analysis of the data, as a peer debriefer (as described in 4.4.5.1) was used in order to ensure that analysis was conducted without any biases.

### 4.5.6. Ethical procedures

Before any of the empirical research was conducted, ethical clearance from the North-West University ethical committee was obtained. This clearance was given to the project within which this study fell. Furthermore, permission from the Department of Basic Education in North-West was obtained in order to allow teachers from North-West schools to participate in the study. Schools were contacted and principals were given a letter requesting permission to conduct research in their schools involving their IT teachers. All three principals agreed and welcomed the additional professional development. After permission was obtained from the principals, teachers (who were selected as participants) were given a letter of informed consent to complete, if they were willing to participate in this study. All three teachers accepted the invitation and completed the informed consent letter.

Lastly, when visits with the teachers were arranged, they were assured of the fact that the visits would be done individually as this would protect their identity as well as give them the opportunity to be as honest as possible. During interviews, participants were again reminded of the confidentiality of the interviews and the protection of their identities and the identities of their schools. Furthermore, participants were ensured that they could withdraw from the study at any given time should they wish to do so. They were not compelled to answer any questions and were assured that answers given would not be held against them. Data gathered during the study was stored in a safe place as stated in the ethical clearance agreement.

#### **4.5.7. Pilot study**

A pilot study to test the proposed DVD for any errors that could have influenced the experience of teachers of the multimedia-based professional development was executed. This pilot study was done on one teacher and two pre-service teaching students in their final year of study. The main objective of the pilot study was to establish whether the data collection methods were sufficient regarding the aim of the study and that no technical errors existed on the DVD.

##### **4.5.7.1. The teacher involved in the pilot study**

The teacher who was asked to participate in the pilot study was an IT teacher who was not selected to participate in the study, but one of the ten teachers identified by the subject advisor. The researcher provided the teacher with the DVD, with the request that the teacher would critically assess the DVD with specific reference to the content, design and overall teaching value thereof.

Once the teacher had completed the DVD, the researcher visited him and conducted the same semi-structured interview planned for research participants. The teacher firstly commented that the DVD was only relatable to teachers and not appropriate for use in his classroom. He further implied that he was aware that IT teachers should have the knowledge and skills regarding the content; however, only they need to be equipped with how it is implemented in Scratch.

With regard to the design of the DVD, the teacher did not find any fault. He was of the opinion that it was a useful tool and that the design of the DVD did not bother him; however, mention was made of additional activities which were then included in the final DVD.

With the above-mentioned interview in mind, the researcher felt convinced that the DVD could be sent out to participants. The semi-structured interview that was conducted also proved to address the aim of the study and could therefore be used in the study.

#### 4.5.7.2. Pre-service teaching students

As the researcher intended to make use of reflection sheets as well as semi-structured interviews, both these instruments needed to be assessed. Furthermore, a second opinion regarding the DVD was needed. In order to accomplish this, the researcher asked two pre-service teaching students, majoring in IT education, to evaluate the multimedia-based professional development DVD and complete a reflection sheet. This reflection sheet addressed the same three elements as the semi-structured interview, but allowed participants to write their experiences rather than participate in an interview.

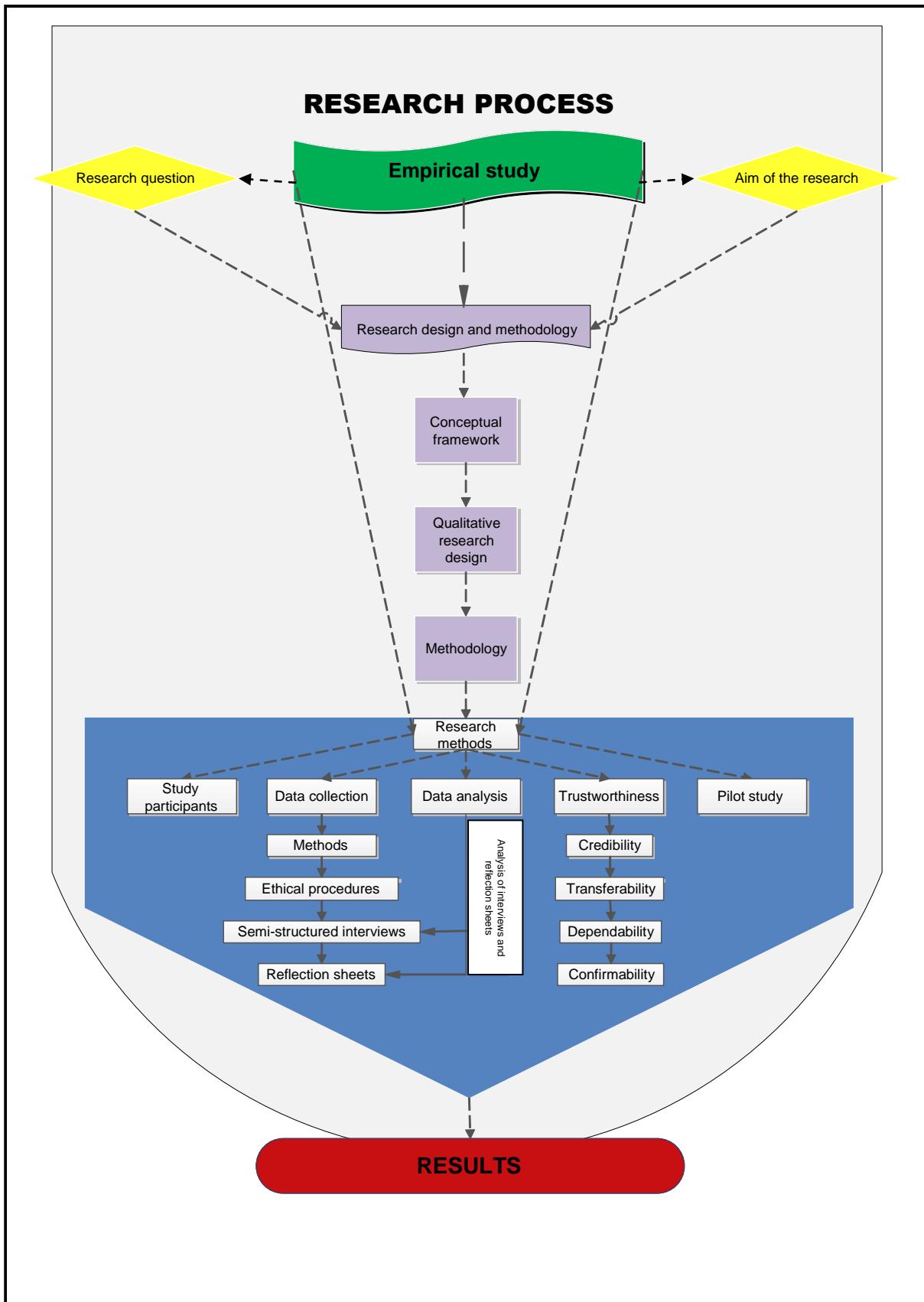
With regard to the content, both students felt that the content was adequate and informative enough.

On the question regarding the design, one of the students mentioned that the volume of the DVD was very low and therefore she struggled to hear but continued to say that she assumed that it could be her earphones or the computer's volume as no one else had a similar problem. The other student also made mention of the sound but specifically during screen recordings. This was noted and improved on the final DVD before distributing it to the participants of the study.

The researcher took into account both the semi-structured interview with the teacher as well as the reflection sheets handed to the two students. Suggestions made by these three participants in the pilot study were addressed on the DVD. New narrations were recorded and the sound of the DVD was tested on several other devices to ensure that it was the computer and not the DVD itself. Content was added to the DVD to give participants the opportunity to apply knowledge of Scratch more in depth. Once these changes had been made, the DVD was distributed to the participants.

The following section will describe the results gathered from this endeavour; however, Figure 4.1 should first be studied as a summary of what the empirical research process (as described in the above sections) entailed. Note that the research process, pertaining to the empirical study, was influenced by the aim and research questions of the study. This empirical study then

resulted in the research paradigm, design and methodology, which served as the vehicle for completing the empirical study and obtaining results.



**Figure 4.1 Research process specifically regarding empirical study**

## **4.6. RESULTS**

When deciding on how to go about reporting data, the researcher could either group participants' data into themes and report on each theme or discuss each individual participant's data separately. As there was an evident discrepancy between the three participants' experiences regarding the DVD, the researcher decided to describe each participant's responses separately. This section will therefore be divided into three sub-sections (one for each participant) describing each participant's background, milieu, experience of the DVD and general comments. Quotes to support the notions made are written in italics.

### **4.6.1. Participant 1**

#### **4.6.1.1. Background and milieu**

Participant 1 was an IT teacher at a school within a metropolitan area. She had been teaching IT for a number of years and was committed to improving her subject. She reported being overwhelmed in her IT classes by the little time she had to teach all of the content prescribed in the syllabi. This teacher attended the CAPS training provided by the Department of Basic Education, which included a section on Scratch programming. The school where she was teaching did not struggle with infrastructure; however, she expressed the need for more IT teaching-learning resources.

Participant 1 agreed to participate in the research by signing the consent form and was willing to meet the researcher twice.

#### **4.6.1.2. Semi-structured interview**

The following sections will describe Participant 1's experience with the multimedia-based professional development DVD.

##### **4.6.1.2.1. Experience regarding content of the DVD**

Participant 1 commented that she was generally satisfied with the content of the DVD as the activities and examples given in the multimedia-based professional development were good. She however expressed her concern about the omission of trace tables on the DVD

*... must include trace tables ...*

#### 4.6.1.2.2. Experience regarding design of the DVD

The participant welcomed the DVD as a multimedia resource as very little multimedia resources in the field of IT are available. She continued to make mention of some design features that did however disturb her:

- ... it must be a little slower; it was too fast at some times.*
- ... too much background noise when every module starts.*

#### 4.6.1.2.3. Experience regarding the training value of the DVD

With regard to the training value of the DVD and to whether the DVD would benefit other IT teachers, Participant 1 felt strongly that other IT teachers would indeed benefit from it. She thought that the DVD contributed to her as a teacher having to teach Scratch.

- ... of course they will benefit.*

#### 4.6.1.2.4. Experience regarding lack of personal attention

Participant 1 was clear about it that she did not feel that a DVD as this one would be able to replace occasional face-to-face interaction with other teachers, as is the case at the moment. Furthermore, she stressed that IT teachers had a need for interaction with other teachers, which the DVD could not provide. She was thus in favour of the DVD, but emphasised the necessity of face-to-face follow-up sessions where discussion with other teachers on topics of mutual interest could take place.

*There are sections where we need communication and interaction with the people, so by sitting and watching the DVD, we are not having that interaction.*

*Meetings that are once in a while cannot be replaced by a DVD ...*

#### 4.6.1.2.5. General comments and suggestions regarding the DVD

Participant 1 felt that the DVD was an additional resource which could be used by teachers at home to support their understanding of Scratch. She also expressed the need for a DVD which could be shown to learners:

*... if we could share it with the learners, it would be even better.*

#### 4.6.1.3. Reflection sheets

When comparing the seven reflection sheets completed by Participant 1, the researcher was able to see three main themes.

#### 4.6.1.3.1. Content

As with the interview, Participant 1 expressed a need for some more content on the DVD. She mentioned that she would also like to see more on event handling. She also suggested that an elaboration on the content in terms of more assignments to practice the skills could add value to the DVD experience.

*The area event handling that are mentioned in this DVD are too little.*

#### 4.6.1.3.2. Presentation

In the majority of sections, the participant commented that the presentation of the content was good and that no unnecessary areas on the DVD were found:

*None of the areas mentioned are unnecessary ...*

*Presentation and the contents are very good.*

#### 4.6.1.3.3. Other

The greatest concern that Participant 1 frequently mentioned in her reflection sheets was that the answers to activities given for additional exercise were not provided on the DVD:

*Answers (examples) to the practical activities are not available on the DVD.*

### 4.6.2. Participant 2

#### 4.6.2.1. Background and milieu

Participant 2 was teaching at a school with a mixed cultural population. The school is situated far from any metropolitan area and may thus be described as rural. Although the participant was a very enthusiastic IT teacher, she only had 4 IT learners; however, this was as a result of the subject only being introduced shortly before the study. She had a very supporting principal who afforded her the opportunity to obtain resources where necessary. Participant 2 was very happy in her job and thoroughly enjoyed teaching IT. This participant attended the CAPS training session provided by the Department of Basic Education which also included a brief introduction to Scratch.

Participant 2 agreed to participate in the research by signing the consent form and was willing to meet the researcher twice.

#### 4.6.2.2. Semi-structured interview

The following sections will describe the participant's experience with the multimedia-based professional development DVD regarding content, design, training value of the DVD and general comments.

##### 4.6.2.2.1. Experience regarding content of the DVD

Participant 2 commented that most of the sections were explained thoroughly and that it was only a specific topic (*Broadcast – When I receive*) which was not covered in the previous programming language that was not addressed sufficiently:

*I did not have a problem with the DVD.*

*Some of the content is nicely explained, but some of the things I would have wanted to see more, specifically “broadcast” and “When I receive”. Specifically things that are unfamiliar to me like “broadcast”.*

The participant thoroughly enjoyed the screen recordings where the programs were explained and expressed an urge for more such examples:

*What I really enjoyed and which one can maybe have a little more of were the [example] programs so one can specifically see how you do things.*

##### 4.6.2.2.2. Experience regarding design of the DVD

Participant 2 was clear that she did not experience any hindrances regarding the design of the DVD. When asked whether the design of the DVD made the DVD boring, she replied that it was not at all boring and that she did not have a problem with the DVD.

A technical problem which she encountered was that the DVD would jump to the next section before it completed the previous section. She mentioned that it would cut off the last few seconds of the previous section and just continued to the next; however, she did also comment that she had a notion that it was her player and not the DVD as it worked fine at home.

##### 4.6.2.2.3. Experience regarding the training value of the DVD

This participant was impressed with the training value of the DVD and expressed the view that she would have liked to have this type of training instead of travelling a long distance to a once-off training session. She was of the opinion that the DVD would indeed be a viable option for other teachers:

*It was actually nice for me to have something like this which I could watch in the evenings instead of me having to travel to trainings.*

#### 4.6.2.2.4. Experience regarding lack of personal attention

The participant expressed that she preferred the DVD over training to which she had to travel. She has no need for interaction and communication with other teachers in order to understand the content of the DVD. When Participant 2 was asked regarding her feeling about the lack of personal attention she replied:

*I think it is people that have not been in teaching for long, the longer you are in the teaching profession; the less you depend on personal attention.*

#### 4.6.2.2.5. General comments and suggestions regarding the DVD

Participant 2 did express a concern regarding the DVD asking whether it would be viable for Grade 10 teachers who have not been trained in Delphi, as it was assumed that teachers, teaching Grade 10 are trained.

#### 4.6.2.3. Reflection sheets

Participant 2's reflection sheets on the seven sections yielded three main themes. These themes are discussed below.

##### 4.6.2.3.1. Content

In all of the reflection sheets, Participant 2 noted that the content covered in the section were good except for Section 2 where, like in the interview, she mentioned that she would have liked to see more explanations and examples on "broadcast" and "when I receive", which are new concepts not used in the Delphi programming language.

*Would have liked to see an example on "broadcast".*

With regard to the question pertaining to unnecessary content on each section, the participant noted with emphasis each time that no areas on the section were unnecessary.

##### 4.6.2.3.2. Presentation

Participant 2 was impressed with the DVD's presentation and not only found content on each section helpful, but also regarded the presentation of sections as good. She described it as a good introductory DVD:

*Good to see how everything works together.*

*Good presentation.*

#### 4.6.2.3.3. Other

As mentioned in the interview, a hindrance that participant 2 mentioned more than once in her reflection sheets, was the DVD stopping seconds before the section was completed, however she reported in the semi-structured interview that she did not experience this technical problem when watching the DVD at home:

*DVD stalls at functions at end of arrays ... at iterations.*

*Ending of different sections does not work properly.*

### 4.6.3. Participant 3

#### 4.6.3.1. Background and milieu

Participant 3 was new to teaching. He had experience in teaching at tertiary level, but had never before taught at a high school. He had experience in other programming languages but no knowledge of Scratch as programming language. His school was situated in a deep rural area far from any urban or metropolitan areas. Though Participant 3 tried his best to gather resources, it posed a challenge to him due to the financial position of the school. Participants 1 and 2 both attended the CAPS training provided by the Department of Basic Education; however, as Participant 3 had only entered the teaching profession in 2012, he had not attended the CAPS training presented by the Department of Basic Education and therefore had no training in Scratch as programming language.

Participant 3 agreed to participate in the research by signing the consent form and was willing to meet the researcher twice. The following sections describe his experience with the multimedia-based professional development DVD.

#### 4.6.3.2. Semi-structured interview

##### 4.6.3.2.1. Experience regarding content of the DVD

Participant 3 had an overwhelmingly positive response when asked about the content of the DVD. He mentioned that it really proved to be helpful to him and that the content covered was sufficient. With regard to the content put on the screen recordings on the DVD he noted that it really helped him:

*... but what I can say is that all the sections were really helpful with all the things I couldn't do, I managed to do them myself.*

*No, basically it was sufficient ...*

*... and the information put on the PowerPoints [screen recordings] were really good and helpful.*

#### 4.6.3.2.2. Experience regarding design of the DVD

As with the content of the DVD, participant 3 also expressed how he was pleased with the design of the DVD. He explained that he sometimes repeated a section when it went too fast for him to comprehend:

*Well I didn't experience any problem regarding that [the design], everything was just absolutely fine.*

#### 4.6.3.2.3. Experience regarding the training value of the DVD

With regard to the training value of the DVD, Participant 3 mentioned that the training was sufficient for him to understand and learn a new programming language and he expressed the opinion that it was good for training IT teachers. He further mentioned that it would especially benefit people unfamiliar with Scratch. Furthermore, he felt that it was a viable option and he really appreciated it because it would save a lot of time spent at a workshop.

*So I watched it and I understood what you said and I tried everything.*

*I had a clear picture of what I was supposed to do.*

*... for people for whom Scratch is new, it really helps.*

*It saves a lot of time from calling up a workshop or a training.*

*... we live in a faraway area so we have to travel and waste time ...*

*When you get off [school] you can watch the DVD ...*

#### 4.6.3.2.4. Experience regarding lack of personal attention

Participant 3 also made mention of the lack of personal attention that a DVD like this entails and was of opinion that most teachers would probably still prefer a workshop even if they would not have the confidence to ask question in a group when they did not understand. In his opinion, the DVD would enable teachers to learn at their own time.

*... you wouldn't ask any questions regarding a certain thing you don't understand ...*

*... most teachers would want to be workshopped on this specific things ...*

He did however continue to say that he appreciated the fact that he could contact the researcher by means of WhatsApp (a cheap instant messaging service for cell phones) to ask about aspects he was unsure of and struggled with:

*... we communicated with WhatsApp so when I have any problems, I consult with [the researcher] so it gets easy for me to understand Scratch.*

With regard to the personal attention, this participant was of the opinion that a program like Skype could enable teachers to check on understanding and that it would further support the understanding of Scratch:

*Skype would really be helpful because we can discuss matters about the DVD and to check on the understandings of the other teacher and to check mine and combine.*

#### 4.6.3.2.5. General comments and suggestions regarding the DVD

Participant 3 was very enthusiastic about the DVD and reiterated how it had helped him:

*... it really cleared up the aspects I really did not understand in Scratch.*

#### 4.6.3.3. Reflection sheets

Participant 3 had no negative comments on any of the seven reflection sheets he completed. The two main themes that emerged from his reflection sheets will be discussed next.

##### 4.6.3.3.1. Content

Participant 3 mentioned several times how the content covered in each section proved to be helpful and sufficient:

*All areas were helpful to me as an individual who didn't go for any training of Scratch.*

*All sections were very helpful in a way that one can finally understand what event handling is all about.*

##### 4.6.3.3.2. Presentation

When given the opportunity to comment on each section's design, participant 3 mentioned that presentations were good and that the overall design of the DVD proved helpful:

*The presentations and design of the DVD was great.*

*DVD is helpful, great and shows everything where it is.*

##### 4.6.3.3.3. Other

Apart from the above-mentioned comments, participant 3 did not make mention of any other aspects with regard to the DVD.

## 4.7. DISCUSSION

In order to get a holistic idea of the participants' experiences (as discussed in 4.6.1–4.6.3), Figure 4.2 gives a summary of the main themes and experiences of each participant. Each experience relating to other participants sharing a similar experience is indicated by means of

arrows. Furthermore, each element (e.g. background and milieu are purple) is coloured in a different colour so as to illustrate the different elements. The discussion following Figure 4.2 focuses on the four main themes derived from the semi-structured interviews as the reflection sheet's themes connect closely to these themes and therefore only serves as confirmation of teachers' experiences.

Results could be discussed by focusing on each participant, or by focusing on each theme. For the purpose of this study, where the experience of participants regarding multimedia-based professional development was investigated, the researcher has decided to discuss each theme separately in order to draw meaningful conclusions pertaining to the DVD but will refer to individual responses where necessary.

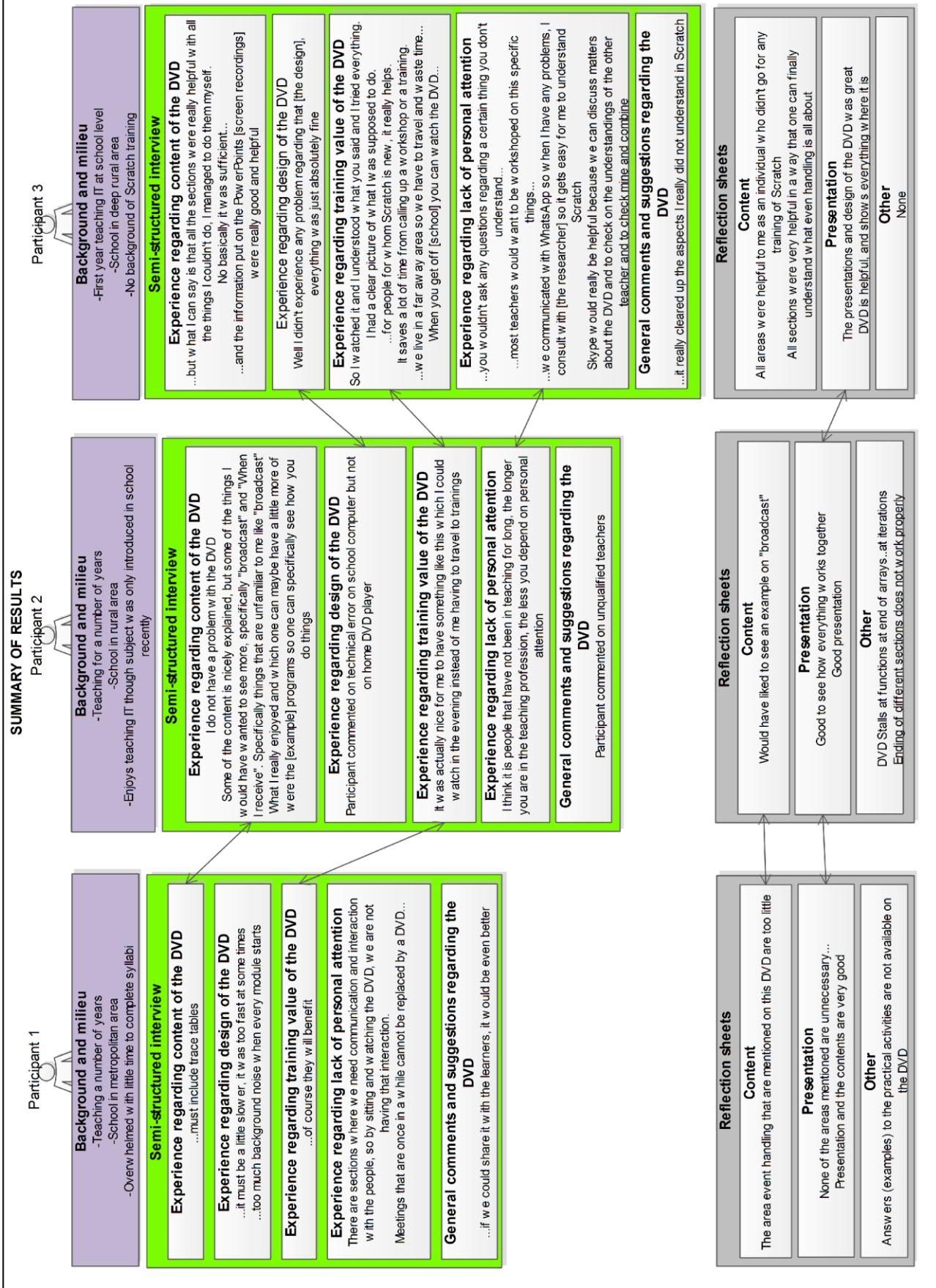


Figure 4.2 Summary of results

#### **4.7.1. Experience regarding content of the DVD**

The overwhelming conclusion derived from the three participants' expressed views regarding the content was that it was good. Keeping in mind that this DVD was developed for teachers with no knowledge of Scratch, it is not surprising that the two participants who had already attended an introductory workshop on Scratch suggested advanced content to be added. The participant with no previous knowledge of Scratch was satisfied and thrilled with the value of the DVD in terms of the content knowledge gained from it. All three participants indicated that the examples and activities proved to be helpful and therefore remarked that even more emphasis could be placed on examples and activities when developing a Scratch training DVD. The notion that not all content seemed sufficient for all three participants coincided with Eylon and Bagno's (2006:2) notion that all teachers should have the opportunity to increase their content knowledge when completing a professional development programme (see 2.6).

#### **4.7.2. Experience regarding design of the DVD**

All three participants indicated that the general design of the DVD was efficient. The design and structure of the DVD were also received in a positive light. However, one of the participants pointed out was that she did not like the sound associated with the introduction of each new section. It should therefore be noted that careful consideration be given to background sounds and music when developing a DVD for teachers as teachers are from different cultural backgrounds with different preferences for music and sound. With the three participants in mind, it may therefore be deduced that the overall experiences of participants of the design of the DVD were positive.

Technical problems such as the DVD stopping sporadically were noted and it was therefore concluded that attention should be given when designing a DVD that it be supported by the specification of the teachers' computers. Different software is needed if the DVD is to be watched on a computer or a DVD player.

#### **4.7.3. Experience regarding training value of the DVD**

The greatest point of interest of the multimedia-based professional development DVD was whether it has value as a training tool. As described in Chapter 1, there is a need for teachers to receive continuous professional development, but due to time and financial strain, this endeavour cannot be realised. With this DVD, the researcher aimed at proposing one possible alternative to assist IT teachers in their training in Scratch programming.

All three participants agreed that the DVD would benefit other IT teachers and that it possesses training value; however, content on the DVD should be carefully considered, especially bearing in mind the audience for whom it is being developed. It might be necessary to introduce an advanced training DVD on Scratch for those participants who have already completed the introductory training (see 4.6.1).

Compared to the Department of Basic Education's CAPS training, the DVD was welcomed as it allowed participants to go through the training in the comfort of their own homes and they did not have to travel to other towns to receive training (see 2.7.2.3). The fact that learners are deprived from teaching time when teachers have to attend training sessions was also mentioned as this is no longer a problem when making use of a DVD.

Although some of the participants expressed the desire for a DVD for learners as well, this was not in the scope of this study.

#### **4.7.4. Experience regarding lack of personal attention**

One concern that was evident throughout all three interviews with participants was that the DVD lacked personal attention, which, if implementing a face-to-face training session, Skype meeting or an SMS helpline, would not have been a problem. This emphasises the need for collaboration during professional development (Fitzgerald *et al.*, 2010:305).

When implementing the DVD it is therefore necessary to ensure that participants have the opportunity to communicate with either the subject coordinator and/or other IT teachers by means of SMS, instant messaging services, Skype, WhatsApp, etc. in order to enhance their learning experiences and comply with Ingvarson *et al.*'s (2005:11) statement that interaction between the facilitator and the participant is necessary.

#### **4.7.5. General comments and suggestions regarding the DVD**

When participants were asked to give general comments or suggestions regarding the DVD, all three had different comments.

Participant 1 was of opinion that the DVD could be used as an additional resource for teachers. This comment indicated that participant 1 realised the value of the DVD as a professional development tool for IT teachers learning Scratch. However, she also believed it cannot replace

the once-a-year workshops where teachers are given the opportunity to discuss mutual Scratch programming problems. Participant 1 clearly confirmed that interaction and collaboration were needed between participants. Her view confirmed Ingvarson *et al.*'s (2005:11) observation (see 2.5).

Participant 2 expressed concern about IT teachers that may not have adequate training but who are teaching Grade 10 learners. Her concern was that the researcher assumed that teachers who watch the DVD have ample programming knowledge and skills and therefore that an elementary DVD such as this one would be viable. Even though the concern expressed by Participant 2 was valid, the aim of the DVD in this study was to assist teachers with the transition from Delphi to Scratch. The researcher assumed that teachers using this DVD had ample knowledge of programming, as IT teachers who teach Grade 10 are supposed to be qualified otherwise they are not suitable for the job. Whether or not teachers have a degree in IT with a teaching diploma or a teaching degree, it can be assumed that they would have had training in one of the programming languages before commencing their teaching position. This concern did therefore not pertain to the experience of IT teachers regarding multimedia-based professional development.

Participant 3 used positive feedback when expressing his experience regarding the DVD. He used quotes like *you made my life easier for me* to explain how much he enjoyed watching the DVD. It can therefore be deduced that participant 3, who did not have any previous exposure to Scratch, had an overwhelmingly positive experience regarding the DVD as a whole and did not have any other suggestions.

#### **4.8. SUMMARY**

This chapter focused on explaining the research design utilised in this study as well as answering the research question regarding IT teachers' experience of multimedia-based professional development.

Making use of a qualitative phenomenological research design served the purpose of this study as this design aims to understand an individual's experience as lived in his or her own context. As this study formed part of a greater research project aimed at empowering Information Technology teachers, the number of participants was purposefully selected to address the specific need established within the project.

From the empirical study it was evident that teachers experienced the use of multimedia-based professional development in a positive light. Having the opportunity to complete the training at home without the additional loss of time due to travelling to another venue was one of the main advantages highlighted by participants. The ability to stop the DVD in order to reflect as well as to repeat a section not yet fully comprehended also proved to be helpful and added to the positive experience of the participants.

Chapter 5 will conclude the study by focusing on conclusions made during the investigation of the body of scholarly work, as well as the empirical study. By focusing on these two aspects, the researcher aims to answer the five research questions.

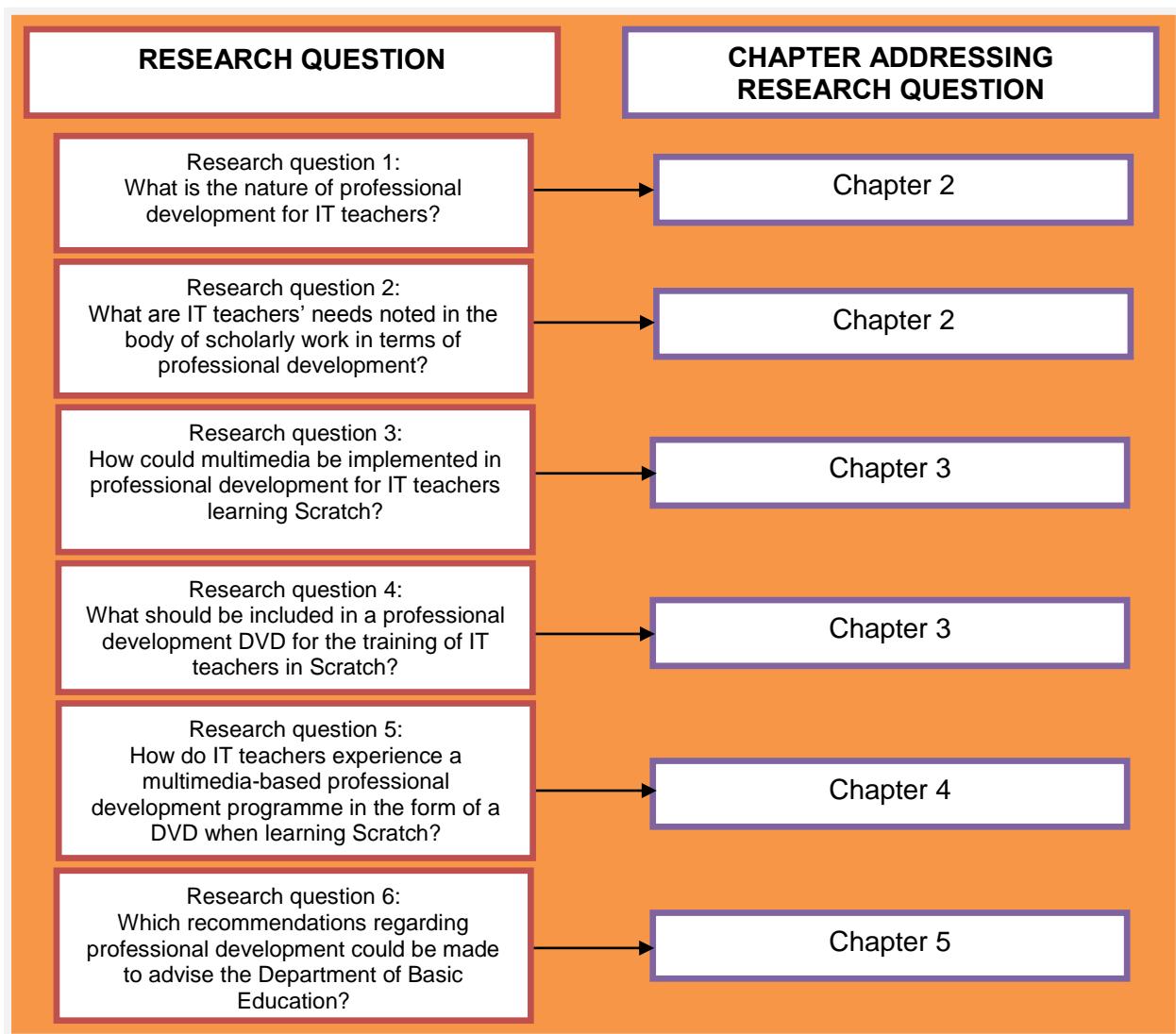
## CHAPTER 5

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1. SYNOPSIS OF THE STUDY

This dissertation was divided into several chapters in order to engage fully with the aims at hand. This chapter will be divided into a synopsis of the study, followed by a discussion on the findings of the study, recommendations and conclusions.

Figure 5.1 illustrates which chapters addressed which research questions, as each research question directed a particular chapter.



**Figure 5.1 Chapters addressing each research question**

Chapter 1 was devoted to describing the orientation of the study pinning the specified research problem leading up to the study as well as the motivation for conducting this study. In order to direct the study, the research problem as well as a preliminary literature review was discussed.

Chapter 2 was devoted to an investigation into the body of scholarly work regarding professional development. In order to answer research questions 1 and 2, specific attention was given to professional development of teachers and professional development in the South African context specifically. In addition, the most effective professional development methods were investigated.

To answer research questions 3 and 4, Chapter 3 reported on the implementation of multimedia within professional development, as it was established in Chapter 2 that a multimedia-based professional development DVD would be a viable option. In Chapter 1 (problem statement) as well as Chapters 2 and 3, it was evident that the professional development needs of IT teachers in South Africa needed to be addressed, and therefore these needs guided the choice of the content of the DVD.

In Chapter 4, a report on the empirical study was given, which focused on the three teachers who had been selected for the intervention of this study and answered research question 5.

In Chapter 5, a discussion of the body of scholarly work as well as the results of the study is given. The discussion is followed by a section focused on the conclusions as well as recommendations drawn from the study in order to answer research question 6.

## **5.2. DISCUSSION OF THE FINDINGS OF THIS STUDY**

The discussion of the study is focused on the research questions as set out in Chapter 1 (see 1.4). Four of the research questions set out for this study were answered by means of a literature review. The following section will therefore focus on the findings regarding the investigation of the scholarly body of knowledge.

### **5.2.1. Investigation of body of scholarly work**

While investigating the body of scholarly work by means of a literature review, the following topics emerged. These topics are dedicated to answering research questions one to four.

### 5.2.1.1. Professional development

Professional development can be defined in various ways depending on the paradigm from which it is viewed. In a wider sense, professional development is defined as an ongoing process, which develops in any profession by creating an opportunity for the professional to acquire knowledge and develop necessary skills to improve him/her holistically (see 2.2). The definition of professional development for teachers is similar to this, apart from the fact that it (the professional development endeavour) aims at equipping the teacher to enhance him/herself in such a way that education as a whole improves.

In the South African context, professional development has mostly been implemented in the form of in-service training sessions, a practice which has not yet proved to be effective (see 1.1). Teachers are described as being silent stones in these training sessions and they therefore describe these training session as an ineffective mode of professional development (see 2.4.1).

In order to implement a professional development programme successfully, careful consideration should be given to the teaching/learning approach followed in the programme (see 2.3). Traditional professional development endeavours, focused on in-service training sessions generally relied on the behaviourist approach, which has been described as a failed attempt to learning. The constructivist approach, however, supports the notion that professional development is an ongoing process, focused on each individual's needs, and therefore the constructivist approach to professional development is a more viable approach than the behaviourist approach (see 2.3.2).

Once the approach to professional development has been established, it is necessary to determine which model of professional development would accommodate a successful professional development programme directed by the constructivist approach (see 2.4). From the nine different models of professional development, the transformative model served the criteria of the current research best (see 2.4.9). The transformative model can be directed by the constructivist approach, notwithstanding all behaviourist elements, to teaching/learning and most importantly can bring about change in educational systems by supporting professional development of teachers the best (see 2.4.9).

From the above-mentioned discussion as well as the study of the body of scholarly work, the answer to **Research Question 1: “What is the nature of professional development for IT teachers?”** is that it is generally a programme that is implemented by means of a face-to-face training session where teachers are described as being silent stones. Professional development

for IT teachers should be a continuous programme where teachers are able to complete their professional development in such a manner that it is convenient to them with as little as possible costs and as effective as possible training. Making use of the transformative model by means of the distance mode of delivery with a DVD as tool seems to be the most viable option.

Several factors were identified as having an effect on the success of professional development programmes. The factors applicable to this study:

- were the efficacy of the facilitator in facilitating the learning process;
- the mode of delivery of the professional development programme; and
- the content covered during the course of the professional development programme (see 2.5; 2.6 and 2.7).

It was determined that professional development programmes focused on effective facilitation by means of the distant mode of delivery (in the form of a multimedia-based DVD) directed by the current needs of teachers in terms of content would be of high value and efficacy (see 2.7, 2.8). Regarding **Research Question 2: “What are IT teachers’ needs noted in the body of scholarly work in terms of professional development?”** IT teachers expressed concern about previous professional development endeavours noting that facilitators were inadequate, while time away from teaching their learners and costs involved with travelling were further concerns. Furthermore, IT teachers teach a subject constantly changing and therefore need continuous professional development endeavours to support them on an ongoing basis.

#### 5.2.1.2. Multimedia-based professional development

From the above-mentioned discussion on professional development in the South African context, it was established that incorporating multimedia into a distance mode of delivery in professional development enhances the efficacy of professional development (see 2.8.1.1).

Multimedia learning holds great advantages when incorporated into learning ventures (2.8.1.1.1). In the context of this study, the most relevant advantages are –

- the ability to schedule learning activities as a multimedia tool making it accessible at any time;
- enhancing the learning process as individuals are able to engage with content in several ways, and
- accommodating different learning styles.

In the South African context, the twofold advantage of incorporation of multimedia holds is the fact that training can be made accessible to professionals situated in rural areas saving schools and the Department of Education money as travelling costs are reduced (see 2.8.1.1.1).

Three disadvantages of incorporating multimedia were also noted (see 2.8.1.1.1), namely –

- the cost of multimedia tools may be high, but it is low in comparison with the costs incurred to have teachers travelling to traditional training sessions;
- not everyone may have multimedia compatible devices – this disadvantage can be overcome by making use of generalised devices like DVD players; and
- a lack of face-to-face interaction was mentioned, and therefore careful consideration should be given when implementing a professional development programme of this type by setting up alternative methods to enhance interaction.

When incorporating multimedia into a professional development programme one should determine which approach to multimedia learning is followed. Of the three approaches to multimedia learning (see 2.8.1.1.2), multimedia learning as knowledge construction, served the purpose of the current study best. The knowledge construction approach views multimedia learning as the infusion of various stimuli to allow individuals to create mental representations and in doing so, to construct their own knowledge and skills (see 2.8.1.1.2). This approach is also known as the cognitive theory of multimedia learning and is directed by three main assumptions: dual-channel assumption, limited-capacity assumption and the active-processing assumption. In this study, these three assumptions were addressed by taking note of each three. Furthermore, seven design principles were adhered to in order to ensure the efficacy of the multimedia implementation.

The design principles included:

- the dual-channel principle (see 2.8.1.2.1);
- the spatial contiguity principle (see 2.8.1.2.2);
- the temporal contiguity design principle (see 2.8.1.2.3);
- the coherence design principle (see 2.8.1.2.4);
- the modality design principle (see 2.8.1.2.5);
- the redundancy design principle (see 2.8.1.2.6); and
- the individual differences design principle (see 2.8.1.2.7).

Each of these principles harbours a greater learning experience by focusing on different aspects influenced by multimedia learning. In order to incorporate all of these principles, one has to be attentive to each of the implications they have on the effect of multimedia learning. In this study,

the developer of the DVD (the researcher) incorporated each principle by focusing on each principle and implementing it as much as possible.

From this discussion, the answer to **Research Question 3: “How could multimedia be implemented in professional development for IT teachers learning Scratch?”** was that it is incorporated by focusing on the multimedia theory of learning embedding the multimedia design principles and in doing so effectively enhancing learning through multimedia.

The above-mentioned principles together with the holistic incorporation of multimedia in the learning process of professional development on a DVD were greatly influenced by the content to be covered. The next section will discuss the main content covered in the professional development programme.

#### 5.2.1.3. Content of the professional development DVD

In order to allow teachers to successfully implement the knowledge and skills acquired during the completion of the professional development programme, it is important to focus the content of the professional development programme according to the immediate needs of the teachers (see 3.3.1). In the case of this study, teachers were faced with teaching of the Scratch programming language for the first time and they therefore expressed a need for additional support in order to assist their acquisition of knowledge about the programming language (see 3.3.1.1).

Scratch is a graphical programming language, which allows programmers to drag and drop programming blocks in order to create a program (see 3.2). Advantages of the use of such a graphical programming language have been noted. Considering the South African context and specifically focusing on Grade 10 learners taking IT as an elective subject (for whom the programming language is prescribed), the most relevant advantage has to be the fact that Scratch places more emphasis on programming and problem-solving than on meticulous programming syntax (see 3.2). Furthermore, the Scratch programming language saves time, which in the context of this study also seemed to be relevant as teachers often complain that they have too little time to guide their learners in the acquisition of programming skills. Although the advantages outweigh the disadvantages when it comes to implementing Scratch as an introductory programming language, the most relevant disadvantage which needed to be noted was that the Scratch programming language often frustrates more sophisticated and higher-skilled programmer due to its inability to address object-oriented principles (see 3.2).

The Scratch programming language content as implemented on the professional development DVD is influenced by the Curriculum and Assessment Policy Statement (CAPS) (see 3.3.1.1), which specifies the scope of knowledge and skills needed for Scratch programming in this context, as well as by the pedagogical principles needed for Computer Science Education (see 3.3.1.2).

From the search of relevant literature regarding the teaching of Computer Science, three appropriate taxonomies were identified:

- The ACM/IEEE-CS Joint Task Force Steering Committee (see Figure 3.2);
- Krathwohl's depiction of Bloom's taxonomy (see Figure 3.3); and
- Johnson and Fuller's rendition of Krathwohl's revision (see Figure 3.4).

From these three taxonomies, Johnson and Fuller's taxonomy serves the teaching of Computer Science best as it is specifically focused on Computer Science Education (see 3.3.1.2).

It is therefore evident that the answer to **Research Question 4: “What should be included in a professional development DVD for the training of IT teachers in Scratch?”** was that the content prescribed in the CAPS document as well as pedagogical principles like Johnson and Fuller's taxonomy should be included in a professional development DVD.

Considering the body of scholarly work relevant to this study and described in the above-mentioned sections (see 5.2.1.1; 5.2.1.2; 5.2.1.3), the professional development DVD was developed accordingly and distributed to teachers. The following section describes the findings from the empirical study.

### **5.2.2. Discussion on the findings of the empirical study**

In order to discuss the empirical study in a constructive way, the five sub-themes forthcoming from the empirical study are relevant here. These sub-themes all contribute to answering **Research Question 5: “How do IT teachers experience a multimedia-based professional development programme in the form of a DVD when learning Scratch?”**

#### **5.2.2.1. Experience regarding content of the DVD**

It was found that all participants regarded the content of the DVD as sufficient, especially considering the fact that it was an introductory DVD not focused on teaching programming skills but rather on illustrating the implementation of programming skills in the Scratch programming environment (see 4.7.1). One of the participants who had not received any training in Scratch

programming especially noted that he/she felt the content of the DVD gave him sufficient knowledge and skills to be able to teach Scratch to his/her Grade 10 IT class (see 4.7.3.2.1). All of the participants agreed that the additional activities and examples included as part of the professional development programme assisted them greatly (4.7.1).

From the above-mentioned aspects, the following regarding IT teachers' experience of the content of the DVD can be deduced:

- *Sufficient content promotes positive experience* (see 4.7.1)

As all of the participants agreed that the content of the DVD was sufficient (see 4.7.1), with minor additions suggested (see 4.7.1.2.1 and 4.7.1.2.2), it can be concluded that the basic introductory content illustrating the implementation of the new programming language, promotes a positive experience of the professional development DVD.

- *Activities and examples promote confidence in implementing content* (see 4.7.1)

Two of the participants commented that the activities and examples provided as part of the professional development programme assisted them in their teaching of Scratch (see 4.7.2.2.1 and 4.6.3.2.1). In order to increase the effectiveness of a professional development programme of this type, it was noted that examples (which contribute to teachers' direct needs in the classroom) were needed (see 2.6). Teachers participating in this study confirmed this notion, and therefore it is a necessity to include examples and activities in order to promote confidence in implementing the content.

#### 5.2.2.2. Experience regarding design of the DVD

The design of the DVD influenced the participants' experiences of the professional development DVD greatly and therefore need to be addressed.

Taking into account the design principles whilst developing the DVD (see 2.8.1.2), it was aimed that the incorporation thereof would influence teachers' experience of the DVD positively. All three participants agreed that the design of the DVD did not pose hindrances to them (see 4.7.2). As participants were not aware of the seven design principles adhered to on the DVD, they could not comment specifically on which of these principles promoted or demoted a positive experience of the professional development DVD. It was however noted that one participant did not enjoy the use of sound in the introductory screen of the DVD (see 4.7.1.2.2).

From the experiences noted by the participants, the following could be deduced regarding the design of the DVD as pertaining to the experience of the professional development DVD:

- *Incorporation of design principles promotes positive experience of DVD* (see 4.7.2)

When referring to the design principles (see 2.8.1.2), it is evident that it can promote or demote a positive experience of the professional development DVD. All the participants in this study had a positive experience regarding the design of the DVD, which was influenced directly by the design principles discussed earlier in the study (see 2.8.1.2). Although a specific principle cannot be highlighted it seemed that the influence of all the principles together ensured a design not problematic to the viewer of the DVD.

- *Personal taste and preference can promote or demote positive experience of DVD* (see 4.7.2)

Design principle seven (see 2.8.1.2.7) noted that each individual has his/her own preference, which was confirmed by the fact that one participant did not enjoy the use of a specific sound on the introduction screen of each section whereas the other participants had no problem with that. This design principle (individual difference design principle) therefore plays an important role and can influence the experience of a professional development DVD of this type.

#### 5.2.2.3. Experience regarding training value of the DVD

One of the focuses of the proposed multimedia-based professional development DVD was to assist teachers in the implementation of Scratch as the new prescribed programming language for Grade 10 IT learners (see 1.3). In order to determine whether teachers who participated in this study felt that the DVD was efficient for equipping them with the knowledge and skills needed to teach this new programming language, they were asked to comment on their experience regarding the training value of the DVD.

From the above-mentioned endeavour, the following conclusions could be drawn regarding the experience of the DVD in terms of its training value:

- *Experience influenced by level of knowledge and skills as well as personal needs* (see 4.7.3)

Although all three participants expressed their positive experience in terms of the training value of the professional development DVD, it was evident that the level of knowledge and skills of each participant as well as their personal needs influenced their experience of the DVD (see 4.7.1.2.3; 4.7.2.2.3 and 4.7.3.2.3). The DVD proposed in this study catered more for teachers who had no previous training in Scratch than for teachers who had previous training.

- *Influence of training in own time and self-selected venue* (see 4.7.3)

Two of the participants emphasised how they enjoyed the idea of being able to watch the DVD in the comfort of their own homes (see 4.7.2.2.3). Furthermore, the fact that they did not need to reduce teaching time due to travelling and being away for training also created a positive experience regarding the professional development DVD (see 4.7.3.2.3).

#### 5.2.2.4. Experience regarding lack of personal attention

One of the major concerns expressed after completion of the professional development DVD was the lack of personal attention, in other words face-to-face interaction (see 4.7.4). Implementing a professional development programme by means of a distance mode of delivery is one of the shortcomings as less emphasis is placed on face-to-face interaction and collaboration. Participants in this study expressed a need for personal attention and therefore it can be deduced that it would have an influence on their experience of the professional development DVD.

The following aspects were concluded regarding the experience of the lack of personal attention:

- *Lack of personal attention during completion of the DVD may influence participants' experience of the DVD* (see 4.7.4)

The majority of participants felt that the lack of personal attention had not influenced their experience of the DVD negatively and that they were able to complete the programme without collaboration with other teachers (see 4.7.2.2.4 and 4.7.3.2.4). One of the participants however noted that she viewed the professional development DVD only as an additional resource as the lack of personal attention created too much of a gap for her and therefore influenced her experience negatively. It can therefore be deduced that the lack of personal attention may influence teachers' experience of the professional development DVD, depending on personal preference.

- *Alternative methods for forging personal attention promote a positive experience of the DVD* (see 4.7.4)

One of the participants mentioned that the fact that he had continuous contact with the facilitator via an instant messaging service helped him greatly (see 4.7.3.2.4). All three participants agreed that an alternative method to forge personal attention and face-to-face interaction would assist their learning and make the experience of the professional development DVD more positive (see 4.7.4). It is therefore possible to say that the lack of personal attention can be overcome by making use of alternative multimedia methods to ensure collaboration between teachers.

#### 5.2.2.5. General comments and suggestions regarding the DVD

Apart from the above-mentioned four sub-themes identified as having an influence on teachers' experience of a multimedia-based professional development DVD, some general aspects were also identified regarding the DVD (see 4.7.5).

From the empirical study three main comments were observed as pertaining to teachers' experience of the DVD:

- *Availability of the DVD for IT learners* (see 4.7.5)

One of the participants remarked that she would have liked to show the DVD to her learners (see 4.7.1.2.5). Although it is necessary to allow teachers to be able to share their knowledge and skills with learners, it is of greater value to equip them in such a way that they are able to process this knowledge and skills and bring it to the level of their learners. This professional development DVD never set out to cater for learners and therefore would not have been available to learners as it was of an introductory nature for teachers who possess prior programming knowledge and skills.

- *Accessibility of DVD for first-time teachers* (see 4.7.5)

One of the participants was a first-time teacher with knowledge and skills of other programming languages. This participant indicated that the DVD assisted him greatly in both knowledge and skills of the Scratch programming language as well as in teaching the programming language to his Grade 10 learners (see 4.7.3.2.5). Being able to overcome a challenge by means of completing the proposed professional development programme may promote a positive experience of the DVD.

The above-mentioned sections answered **Research Question 5: “How do IT teachers experience a multimedia-based professional development programme in the form of a DVD when learning Scratch?”** as it was found that IT teachers in this study experienced the use of a multimedia-based professional development DVD positively and noted that the training value of the DVD was sufficient for them.

### **5.3. RECOMMENDATIONS FROM THIS STUDY**

This section is aimed at answering **Research Question 6: “Which recommendations regarding professional development could be made to advise the Department of Basic Education?”**

With regard to professional development as discussed in this study, the following recommendations are made:

- Professional development is an ongoing process executed by means of various methods in order to give teachers the opportunity to increase their knowledge and skills and in doing so to develop themselves holistically as better facilitators of the learning process (see 2.2). In IT education, the continuous changes regarding programming languages and technology make it necessary for teachers to be assisted in their professional development endeavours on an ongoing basis.
- Professional development has to be done at a time and place that would suit them and not interfere with their teaching time and/or place additional financial and time strains on them or their schools. A multimedia-based DVD will therefore be advisable providing that additional support be given (see 2.8.1.1.1).
- Professional development should be directed by the constructivist learning approach in order to allow teachers to make their own meaning of the knowledge and skills and to equip them to implement this approach in their own classrooms (see 2.3.2). When implementing professional development on a multimedia-based DVD, teachers should be able to monitor their progress (within the learning process) and they should be guided in the learning process instead of merely being fed knowledge perhaps irrelevant to their contexts. This can be done by allowing teachers to repeat sections with which they do not yet feel comfortable and to skip sections, which they have already mastered.
- Professional development with a constructivist approach should follow the transformative model in order to bring about transformation in each individual’s holistic being (see 2.4.9). By giving teachers the opportunity to complete the professional development programme individually, in their own time and in their own comfortable setting, they are more readily focused on learning as they are able to go through the learning stages at their own pace in order to change holistically.

- Teachers need a professional development programme which would enhance their professional attitudes set in a school-based form resulting in adequate training for them (see 2.5). If teachers are given the opportunity to complete a professional development programme directly relevant to their current circumstances and challenges, they are more willing to invest time and efforts in completing the programme and therefore they are indirectly changing their professional attitudes in a positive way.
- The incorporation of pedagogical skills and different teaching-learning strategies need to be included as these are aspects, which pose a challenge to teachers (see 2.6).
- In order to implement multimedia successfully in professional development all seven design principles described in section 2.8.1.2 should be included.
- When teachers complete professional development programmes, they should be guided in the aims and outcomes of the programme. When teachers are informed of the benefits the professional development programme holds for them, they will be able to see that the professional development would not only be beneficial for them, but that it would most probably also have a positive influence on their learners as well (see 2.6).
- Teachers' needs however differ and therefore it should perhaps be considered to make the DVD applicable for different levels for example general programming principles, Introduction to Scratch, Intermediate or Advanced Scratch.
- It is also advisable that the DVD be accompanied with some instruction stating that if the speed is too fast, a teacher could go back and play any section repeatedly until satisfaction is reached.
- Bearing in mind De Sousa's (2008:76) finding that a portable DVD player can be purchased at a low price, it is advisable to equip teachers with a portable DVD player rather than having them experience technical problems due to incompatible software (see 2.7.2.3).
- Lastly, the Department of Basic Education needs to adopt other alternatives (like this training DVD) with regard to professional development as a distance mode of delivery in order to allow teachers to complete these sessions at their own pace as well as in their own time, without having to travel to faraway towns and leaving learners unattended for three or more days (see 2.5).

In conclusion, recommendations regarding professional development which could be made to advise the Department of Basic Education are the following:

Implementing multimedia-based professional development is advisable provided such implementation addresses teachers' needs and allows for a holistic development of the teacher as a human being. Furthermore, the design and development of the multimedia-based professional development programme needs to be considered carefully in order to accommodate as many teachers' different learning styles as possible and to allow teachers from different backgrounds to benefit from the professional development programme. Lastly, when implementing a multimedia-based professional development DVD in a distance mode of delivery setting, collaboration is needed. A platform should be developed to allow constant collaboration between the facilitator and the teachers as well as between teachers themselves.

#### **5.4. SHORTCOMINGS IN THIS STUDY**

There were only three participants in the study as the study formed part of a larger research project on empowerment of IT teachers where sets of three teachers were used in each intervention to determine the value of each intervention in the empowerment. The researcher therefore did not try to generalise, but rather attempted to understand each participant's personal experiences and get some rich data on their experiences. These experiences can give an indication of the views of other IT teachers as well. It should however be valuable to extend the study to a bigger population and use a questionnaire to determine whether other teachers share the experiences of the three teachers in this study.

#### **5.5. RECOMMENDATIONS FOR FUTURE RESEARCH ENDEAVOURS**

It is recommended that a similar study be conducted with more participants from different provinces involved. This will bring about the possibility to truly see how a larger sample of teachers experience the Scratch multimedia-based professional development. A questionnaire can be developed based on the perceptions of the teachers of this study, and results could then be generalisable.

#### **5.6. FINAL REMARKS REGARDING THE STUDY**

This study was aimed at determining IT teachers' experience of multimedia-based professional development. The study posed some challenges as the researcher decided to develop the DVD herself as well as complete all other aspects surrounding a study like this herself. The work bore

fruit, and it was gathered that such a study could be done without expensive professional help and resources. It is therefore a viable option for education departments to build on the proposed professional development programme to address other needs of IT teachers.

The teachers involved in the study (as well as the participants in the pilot study) were all grateful for the additional support they received from the researcher and the potential of the DVD. The endeavour to propose a multimedia-based professional development DVD was therefore not in vain and definitely holds ground.

Teachers might still need the personal attention given during a face-to-face training session or by means of Skype, SMS or WhatsApp, but the benefits of being able to train at home and at their own pace should start becoming evident and soon more teachers will be able to be involved in professional development programmes continuously rather than only receiving once-off face-to-face training.

I would like to close with a comment that clearly reflects the spirit of multimedia-based professional development:

*It was actually nice for me to have something like this which I could watch in the evenings*

*instead of me having to travel to trainings*

(Participant 2)

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## **ADDENDA**

**ADDENDUM A:**  
**TEACHER'S USER MANUAL**

# Scratch user manual and workbook



## PREFACE

I would like to start off by thanking you for allowing me this opportunity to work with you on this project. Scratch is a fun and exciting programming language and therefore seemed to be a great platform to test the viability of a multimedia-based professional development programme. Please note that this study is focused on your experience of the multimedia-based professional development and not on Scratch as such, however Scratch was used as the tool to establish this.

As you go through all the sections, make use of both the manual and the DVD to guide you through the different sections (as derived from the Curriculum and Assessment Policy Statement). After each section has been completed, please take a few minutes to reflect on what you have learnt focussing mostly on the idea of receiving professional development via the DVD instead of a training course (as with the CAPS training for instance).

Thank you once again and I hope and trust that this DVD will assist you. Please note that the DVD distributed to you is still a working progress and therefore I will have to take it in at the end of the research. You will however be given a final copy once the research has been completed.

Roxanne Bailey (Master's student and DVD developer)

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## **1. INTRODUCTION TO SCRATCH**

Before starting any programming language, it is important to look at the background of the language in order to see the rationale of it. Furthermore it will prove difficult to master the language if you are not comfortable with the programming environment. The following two sections are focused on these two topics. Take the time to work through the first section on the DVD and then return to this manual for further assistance. Also remember to complete the reflection part of the section in order to structure your thoughts and ensure that you have fully understood the scope of the section.

### **1.1. Background of Scratch**

Research in the implementation of Scratch as an introductory programming language has shown various advantages. Adams (2010:360) found that children attending their after school computer programming camps enjoyed Scratch as they were able to create their own characters and games. It proved to be a viable option for the introduction to programming for young people (Sivilotti & Laugel, 2008:1). Though Scratch has been implemented mostly in children's classes, Malan and Leitner (2007:1) have experienced great success when implementing Scratch in their higher education classes thus implying that the programming language is not bound to only serve children but young adults too (Giganti, 2010:1). Scratch programs can be shared on the Scratch online community fostering collaborative learning between learners (Grippin, 2010:3). Idlbi (2009:18) notes that a greater emphasis is placed on the concept of programming rather than on meticulous programming syntax. Lewis (2010:346) agrees and argues that due to Scratch programming blocks only fitting in syntactically valid ways, errors that occur are always semantic errors and not negligent typing errors. This saves time for learners as less time has to be spent on correcting faulty typing and syntax errors. With Scratch being a visual programming environment software development can be done in a way that is non-threatening and fun (Meerbaum-Salant *et al.*, 2010:69). Utting *et al.* (2010:3) is of opinion that Scratch attracts a broader range of students to computer science.

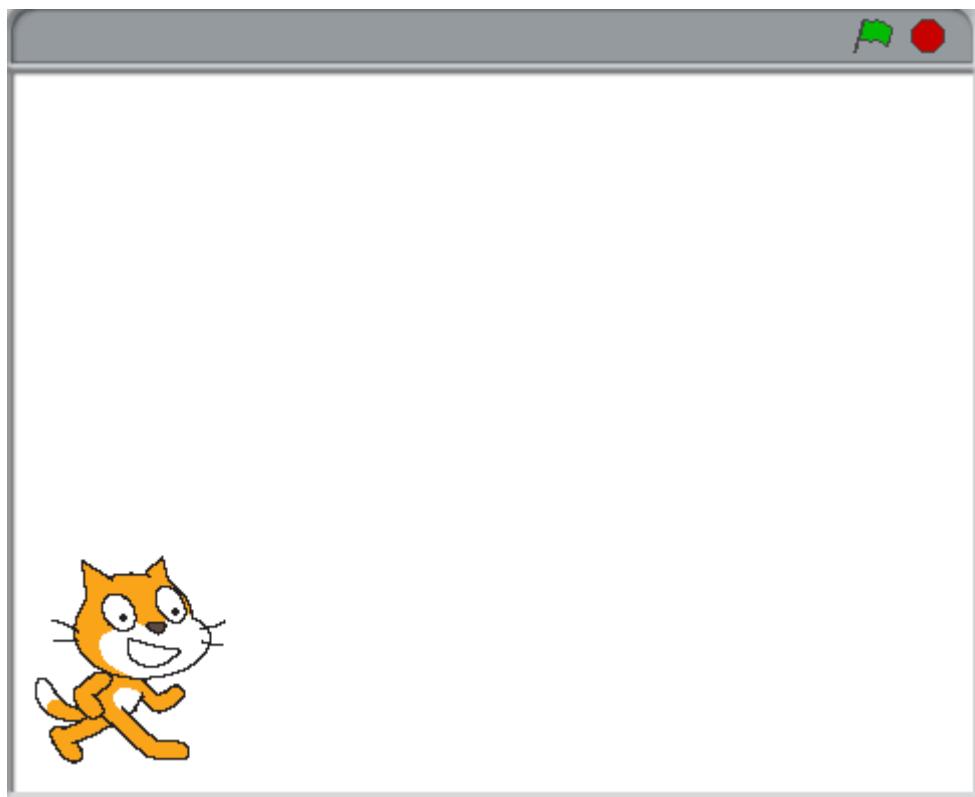
As with all good things, Scratch also holds some disadvantages. Some researchers like Harvey and Mönig (2010:2) note that object-oriented programming skills are not addressed in Scratch which might result in difficulty when moving to programming languages like Java. Sophisticated programmers might find the graphical interface too frustrating as some programming code can be expressed clearer in a text-based programming language (Begel, 1996:8). Heise and Joyner (2004:8) argue that visual programming languages' codes are not as easily readable as text-based programming languages. The three above mentioned disadvantages are the only

disadvantages that were found in the attempt to search the literature on Scratch and visual programming languages. Though these disadvantages are important to be noted it is clear that Scratch holds many more advantages than disadvantages clarifying why the South African Department of Basic Education proposed it as the introductory programming language to be used in the new Curriculum and Assessment Policy (CAPS) (Department of Basic Education, 2011:11).

## **1.2. Scratch programming environment**

The Scratch programming environment is basically made up of:

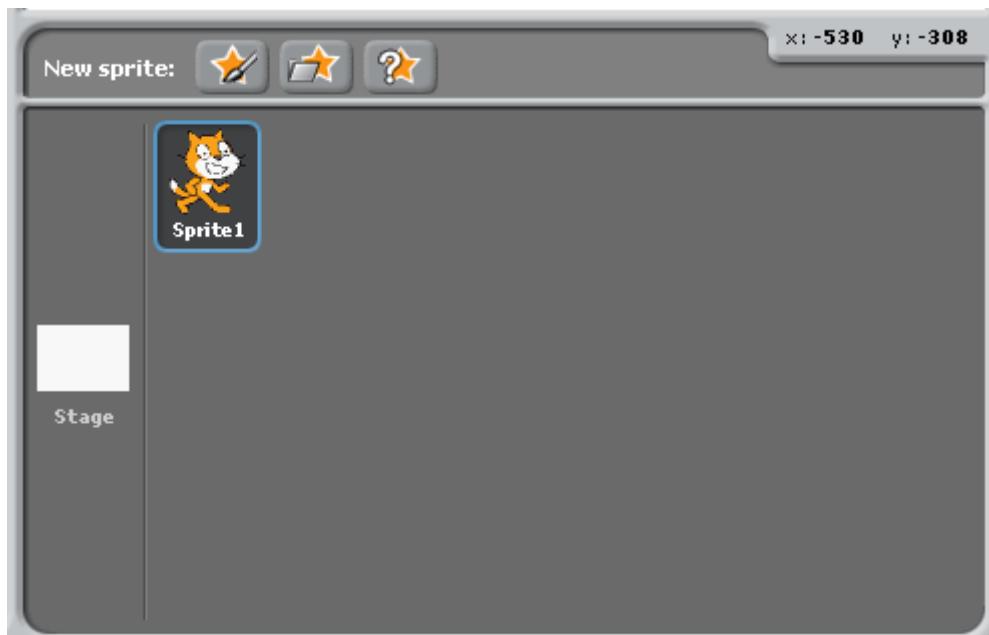
A stage:



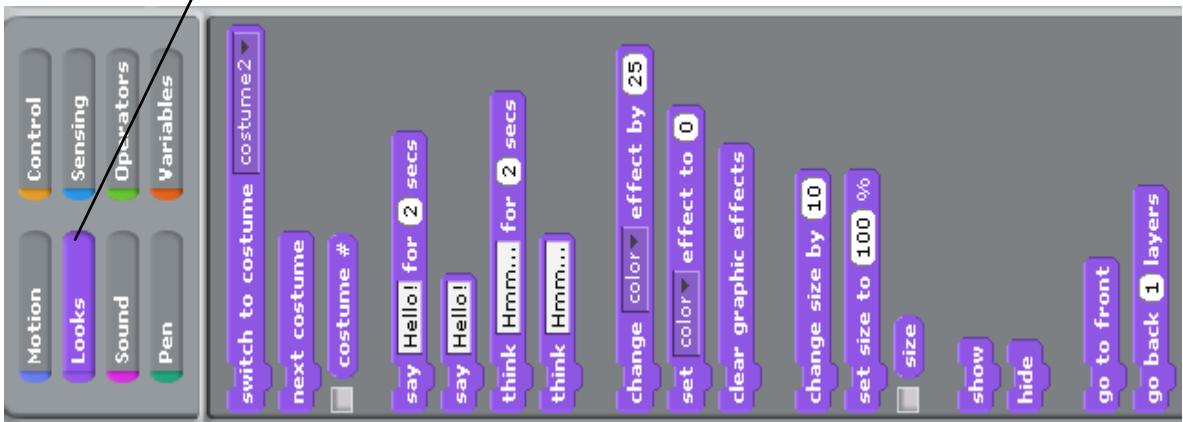
A scripts area:



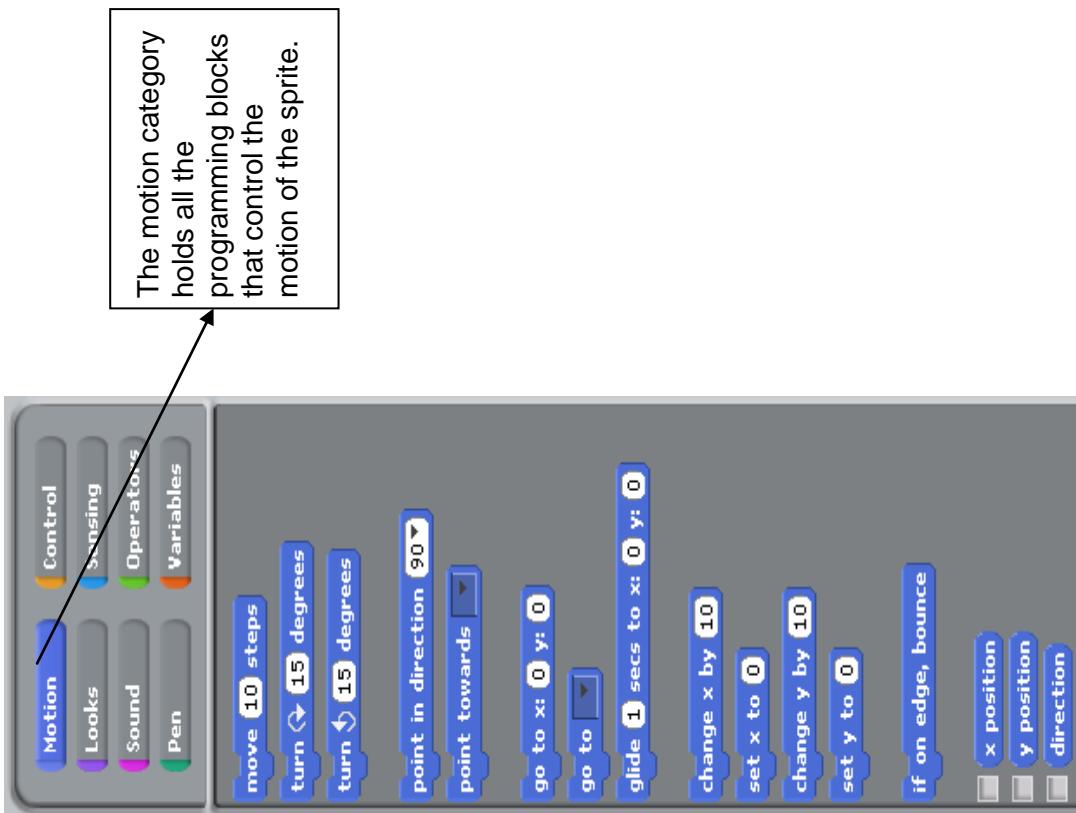
A sprite list:



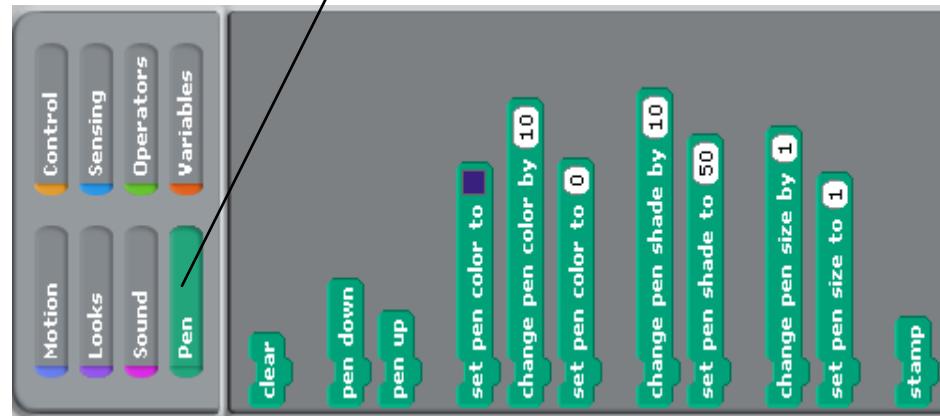
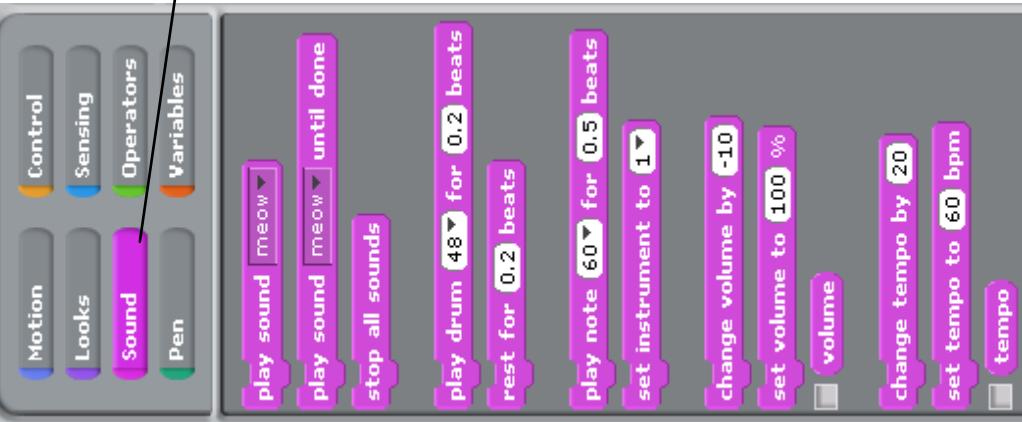
Another important component found in Scratch is the blocks palette. This palette holds all the different programming blocks that can be used in your project. Programming blocks are divided into categories.

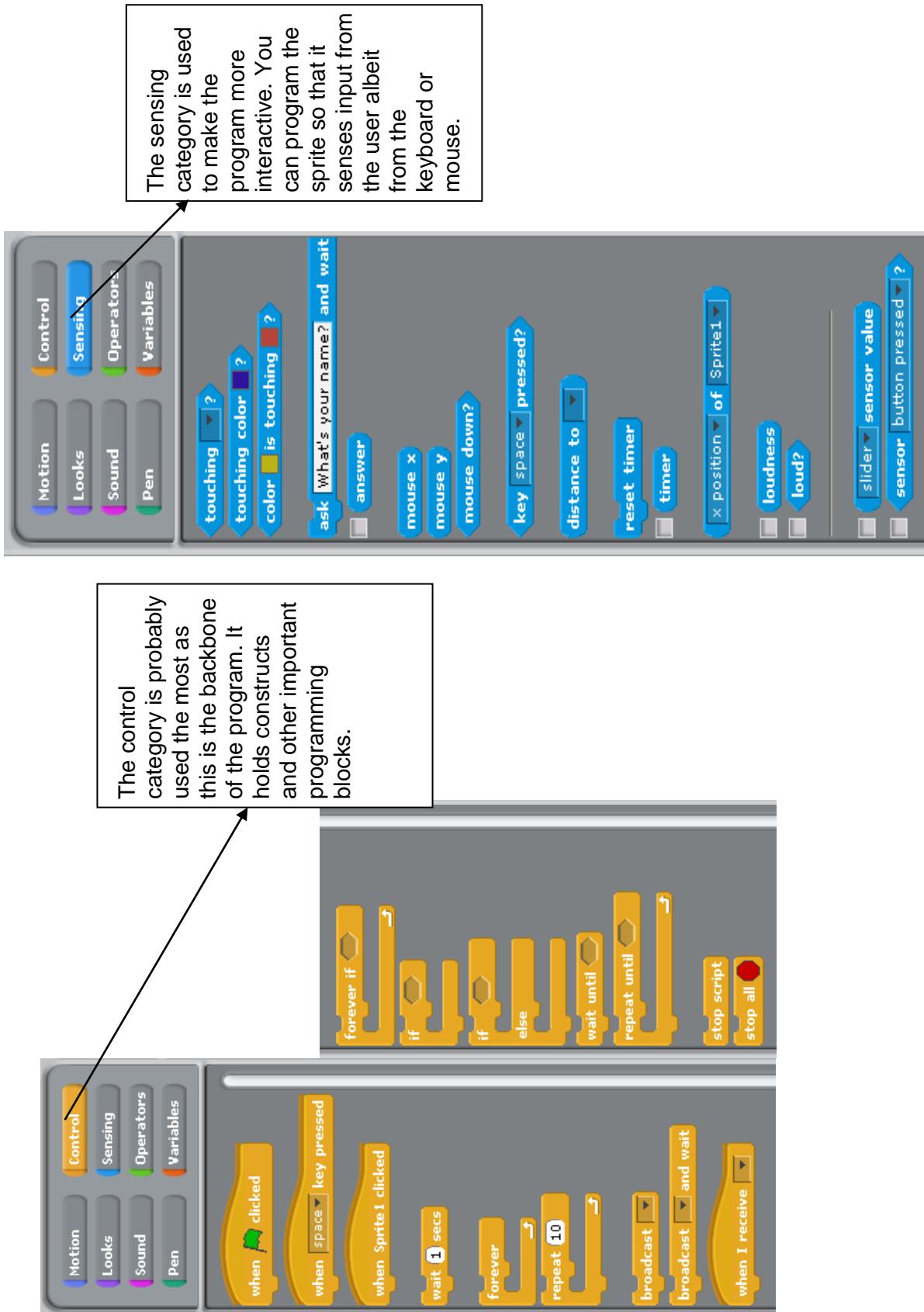


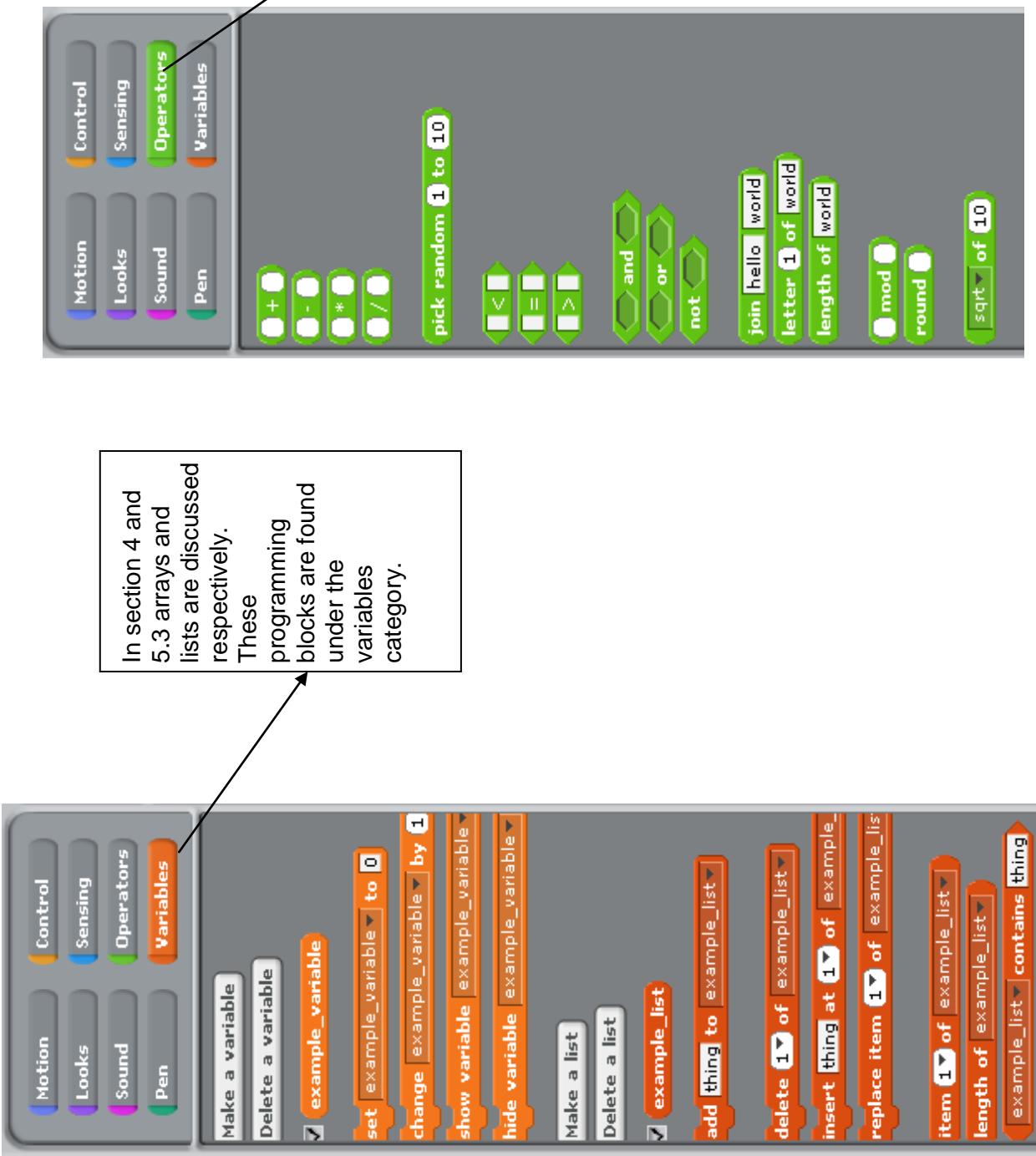
The looks category holds all the programming blocks that affect the look and reaction of the sprite.



The motion category holds all the programming blocks that control the motion of the sprite.







## **REFLECTION ON SECTION 1:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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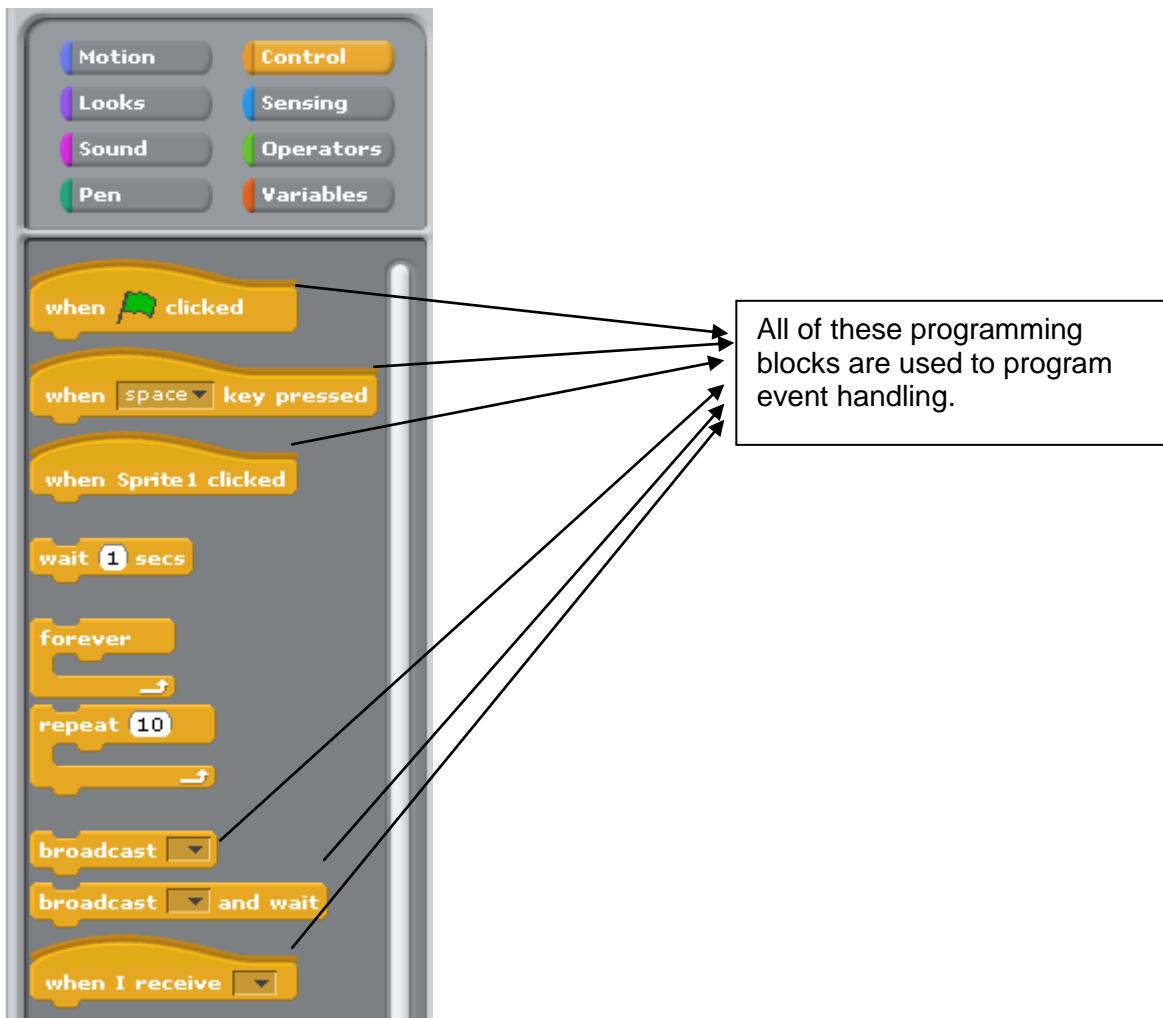
**3. General comments on the DVD (refer to the design, the presentation and the content.)**

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## 2. EVENT HANDLING

Event handlers are the backbone of making your project interactive. It allows the user to feel in control of what is happening and therefore makes the program more exciting. Examples of event handlers can be found under the control category.



### Activity 2.1

You are asked to judge South Africa's got talent. Three contestants are participating. To listen to each, you have to click on them. Write a program to allow the user to do just that. Be creative in the use of backgrounds, sounds and the sprites you choose.

### Activity 2.2

In foundation phase it is important for learners to develop a sound sense of different animals and the sounds they make. Write a program for your Grade 1 teacher where learners can click on different animals and read their names as well as listen to the sound they make.

## **REFLECTION ON SECTION 2:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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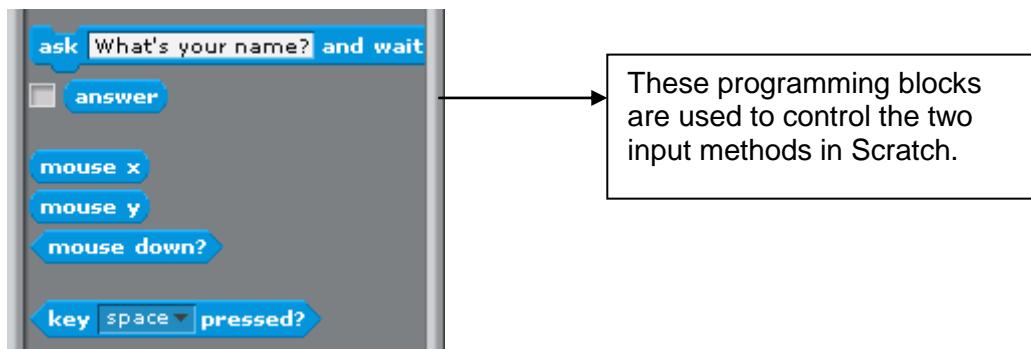
**3. General comments on the DVD (refer to the design, the presentation and the content.)**

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### 3. DATA TYPES AND INPUT METHODS

Data types that are allowed in Scratch are: integers (both decimal and whole numbers) and string (text). These are entered into the program via the keyboard; however mouse input is also functional. The “Ask and Wait” block as well as the “Answer” block is helpful when requiring data from the user.



These programming blocks are used to control the two input methods in Scratch.

#### Activity 3.1

Write a Scratch project asking a user to enter his/her name and then displaying it in a speech bubble. Hint: Make use of the “Say” programming block to display the user’s answer.

#### Activity 3.2

You are asked to capture information of all rugby players in the South African squad. Write a program asking each player their name as well as their position, displaying it one after the other when the process button is clicked.

**REFLECTION ON SECTION 3:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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**3. General comments on the DVD (refer to the design, the presentation and the content).**

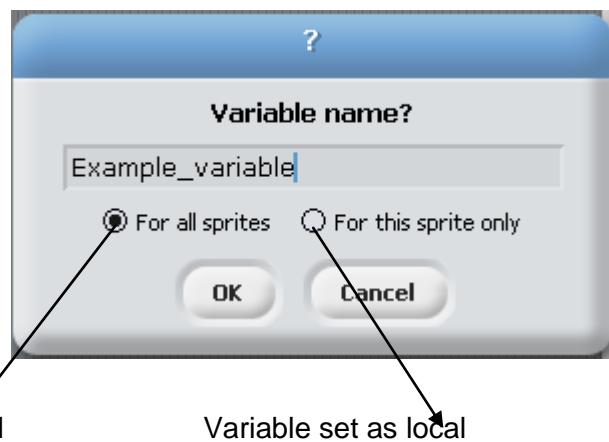
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#### 4. VARIABLES

Variables are categorised by their scope. If a variable applies to all sprites, implying the whole Scratch program, it is said to be a global variable. If it only applies to a specific sprite, implying that not all sprites and components in the project can access it, it is said to be a local variable.

When defining a new variable, you will have the opportunity to declare whether it has a global or local scope.



Properties of variables are as follows:



**Activity 4.1**

When shopping at any convenient store, managers are usually interested in knowing the number of customers entering their store daily. Write a Scratch program that counts the customers (as they enter the store) and displays it as soon as the manager presses the “D” key on the keyboard.

**Activity 4.2**

South Africa is doing a census. They have appointed you to determine whether someone has been counted or not. When the resident has been counted, press “Y” on the keyboard, when the resident has not been counted yet, press “N” on the keyboard. Each time the “Y” and “N” is pressed a variable for each should increase. You can ask a maximum of 10 people per day. Display (by pressing “D” key) the number of counted and not counted respectively.

**REFLECTION ON SECTION 4:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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**3. General comments on the DVD (refer to the design, the presentation and the content).**

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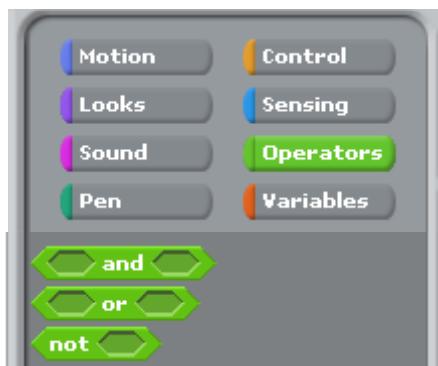
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## 5. DATA HANDLING

Data handling in Scratch is done by the use of Operators, Functions and Arrays (which are called “lists” in Scratch). Work through each section on the DVD and refer to your manual for additional assistance.

### 5.1. Operators

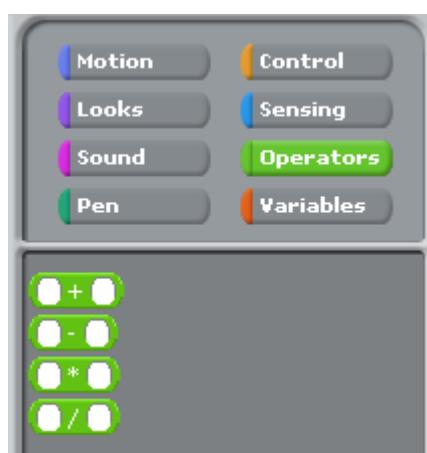
Boolean (and, or, not)



Relational (>, <, =)



Mathematical (+, -, \*, /)



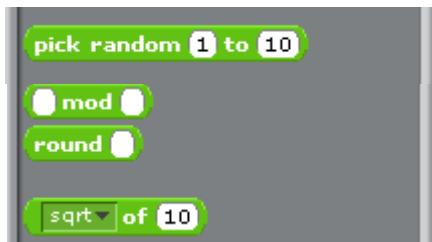
### Activity 5.1

You are asked to design a basic calculator. Ask the user to enter 2 numbers by clicking on a button “Number 1” and “Number 2”. Also add buttons for the basic mathematical operators. When they click on the mathematical operator, they are shown the answer in a speech bubble on another sprite. Tip: Broadcast the answer after completing the sum and use the “When I receive” programming block to activate the sprite that displays the answer.

## 5.2. Functions

In Scratch the most frequently used mathematical functions are:

Mod (for calculating the remainder of a division equation), Random (for randomly generating a number), Round (for rounding a decimal) and Square root (for calculating the square root of a number).



Other mathematical functions include: abs, sin, cos, tan, asin, acos, atan, ln, log, e<sup>^</sup> and 10<sup>^</sup> but are not as regularly used. They are found when clicking on the drop-down list where “sqrt” is the default.

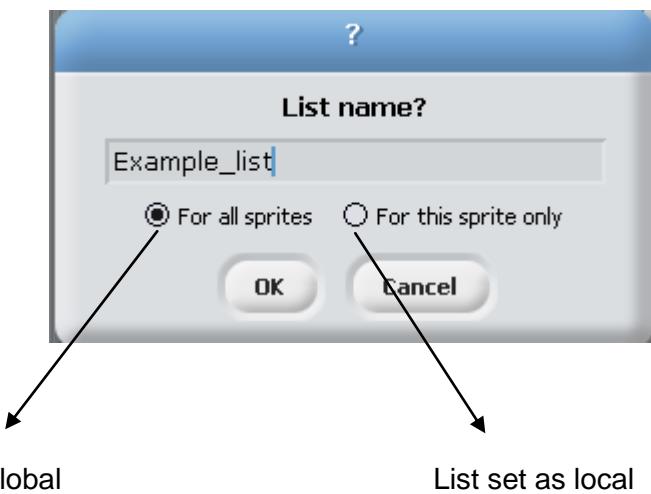
String functions include: Join (for joining two strings), Letter (for selecting a specific letter in a string) and Length (for calculating the length of a string)

### Activity 5.2

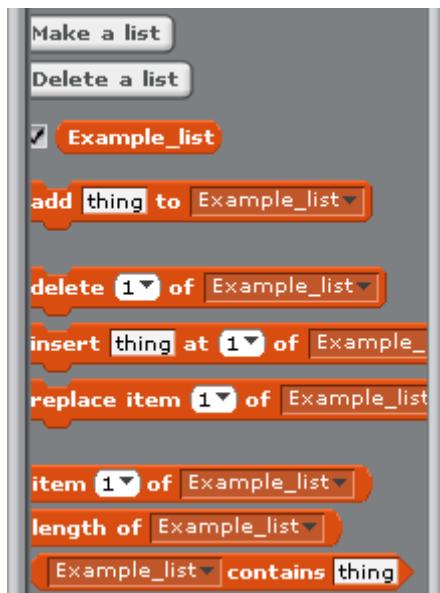
You are asked to write a program for a security company helping staff members to generate secret passwords. These passwords consist of the first 3 letters of their surname added to a randomly generated double digit number and the first letter of their first name.

### 5.3. Arrays

In Scratch arrays are referred to as “Lists”, this is as a result of the fact that an array of items is placed in a list on the computer. As with variables, lists can also be set to have either a global or a local scope. This is done when a new list is created.



Properties pertaining to lists:



#### Activity 5.3

Write a program where a teacher can enter 10 equations into one list. Use a sprite to ask the teacher for the equation. Once the teacher has entered the equation add the equation to the question paper list.

## **REFLECTION ON SECTION 5:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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**3. General comments on the DVD (refer to the design, the presentation and the content.)**

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## 6. CONSTRUCTS

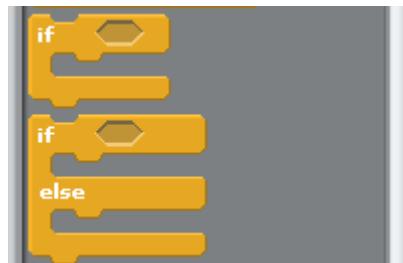
Constructs are programming blocks that already have certain programming code built in. Conditional constructs and Iteration constructs can be found in the Scratch programming language. Constructs are found under the control category in Scratch.

### 6.1. Conditional constructs

#### 6.1.1. If and if-then-else constructs

Conditional constructs are constructs that test whether a certain condition is applied or not, and according to the outcome executes a certain set of tasks.

In Scratch the If and the If-then-else conditional constructs can be found and are designed as follow:

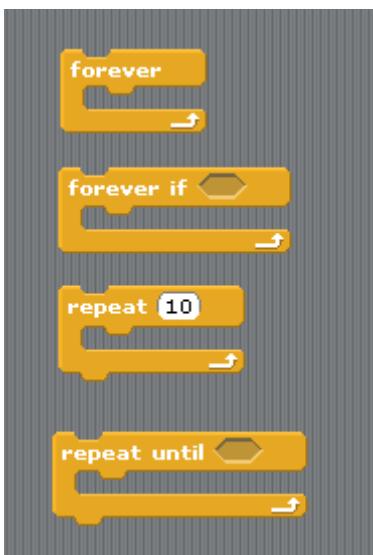


#### Activity 6.1.1

Make use of the project you wrote in Activity 5.2 (The password generator). When the program starts, the user is asked to execute the program that generates the password. They are shown what the password is but only for two seconds-thereafter they have to retype the password in order to continue the program. If the password is entered correctly display a message saying that they have successfully entered a password, else stop all codes.

### 6.2. Iteration constructs

Iteration constructs do just as the name suggests. These are constructs that are used whenever iteration of code/programming blocks needs to take place. The four iteration constructs that are used in Scratch are: Forever, Forever-if, Repeat and Repeat-until.



### 6.2.1 Forever and Forever-if

The Forever and Forever-if iteration constructs allow codes to iterate either throughout the whole program continuously or throughout the whole program if a certain condition is met.

#### Activity 6.2.1

Write a screensaver for your computer where a ball will bounce from left to right up and down the whole time till you press the stop sign. Hint: Remember the motion programming block “if on edge bounce” which will let the ball bounce away from the sides once it has touched it.

### 6.2.2 Repeat and Repeat-until

Where the Forever and Forever-if iteration constructs continuously iterate, the Repeat and Repeat-until are more restricted. With the Repeat iteration construct, you can let code repeat only a certain number of times, furthermore the Repeat-until construct allows you to set a boundary that will let the program stop as soon as an action takes place. Repeat-until and Forever-if constructs are quite similar.

#### Activity 6.2.2

Your little sister is struggling with Maths again and asks you to write her a game to help her practice her addition sums. Write a program asking her to complete 10 sums at a time, generating random numbers (2 digits) to add. After she has completed the 10 sums give her a score of how many she got right.

**REFLECTION ON SECTION 6:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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**3. General comments on the DVD (refer to the design, the presentation and the content.)**

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## **7. PUTTING IT ALL TOGETHER**

Now that you have worked through all of the previous sections it is time to see whether all you have learned can be combined into bigger projects.

### **Activity 7.1**

Write a program that will assist learners in learning their times table. This program needs to give the learner the opportunity of selecting what times table (between 1 and 10) they want to learn and then ask them 10 equations.

Store the equations in a list so that they can reflect on it once they have completed the task.

### **Activity 7.2**

Playing the “matching game” has proven to be helpful in developing learners. Write a game that will give learners the opportunity to test their memory by trying to match two cards (pictures) with each other.

### **Activity 7.3**

Cartoons and animated films are becoming more popular each day. Use your own initiative to write an animation with one of the popular fairy tales or nursery rhymes.

**REFLECTION ON SECTION 7:**

**1. Which areas of this section proved to be helpful?**

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**2. Which areas of this section seem to be unnecessary?**

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**3. General comments on the DVD (refer to the design, the presentation and the content.)**

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**ADDENDUM B:**  
**PERMISSION TO CONDUCT RESEARCH: NORTH-WEST UNIVERSITY**



NORTH-WEST UNIVERSITY  
YUNIBESITI YA BOKONE-BOPHIRIMA  
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom  
South Africa 2520

Tel: (018) 299-4900  
Fax: (018) 299-4910  
Web: <http://www.nwu.ac.za>

**ETHICS APPROVAL OF PROJECT**

**Ethics Committee**  
Tel +27 18 299 4850  
Fax +27 18 293 5329  
Email [Ethics@nwu.ac.za](mailto:Ethics@nwu.ac.za)

2010-11-19

This is to certify that the next project was approved by the NWU Ethics Committee:

**Project title :** Empowering Information Technology teachers in economically deprived rural schools

**Project leader:** Prof. Elsa Mentz

**Ethics number:** **NWU-00113-10-A2**

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

**Expiry date:** 2015/11/18

The Ethics Committee would like to remain at your service as scientist and researcher, and wishes you well with your project.  
Please do not hesitate to contact the Ethics Committee for any further enquiries or requests for assistance.

The formal Ethics approval certificate will be sent to you as soon as possible.

Yours sincerely

Me. Marietjie Halgryn  
NWU Ethics Secretariate

**ADDENDUM C:**  
**PERMISSION TO CONDUCT RESEARCH: DEPARTMENT OF EDUCATION**



## education

Lefapha la Thuto  
Onderwys Departement  
Department of Education  
**NORTH WEST PROVINCE**

First Floor,  
Garona Building  
Private Bag X2044,  
Mmabatho 2735  
Tel.: (018) 387-3429  
Fax: (018) 387-3430  
e-mail: pjansen@nwpg.gov.za

### OFFICE OF THE SUPERINTENDENT-GENERAL

Inquiries: Mpiliso Tyatya  
Tel: 018 308 3429  
Fax: 018 387 3430  
Email: SGexly@nwpg.gov.za

06 December 2010

To: University of the North West  
Potchefstroom Campus  
Faculty of Education Sciences  
  
Attention: Prof. Elize Mentz  
  
From: Mr. Charles Mpopodi Raseala  
Superintendent-General

### REQUEST TO CONDUCT PILOT RESEARCH IN NORTH WEST SCHOOLS

Reference is made to your letter dated 1 December 2010 regarding the above matter. The content is noted and accordingly, approval is granted for you to conduct the research as per your request, subject to the following provisions:-

- That you notify the relevant District Offices about your request and this subsequent letter of approval.
- That participation in your project will be voluntary.
- That, as far as possible, the general functionality of the school should not be compromised.
- That the findings of this research will be made available to the Education Department upon request.

With my best wishes,

Mr. Charles Mpopodi Raseala  
SUPERINTENDENT GENERAL

"STAND UP, TEAM UP AND REACH OUT"  
"A PORTRAIT OF EXCELLENCE"

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10/12/2010 08:43 PAGE 01/60

4 HOPE



**ADDENDUM D:**  
**LETTER TO PARTICIPATING SCHOOL'S PRINCIPAL**

Private Bag X6001, Potchefstroom  
South Africa 2520  
Tel: (018) 299-1858/4769  
Web: <http://www.nwu.ac.za>

The Principal of

15 March 2012

## **INFORMATION TECHNOLOGY TEACHERS' EXPERIENCE OF MULTIMEDIA-BASED PROFESSIONAL DEVELOPMENT**

I am currently conducting research for my Masters degree on the professional development of Information Technology (IT) teachers in the North West province.

Professional development is an area that has for a long time been in need of adequate, practice orientated research. With the implementation of the new Curriculum and Assessment Policy Statement, that will replace the National Curriculum Statement teachers are in dire need of support in terms of content knowledge as well as pedagogical skills.

The North West Department of Education has already granted me permission to conduct the research in the province's schools (Please find the letter from the Department attached). I have also informed the different district managers of this research.

I hereby kindly request you to allow your Gr.10 IT-teacher to be involved in the research that will be conducted from March 2012 to November 2012. On the first visit teachers will receive a DVD focused on the new programming language Scratch. They will be asked to go through the DVD (on their own time) and assess the quality of the DVD. This should not take too much time. On the second visit, a very short interview will be conducted where I will ask the teachers about their experience of the DVD as a professional development tool. The research does not however focus solely on the teaching of Scratch, but rather on professional development by means of a multimedia-based disc. With this I hope to establish whether it would be a viable option for future professional development endeavours. This will not interrupt teaching in any way as I will schedule individual meetings with IT teachers when it suits them. All results will be available to you and your teacher upon request and will further be used to develop a guideline for professional development of IT teachers in South Africa. I am convinced that this research will contribute to more effective IT education in South Africa and will also strengthen the relationship between the university and schools.

I will appreciate it if you could kindly complete the attached form with your particulars and fax it back to me. If you have any enquiries, please indicate it on the form and I will gladly contact you. If you are willing to let your school participate in this research, I will contact your IT teacher shortly to arrange a first meeting.

Kind regards

Roxanne Bailey (Masters Student)

**ADDENDUM E:**  
**LETTER OF INFORMED CONSENT FOR PARTICIPANTS**

Private Bag X6001, Potchefstroom  
South Africa 2520  
Tel: (018) 299-4775  
Web: <http://www.nwu.ac.za>

April 2012

**INFORMATION TECHNOLOGY TEACHERS' EXPERIENCE OF MULTIMEDIA-BASED  
PROFESSIONAL DEVELOPMENT**

PLEASE COMPLETE AND FAX BACK TO:  
MISS ROXANNE BAILEY  
FAX: 018 299 4788

NAME OF SCHOOL: \_\_\_\_\_

PRINCIPAL: \_\_\_\_\_

I hereby grant permission that the project may be conducted in my school

I hereby request that the project leader contacts me first in order to give more information

ANY OTHER COMMENTS OR REQUESTS:

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SIGNATURE: PRINCIPAL

DATE

GR 10 IT TEACHER: \_\_\_\_\_

CONTACT NUMBER OF GR 10 IT TEACHER: \_\_\_\_\_

I am willing to participate in the project

ANY OTHER COMMENTS OR REQUESTS:

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SIGNATURE: GR 10 TEACHER

DATE

**ADDENDUM F:**  
**LANGUAGE EDITOR CONFIRMATION LETTER**

Jackie Viljoen  
Language Editor and Translator  
16 Bergzicht Gardens  
Fijnbos Close  
STRAND 7140

Accredited member of the South African Translators' Institute No 1000017  
Member of the Professional Editors' Group (PEG)  
 +27+21-854 5095  082 783 0263  086 585 3740  
Postal address: 16 Bergzicht Gardens, Fijnbos Close, STRAND 7140 South Africa

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### DECLARATION

I hereby certify that the MEd dissertation of **ROXANNE BAILEY** (including the reference list) was properly language edited.

Title of dissertation:

**INFORMATION TECHNOLOGY TEACHERS' EXPERIENCE OF MULTIMEDIA-BASED PROFESSIONAL DEVELOPMENT**

JACKIE VILJOEN  
Strand  
South Africa  
04 October 2012