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The experiences of grade 6 science and technology learners of experiential learning as method of instruction

Domenico Balsamo

2009

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The experiences of grade 6 science and technology learners of experiential learning as method of instruction

by

Domenico Balsamo

Submitted in partial fulfilment of the requirements for the degree

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(Educational Psychology)

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Declaration of own work

I, Domenico Balsamo (student number 25274733), declare that this mini-dissertation titled:

The experiences of grade 6 science and technology learners of experiential learning as method of instruction

which I hereby submit for the degree Magister Educationis at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

_____

Domenico Balsamo
August 2009

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Summary

The purpose of this study was to explore and describe grade 6 learners' experiences of experiential learning in the context of the TekkiKids Programme. The TekkiKids Programme followed a constructivist approach to learning and emphasis was placed on a learner-centred approach. Documents that were written by a consultant, who was involved with the TekkiKids Program, were selected as data sources. These documents included: A feedback report to the facilitators regarding the sessions; general field notes of the consultant pertaining to observations made during lessons; notes of individual unstructured interviews; a questionnaire that explored learners' experiences of TekkiKids; and notes of a focus group discussion. A qualitative, documentary research design was implemented, and the documents were analysed according to guidelines pertaining to a process of inductive analysis. This study found that learners experienced experiential learning as a method of instruction to be but only partially supportive and encouraging. They furthermore experienced a need for more structure pertaining to problem-solving. Multicultural differences and group conflict had a negative influence on their learning experiences. Learners experienced cognitive load distribution as positive . English as the language of instruction was experienced as a barrier to learners from other language groups

List of Key Words

Learning experience
Experiential learning
Children
Documentary research
Interpretivism
Method of instruction
Science and technology
TekkiKids
Document analysis
Constructivism

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CHAPTER 1
INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION AND RATIONALE

> *Science and engineering research and innovation are intricately linked to societal needs and the nation's economy in areas such as transportation, communication, agriculture, education, environment, health, defence, and jobs* (Stine, 2008:2).

The importance of science and technology in most societies is highlighted by the aforementioned statement by Stine. Given that the world currently experiences a global recession, the importance of developing skills in the fields of science and technology seems more urgent now than ever before (Organization for Economic Cooperation and Development, 2007). However, the failure of schools to produce adequate numbers of students qualified to study in these fields (Inglesi & Pouris, 2008) is causing educationists concern about the impact on our day-to-day activities.

TekkiKids[1] is an extramural technology club designed to address this concern in South Africa. Learners from well-resourced and under-resourced schools were selected and exposed to science and technology via challenges and other activities. The aim of this programme was to confront learners with experiential learning experiences in the fields of science and technology as well as to foster an interest in the aforementioned fields.

I joined the TekkiKids team as a consultant to the facilitators in July 2007 and at that stage the programme had already been in operation for several months. TekkiKids follows a constructivist approach, where emphasis is placed on problem-based learning, learning-by-doing, experiential learning, and self-directed learning (Marais, Smith & Duveskog, 2007).

My role in the TekkiKids team was to gather information that could contribute to the further development of the said programme. As a consultant I assisted the facilitators regarding the improvement of the sessions of the programme, to ensure a supportive learning environment. As I observed the TekkiKids-learners during sessions in the period July 2007 to February 2008, certain observations triggered questions needing answers. I made several observations relating to the learners' behaviour during these sessions. Amongst

[1] TekkiKids is sponsored by the Department of Science and Technology and the Finnish Embassy and done in partnership with the University of Pretoria and the University of Joensuu in Finland (Marais, Smith & Duveskog, 2007). The TekkiKids programme is discussed in more detail in Chapter 2 (2.6) p 31.

others I observed restlessness, a lack of participation at times, withdrawal and conflict which occurred between the learners. I asked myself various questions about these observations of which the following were: Could it be ascribed to boredom? Are the learners experiencing the work too difficult and therefore have lost interest? How do the learners experience the methods of instruction implemented by the facilitator? Can this be addressed? What do the learners need the facilitators to do differently to stimulate and maintain their interest in the learning activities? What are the experiences of the learners pertaining to the role of the facilitator?

My observations of these learners in a multicultural setting also added to my curiosity: Why are learners from a so-called previously disadvantaged environment not participating in the activities in the same manner learners from advantaged environments do? What role does a learner's cultural background play in his experiences of learning? Could the learners' lack of participation be ascribed to a language barrier? In order to improve on the method of instruction, I asked: Does the level of interest in the activities pertain to motivation? Is it possible that the level of difficulty may influence a learner's motivation to participate in the activities? How do all these factors influence the learners' learning experiences in the TekkiKids programme? I came to the conclusion that the answers to all of the aforementioned questions can be found with the learners.

This study will be looking at learners' experiences of a science and technology programme based on constructivist learning theory and methods of instruction. In the process of positioning this study in the field of educational psychology, it is very important to note that experiential learning focuses on the learning process for the individual, in this case the grade 6 learner as an individual. *Unlike experiential education, which focuses on the transactive process between teacher and learner* (Wikipedia, 2009: Retrieved August, 30, 2009, from http://en.wikipedia.org/wiki/Experiential_learning). It is this very important distinction on experiential learning that combines the experience, perception, cognition, and behaviour of an individual in the learning process that draws on the knowledge base of the educational psychologist.

Kelly (1997:1) stated the following regarding the background of learning theories:

> *In my opinion, the greatest single event in this century that has shaped our view of teaching did not occur in the field of education at all, but rather, in psychology. It was the dramatic shift in the early sixties from the reductionist view of human behaviour to non-reductionist view…the non-reductionist perspective did not lead directly to the Theory of Experiential Learning itself, but it spawned a number of its*

predecessors: new interpretations known as cognitive theories and revitalised progressivism known as humanist theories.

It is more specifically against the background of the theoretical frameworks of earlier theorists such as Piaget and in particular David Kolb, who believed that *learning is the process whereby knowledge is created through the transformation of experience* (Kolb, 1984: 38) that I position this study.

1.2 PURPOSE OF THE RESEARCH STUDY

The purpose of this study was to explore and describe grade 6 learners' experiences of experiential learning as method of instruction used in a science and technology programme.

1.3 RESEARCH QUESTIONS

1.3.1 PRIMARY RESEARCH QUESTION

The primary research question guiding this study was formulated as follows:

What are the experiences of grade 6 science and technology learners of experiential learning as method of instruction?

1.3.2 SECONDARY RESEARCH QUESTIONS

In addition to the primary question, the following secondary research questions were explored.

- How does the method of instruction in the TekkiKids science and technology programme influence the learning experiences of grade 6 children?
- What learning experiences of a group of grade 6 learners in the TekkiKids programme were encouraging to them?

1.4 PRELIMINARY LITERATURE STUDY

Theories on learning have changed considerably over the past few decades and substantial knowledge exists on this subject. Examples of how this has affected the nature of teaching and learning in science in terms of curriculum development are science and technology programmes that have been developed by Germany, the Netherlands and the United States of America. These projects are evidence of a movement towards activity-based learning that stemmed from research suggesting that traditionally top-down patterns of teacher-

focused instruction seemed to severely inhibit active learning (Hameyer *et al*., 1995). This pattern of traditional teacher-focused[2] instruction also discouraged student involvement and generally leds to an undesirable orientation towards learning in terms of negative experiences and attitudes towards subject matter (Goodland, 1984). In accordance with this, Carin, Bass and Contant (2005) warn against using a direct instruction and reading approach, especially when it comes to teaching science, as they argue that this will likely have a negative and inhibiting effect on the child.

Research ensures that knowledge is continually engaged with, revised and subsequently built upon. According to Victor and Kellough (2000) learning theorists such as Piaget, Vygotsky, Gagné, Bruner and Ausubel have played major roles in today's theories of effective instruction. While acknowledging contributions from other psychologists, they are of the opinion that *perhaps no other had such a wide-ranging influence on education as the Swiss psychologist Jean Piaget* (Victor & Kellough 2000:43).

Research done by Piaget on the development of children's thinking abilities indicated the importance of exposing children in the first three stages of development, as per his developmental model, to hands-on experiences in order to develop their intellectual capabilities. In this regard Esler and Esler (2001) deem Piaget, and subsequently Bruner, with his discovery-learning model, to be the godfathers of constructivism in science and education.

According to Jansen (2003), constructivism is the belief that knowledge is constructed by meaning-making processes. In this paradigm, learners are active, self-conscious beings, seeking meaning in their experiences by using a cognitive process (Jansen, 2003; Schurink, 1998). This cognitive process takes place when prior knowledge (previous experiences) interacts with new knowledge (new experiences). Knowledge that develops through this process therefore is due to new experiences (Von Glasersfeld, 1996). Furthermore, Brooks and Brooks (1993) define knowledge as an internal representation of the world that is mediated through temporary, developmental, social and cultural experiences. When looking at contemporary literature on science and technology, it is evident that constructivism plays a fundamental role in current methods of instruction, both practised and proposed.

In recent years the Department of Education (DoE) has placed great emphasis on, and subsequently proposed a learner-centred and activity-based approach to education. This is in line with global trends in science and technology education. The Revised National

[2] An approach to education that is characteristic of direct instruction and limited learner-teacher interaction. It is also known as the so-called "talk and chalk" approach to education.

Curriculum Statement Grades R to 9 (Department of Education, 2003:26) proposes a teaching strategy that *should focus on the development of transferable skills leading to an interactive, process approach to solving problems in contexts.* The DoE (2003:26) also strongly advocates the following with regard to teaching strategies in technology teaching:

- a shift towards learning-centredness, where the educator should facilitate learning by creating a supportive environment for the learners, affording them the opportunity to make sense of learning material for themselves
- experiential learning, claiming it to be a powerful tool in ensuring meaningful learning in technology
- a hands-on approach to teaching technology, referring to learning-through-experiences (i.e. through practical engagement in investigating, designing, making, evaluating and communicating ideas and plans).

In accordance with this movement, the University of Joensuu started an extramural technology club, called Kids' Club, for children, based on the epistemological beliefs of constructivism, and preliminary reports suggest that the approach followed indeed seems to be a good fit (Eronen *et al*., 2002).

Subsequently, this project inspired the CSIR and, in conjunction with the University of Joensuu and the University of Pretoria, TekkiKids was born. The TekkiKids programme is based on the Kids' Clubs initiative of the University of Joensuu, especially pertaining to method of instruction (Marais, Smith, & Duveskog, 2007).

Set against the backdrop of educational psychology, the point of departure of this study is that in order to increase a learner's interest and involvement in the science and technology field, the learning experience of a child should be encouraging. Considering the factors involved in creating a learning experience that is encouraging, this study sets out to explore the different factors leading up to a positive and encouraging learning experience, i.e. teaching approaches and methods of instruction, as prescribed by literature on the subject of successful science and technology teaching practice. Specifically with regard to this study (the TekkiKids Programme), these factors include the teaching method implemented during this specific programme, the level of enjoyment and motivation of the learners, the expectations of the learners regarding their learning experiences, and finally, the social context in which the learning experiences took place.

One can argue that the theoretical foundation on which the Kids' Club and TekkiKids Programmes are based is in accordance with contemporary literature on science and technology, as will be discussed in greater detail in Chapter 2 of this mini-dissertation. I

intend to explore and describe the participants' experiences of the TekkiKids Programme, in so doing exploring possible discrepancies between theory and practice.

1.5 CONTRIBUTION OF THE STUDY

This study contributes in the following ways:

- Assisting TekkiKids to improve their existing programme in order to more effectively develop learners' interest in the science and technology field;
- Contributing to the existing body of knowledge pertaining to the improvement of methods of instruction that science and technology teachers employ;
- Contributing to the existing body of knowledge pertaining to the practice and implementation of methods to address barriers to learning in an experiential learning environment;
- Awareness of existing science and technology clubs may prove to be helpful aids in referral procedures relating to:
    - support for learners who experience difficulty in learning regarding science and technology and
    - support for learners who are interested in the field;
- Contributing to intervention strategies pertaining to teacher guidance:
    - effective teaching strategies in a multicultural and experiential learning environment,
    - dealing with barriers to learning in group context,
    - dealing with group dynamics, and
    - improving teacher-child relationship skills.

1.6 KEY CONCEPTS

The following key concepts were used in this study:

1.6.1 LEARNING EXPERIENCE

In the context of this study, following a constructivist approach, learning and experience are viewed as inseparable. Good (1973:227) defines a learning experience as *a purposeful activity that has meaning to students at their developmental level, carried through to completion and evaluated.* Arguably more explanatory and complementary, it also defines experience as *the acquisition of knowledge, attitudes, or skills through one's own perception and participation, or knowledge, attitudes, or skills so acquired* (Good, 1973:226). Thus, in

the context of this study, a learning experience will refer to exposure to, and subsequent participation in, the educationally orientated activities that result in the (inevitable) attitude and perceptual laden cognitive meaning-making processes of the children engaged in these activities during their participation in the TekkiKids programme.

1.6.2 METHODS OF INSTRUCTION

For the purpose of this study, methods of instruction will refer to ways of supporting and facilitating human learning and development. In this context it can also be referred to as teaching methods, defined by The Greenwood Dictionary of Education (2003:350) as *the exercises, lessons, and materials used to teach. The techniques used to impart knowledge or develop skills; the tools and strategies of instruction.* TekkiKids follows a constructivist approach where emphasis is placed on problem-based learning, learning-by-doing, experiential learning, and self-directed learning.

1.6.3 EXPERIENTIAL LEARNING

According to Warren *et al*. (2008), Moon (2004) and Kolb (1984), experiential learning can be defined as a method of instruction where the teacher has a learner-centred approach. Teaching activities are largely unstructured and an emphasis is placed on the learner's active responsibility for his[3] application of knowledge gained through an experiential learning experience. Therefore, it can be said that the concrete experiences of the learner direct the learning process. These experiences include the learner's judgments, feelings, or skills gained through these concrete learning experiences. Experiential learning furthermore involves a cyclical process that firstly starts with the learner's concrete experiences, followed by abstract conceptualisation. Secondly, abstract conceptualisation involves the internalization process in which a learner's concrete experience builds upon his prior experiences or knowledge. In the third stage the learner's actions and experiences guide him toward observation and reflection in order to have meaningful discoveries. Lastly, active experimenting by the learner leads to a new concrete experience, therefore starting the cycle of learning again.

1.6.4 SCIENCE AND TECHNOLOGY

According to the Hutchinson Dictionary of Science (1993:523), science can be defined as *any systematic field of study or body of knowledge that aims, through experiment,*

[3] The pronoun "he/his/him" also refers to female learners.

observation, and deduction, to produce reliable explanation of phenomena, with reference to the material and physical world.

The Department of Education (2002:4) defines technology as the *use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration.*

Even though these two entities can stand on their own, during this study science and technology will refer to a singular field, one which comprises a combination and culmination of the aforementioned separate definitions.

1.6.5 LEARNERS

In this study, the term learners comprises of male and female, school going children between the ages of 9-12 years old, whom participated in a science and technology club for children (TekkiKids) at the CSIR during 2007

1.6.6 TEKKIKIDS

TekkiKids is an extramural educationally orientated club aimed at promoting the general field of science and technology by exposing grade 6 children to fun-filled technology-related, hands-on activities.

1.7 PARADIGMATIC PERSPECTIVE

During this study the philosophy of interpretivism and constructivism was used. The explanation that follows constitutes my current conviction of reality, the lens through which I view the world, and subsequently the data.

According to the constructivist philosophy, knowledge is viewed as actively constructed by individuals, groups and society, and not as merely transferred (Donald, Lazarus & Lolwana, 2002). Brooks and Brooks (1993) define knowledge as an internal representation of the world that is mediated through temporary, developmental, social and cultural experiences. Constructivists believe that realities are not universal and absolute, and place great emphasis on individual perspectives and constructions of reality (Hatch, 2002). The participants in the TekkiKids programme will have a unique reality and will share unique experiences of this programme.

From within the realm of interpretivism, great emphasis is placed on understanding the experiences and contexts of people by means of interaction. Interpretivist researchers acknowledge and respect people's subjective experiences as their own realities, the one being just as valid and significant as any other (Terre Blanche, Durrheim & Painter, 2006). Interpretivists seek to describe, explain and understand (interpret) social phenomena (De Vos, 2002).

On the matter of how constructivism and interpretivism relate to one another, Schwandt (1998:222) states that:

> *The constructivist or interpretivist believes that, to understand this world of meaning, one must interpret it. The inquirer must elucidate the process of meaning construction and clarify what and how meanings are embodied in the language and actions of social actors. To prepare an interpretation is itself to construct a reading of these meanings; it is to offer the inquirer's construction of the constructions of the actors one studies.*

I shall engage in this study from an educational-psychological perspective, believing that psychological processes and the act of learning (*per se*) are inseparable. Accordingly, this study intends to describe, explain and understand the subjective experiences of the participants with regard to their unique learning experiences of the TekkiKids programme in general; but also with particular reference to their experiences of the teaching method implemented during this programme, the level of enjoyment and motivation of the learners, the expectations of the learners regarding their learning experiences, and, finally, the social context in which these learning experiences were actualised.

1.8 RESEARCH DESIGN AND METHODOLOGY

The proposed study will be conducted by applying a qualitative methodological approach, using a documentary research design.

1.8.1 RESEARCH DESIGN

In this study, a documentary research design was followed. Documents accumulated during the TekkiKids project were analysed.

According to De Vos (2002) and Bailey (1994), documents are generally not written with research in mind. However, if documents are studied and analysed for research purposes,

document study as a research method and means of data collection becomes operative and warranted.

While documents are usually used as an auxiliary source of data, qualitative researchers are increasingly turning to documents as their primary source of data (Bogdan & Biklen, 2003). In accordance with this notion, Mason (2002) posits that documentary analysis is an underestimated method of social research that is gaining popularity within the field of qualitative research. Marshall and Rosman (1999) also advocate documentary analysis, stating that: *the review of documents is an unobtrusive method, rich in portraying the values and beliefs of participants in the setting* (p. 116).

Cohen, Manion and Morrison (2007) also stress the importance of the context in which the documents originated, and include the purpose of the document, the author of the document, the relationship between the researcher and the document, as well as institutional, social and cultural aspects that need to be considered.

Subsequently, the origin and context of the documents that will be used in the research process will be discussed in Chapter 3.

1.8.2 SELECTION OF DOCUMENTS

According to Bailey (1994) most documents are written for purposes other than research. However, Mason (2002) states that the analysis of documentary sources is a major method in social research, and one which many qualitative researchers see as meaningful and appropriate in the context of their research. In accordance with this notion, Marshall and Rossman (1999:116) states that: *minutes of meetings, logs, announcements, formal policy statements, letters, and so on are all useful in developing an understanding of the setting or group studied. Similarly, research journals and samples of free writing about the topic can be quite informative.*

For the purpose of this study the following documents[4] will be selected and analysed:

- A feedback report to the facilitators regarding the sessions;
- General field notes of the consultant pertaining to observations made during sessions;
- Notes of individual unstructured interviews;
- A questionnaire that explored learners' experiences of TekkiKids; and

[4] The nature and origin of the documents will be discussed in Chapter 3.

- Notes of a focus group discussion.

The aforementioned documents came into existence in a process that was aimed at addressing issues relating to the method of instruction. It was written with the purpose of providing structured feedback to the facilitators of the TekkiKids programme, to assist them in enhancing their teaching strategies. The documents were furthermore selected for this research, after I had worked through them and found that clear themes emerged regarding the children's experiences of learning in an experiential learning environment. This provided me with rich sources of data for coming to a better understanding of said experiences.

Babbie and Mouton (2001:100) warn about generalization of findings when using convenience sampling, however, they state that …[convenience sampling] *could provide a springboard for further research or allow links to be forged with existing findings in an area.*

1.8.3 DOCUMENT ANALYSIS

The analysis will be guided by the general guidelines for inductive analysis as set out in McMillan and Schumacher (1993):

- Using analytical notes or memos to engage with the data reflectively.
- Data will be segmented into relevant units, within a holistic perspective.
- Reading the data will initiate interpretation.
- Categorisation of the data according to relevant units will take place.
- Data will be studied for their content, and categories are formed as a result with the goal of identifying similarities and discovering patterns between categories.
- Synthesis of the data will emerge as portraying themes suited to fit into the identified categories.

Responses were listed in a table of meaning, thematically analysed (Mayan, 2001) and grouped into clusters of meaning. In so doing, specific and recurring themes, qualities, issues, characteristics and concerns were identified. The analysis and interpretation of the data will be discussed in more depth in Chapter 3.

1.9 ROLE OF THE RESEARCHER

The primary role of the researcher was that of a document analyst using inductive analysis. Additional to this, the role of the researcher was to integrate and present the results. The researcher also acted as a reporter to the CSIR with regard to the findings of this study.

1.10 CREDIBILITY[5] AND DEPENDABILITY[6]

Patton (2002) argues that credibility depends less on sample size than on the richness of the information gathered and on the analytical abilities of the researcher.

According to De Vos (2002), it is crucial that the researcher evaluates the authenticity, or validity and reliability of documents when conducting document studies. Therefore, the credibility and dependability of this study was causally be linked and subjected to the degree of credibility and dependability of the documents that were used during this study. It was mentioned earlier on that the documents used during this study stemmed from a consultative process in which I was involved. It is important to reiterate and acknowledge the fact that I acted as a consultant ,and, as such, did not explicitly act as a researcher in the formal sense of the word. I was furthermore the author of the documents, although I was reporting the experiences of the learners which they shared with me during the consultative process. Although an element of bias could exist due to my former involvement with the TekkiKids Programme, I can vouch for the credibility of the documents and for the process in which it came into existance.

Due to the importance[7] of the context of the documents, the research that might have led to a particular document, as well as the role of the author of the document, the process of investigation and the documentation thereof are deemed vital and will be discussed in detail in Chapter 3 (Cohen, Manion & Morrison, 2007). I attempted in Chapter 3 to present an in-depth explanation of the manner in which the various documents were analysed, and I shall provide an audit trail that will enable the reader to evaluate the credibility and dependability of the documents used in this study.

With regard to qualitative research, Creswell (2007) identifies eight[8] validation strategies that are frequently used in qualitative research. According to the authors, at least two of the proposed strategies should be engaged with in a qualitative study. This study will be guided by three strategies as identified by the authors:

- Triangulation: During this study, multiple sources of data (documents) were utilised in order to derive preliminary conclusions from common themes by converging the different data sources.

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5 Credibility (a qualitative research term) is comparable with internal validity (a quantitative research term) (Hoepfl, 1997).

6 Reliability (a qualitative research term) is comparable with reliability (a quantitative research term) (Hoepfl, 1997).

7 As explained in section 7.1 “Research design” of this paper.

8 According to the authors, these strategies are in no particular order of importance, and are as follows: Prolonged engagement and persistent observation; triangulation; peer review; negative case analysis; clarifying research bias; member checking; rich, thick descriptions, and external audits.

- Clarifying researcher bias: My prior involvement with the TekkiKids programme was transparently acknowledged and clarified.
- Peer review: The analysis of the documents and the subsequent findings (interpretations) that resulted from this process were monitored and checked by an esteemed peer.

The fact that I was the author of the documents and revisited and analysed the documents with vigour and with a different focus and purpose, can arguably represent two sides of a coin. According to Babbie and Mouton (2002), when a researcher consults with the author of the documents being analysed, it will contribute to the validity and reliability of the study. Thus, in a sense it can be regarded as *member checking* (Creswell, 2007:208). On the other hand, bias will be anticipated and duly dealt with through constant reflection and being vigilant about the particular possibility, and will be challenged by peer review.

1.11 SHORTCOMINGS OF THE RESEARCH DESIGN

Due to the fact that I shall use non-probability sampling (convenience sampling), any generalisation of my findings were attempted with extreme caution, yet only regarded as a *working hypothesis* and not a conclusion (Cronbach, 1975:125). Continuing with this notion, Hoepfl (1997:12-13) is of the opinion that indeed no researcher can specify the *generalizability* of his study but *can only provide sufficient information that can then be used by the reader to determine whether the findings are applicable to the new situation.* Subsequently, I also followed and honoured this notion throughout my study, as the nature of the initiative and the context of the programme was unique.

Also, my prolonged involvement with the TekkiKids programme (as consultant) may open the door to bias at some level, as I supported the cause of the initiative passionately. Even though I constantly reflected upon this matter, and subsequently strived to be as objective as possible, this too needs to be acknowledged.

Another limitation of this study pertains to the fact that the results of the document analysis could not be discussed with the grade 6 TekkiKids-learners. It should be noted, however, that while the documents were initially being compiled, observations and notes were discussed with the learners, that can therefore be regarded as a form of member checking.

1.12 STRENGTHS OF THE RESEARCH DESIGN

The strengths of this research design can be summarised as follows (Cohen, Manion & Morrison 2007; Bowling, 1997; Bailey, 1994):

- Accessibility to inaccessible subjects.
- Little or no reactivity with the investigator.
- Particularly useful in longitudinal analysis.
- Spontaneity: documents such as journals and observational notes often include spontaneously recorded actions or feelings.
- Confessions: a person may be more willing to share personal information in a document, as opposed to face-to-face interaction.
- Convenience: Documents may be easily accessible in archives.
- Low cost: Large samples can be addressed with minimal cost and time involved.

It should be noted that an important strength of this document study lies in the quality of the written documents, as they were written by the researcher himself, being a psychology student in the field of educational psychology. This is in accordance with the strengths as listed by Cohen *et al*. (2007).

1.13 ETHICAL CONSIDERATIONS

Due to the fact that the data that I obtained during this study are the intellectual property of the CSIR, I first and foremost obtained permission from the CSIR to use the data in my dissertation and in an article to be published at a later stage. I also obtained permission from the Faculty of Education's Research and Ethics Committee of the University of Pretoria. I consulted with the relevant role players from the CSIR before I finally submitted this dissertation and the article that will be published in this regard. The CSIR obtained the necessary permission from the participants prior to their involvement in the TekkiKids Programme and informed consent was obtained to publish the research findings obtained from the CSIR project. Documents confirming the informed consent were obtained from the participants and from the CSIR, and submitted to the Ethics Committee of UP.

As a researcher I also adhered to the principles set forth by the University of Pretoria's Faculty of Education, Research and Ethics Committee (2005). Accordingly I furthermore adhered to the following ethical guidelines in my writing up of the data:

- The researcher at all times considered ethical implications and potential psychological consequences for the involved participants.

- The confidentiality and anonymity of the participants, the facilitators as well as participating schools were protected and respected at all times.

1.14 OUTLINE OF THIS RESEARCH STUDY

Chapter 1 dealt with the outline of this research project in terms of a summary regarding the rationale of this study. It presented the reader with the research questions, the preliminary literature study, a definition of concepts, and the research design and methodology.

Chapter 2 will provide an overview of the literature study pertaining to the importance of children's curiosity in the development of an interest in the science and technology field. Furthermore, experiential learning as method of instruction, based on the constructivist movement, was discussed. The latter part of Chapter 2 was a discussion on the nature of experiential learning as the preferred method of instruction in science and technology programmes. An overview of the TekkiKids Programme was also provided in this chapter.

Chapter 3 will present the reader with an explanation of the planning and execution of the empirical part of this research study. An overview of the constructivist and interpretivist paradigm will be presented, as well as regarding documentary research as research design. Issues regarding validity and dependability, limitations, contributions and ethical considerations will be discussed.

Chapter 4 presents a detailed discussion of the results from an inductive analysis of the data that were used in table format during this study.

Chapter 5 reports on the findings of the research study against the backdrop of the literature study as presented in Chapter 2. The latter part of the chapter will address the research questions as set out in Chapter 1, as well as limitations, contributions and recommendations pertaining to research and practice.

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CHAPTER 2
LITERATURE STUDY AND THEORETICAL FRAMEWORK: METHODS OF INSTRUCTION AND EXPERIANTIAL TRAINING

2.1 INTRODUCTION

In this chapter I attempt to introduce the reader to the importance of children's curiosity in engaging their interest in science and technology. It is my conviction that the method of instruction plays a crucial role in arousing and maintaining children's curiosity. The most effective method of instruction according to the literature, will be discussed. Emphasis will be placed on the constructivist movement which provides the theoretical basis of experiential teaching methods. Finally, a discussion on the nature of experiential learning, as the preferred method of instruction for science and technology, will be presented, and the reader will be introduced to the TekkiKids Programme.

2.2 HOW CHILDREN LEARN TECHNOLOGY

One just need to take a trip down memory lane to remember one's early childhood as a life stage filled with exciting, fascinating and some times frustrating questions: What is that thing? How does it work? Where did it come from? How do I solve this problem?

Children are naturally curious about their environment – observing and openly seeking to understand what they see. This innate curiosity is the force that may drive a person to seek an explanation of a particular phenomenon and is therefore the point of departure for initiating and creating learning experiences in science and technology (Esler & Esler, 2001).

According to Carin *et al.* (2005), the way in which teachers view science and technology, as well as the learning thereof, informs the way in which they respond to children's questions – in other words their teaching approaches. Their teaching approaches determine how they build on, and nurture children's inborn curiosity. In this regard, Rowe (1996:164) believes that teachers who view science *as finding the right answer* tend to focus on providing factual answers to children. Teachers with this view further make use of direct instruction, and a reading approach to teaching science.

These traditional top-down patterns of teacher-focused instruction were criticised by Hameyer, Van den Akker, Anderson, and Ekholm (1995) as inhibiting active learning. They found that science and technology projects implemented in Germany, the Netherlands and

the United States of America that used activity-based learning, were highly effective in the development of children's interest in the science and technology field. Furthermore, teacher-focused instruction also discourages student involvement, leading to an undesirable orientation towards learning, due to negative experiences and attitudes towards science and technology (Goodland, 1984 & Carin *et al*., 2005). It is therefore important that

> *…teachers view science as inquiry and children as constructive learners, they will want to teach science in a way that engages students in the active construction of ideas and explanations and enhances their abilities to inquire* (Carin *et al*., 2005, p.5).

In accordance with the findings of Hameyer *et al*. (1995), Mathews (2002) states that constructivism has undoubtedly had a major theoretical influence on contemporary science and mathematical education. Few will argue with Fensham's (1992:801) claim that: *the most conspicuous psychological influence on curriculum thinking in science since 1980 has been the constructivist view of learning*.

In order to situate the constructivist view of learning as the preferable approach to learning in the science and technology field, a brief overview of the difference between the constructivist view and traditional, teacher-focused instruction is presented in Table 2.1.

Table 2.1: The differences between Constructivist and Traditional Learning (Potgieter, 2001:16)

Item	Constructivist Learning	Traditional Learning
The acquisition of knowledge	Knowledge is: • Constructed • Emergent • Situated in action or experience • Distributed	Knowledge is: • Transmitted • External to knower • Objective • Stable • Fixed • Decontextualised
Reality	Product of mind	External to the knower
Meaning	Reflects perceptions and understanding of experiences	Reflects the external world
Symbols	Tools for constructing reality	Represents the world
Learning	Knowledge construction is: • Interpreting the world • Constructing meaning • Ill-structured • Authentic-experiential	Knowledge transmission is: • Reflecting what teacher knows • Well-structured • Abstract-symbolic • Encoding-retention-retrieval

	• Articulation-reflection • Process-orientated	• Product-orientated
Instruction	Instruction relates to: • Reflecting multiple perspectives • Increasing complexity • Diversity • Bottom-up • Inductive • Apprenticeship • Modelling • Coaching • Exploration • Learner-generated	Instruction relates to: • Simplify knowledge • Abstract rules • Basic first • Top-down • Deductive • Application of symbols (rules, principles) • Lecturing • Tutoring • Instructor-derived and -controlled • Individual • Competitive

Major differences between the above-mentioned approaches to learning exist regarding the acquisition of knowledge, reality, meaning, symbols, learning and methods of instruction. A brief discussion of the constructivist view of learning will be presented next, in order to orientate the reader regarding the nature of teaching in the science and technology field.

2.3 THE CONSTRUCTIVIST MOVEMENT

According to Victor and Kellough (2000), learning theorists such as Piaget, Vygotsky, Gagné, Bruner and Ausubel have played major roles in today's theories of effective instruction, with their roots firmly grounded in constructivist theory. Both Piaget and Vygotsky emphasise that change in cognition takes place only when previous conceptions undergo a process of dissonance in the presence of new information.

Constructivist theory is based on the belief that knowledge is constructed by meaning-making processes, and emphasis is placed on the learner as an active, self-conscious being seeking meaning in his experiences by using cognitive processes (Jansen, 2003; Schurink, 1998). These cognitive processes actualise when previous experiences interact with new experiences. Knowledge that develops as a result of these processes is therefore due to new experiences being internalised by the learner (Von Glasersfeld, 1996). This is in accordance with Brooks and Brooks (1993), who define knowledge as an internal representation of the world, mediated through experiences on a temporary, developmental, social, and cultural level.

According to Wertsch (1997), constructivist teaching methods acknowledge the learner as a unique individual whose background and culture play important roles in his construction of reality. Von Glaserfeld (1996) states that the responsibility of learning lies heavily on the learner's shoulders, due to the fact that motivation to learn is dependent on the ability to take responsibility. Teachers are regarded as facilitators rather than instructors/teachers (Bauersfeld, 1995). Learning is based on active, social processes that are highly dependent on collaboration among learners to discover knowledge together (Vygotsky, 1978). According to Wertsch (1997), these methods, based on constructivism, emphasise the interaction between task, learner and facilitator. Dynamic assessment is used to develop the learner's true potential by acting as an interactive method between the learner and the learning process (Holt & Willard-Holt, 2000). In addition to dynamic assessment, learning materials used by constructivist teaching methods attempt to engage and challenge the learner (Wertsch, 1997).

In addition to the constructivist methods of instruction, other commonly followed methods of instruction are described by various authors as teaching methods utilised in the science and technology fields. These different methods of instruction will be described in the next section.

2.4 METHODS OF INSTRUCTION

For the purpose of this study, *methods of instruction* will refer to the different ways and approaches that support and facilitate human learning and development. Methods of instruction can also be referred to as *teaching methods*, defined by the Greenwood Dictionary of Education (2003:350) as *The exercises, lessons, and materials used to teach. The techniques used to impart knowledge or develop skills; the tools and strategies of instruction.*

It is important to note that methods of instruction can also be defined as teaching methods and learning activities (exercises, lessons and materials used).

According to Treagust (2007), instructional methods and strategies used in science classes have been influenced by four considerations over the last two decades. Firstly, learners intentionally construct their own knowledge, using their existing knowledge, and therefore viewing the world in ways that are coherent and useful to them. Secondly, few researchers comment on the content of the science and technology curriculum. Rather, researchers focus on recommendations for improving the teaching and learning of the science and technology curriculum (Treagust, 2007).

Thirdly, Treagust (2007) describes researchers' promise that teaching strategies and approaches aimed at enhancing student meta-cognition may lead to corresponding improvements in the conceptual understanding of curricula. The fourth consideration is the realisation that a wealth of knowledge already exists on the subject of successful methods of instruction. Many teachers have used a variety of methods while experimenting, implementing, and evaluating these methods (Treagust, 2007). It is obvious then that educators should arm themselves with a variety of teaching strategies as part of their instructional repertoire in order to optimize the actualisation of learning and to develop an interest in the science and technology field.

This leads to the question: Which method of instruction is viewed as most effective for teaching science and technology? Bransford, Brown and Cocking (2000:22) remind us that, by asking which technique is best for teaching, is asking the wrong question: …*are some teaching techniques better than others? Is lecturing a poor way to teach, is cooperative learning effective?*

The following section will give a brief overview of the various methods of instruction that can be used to teach science and technology.

Zaidi (2004) identifies fourteen commonly used methods of teaching elementary science and technology:

1) The Lecture Method (also known as The Talk-and-Chalk Method)

This is a teacher-centred method, with learners as passive listeners most of the time. Very few questions are allowed during the lesson, though some teachers give learners some time to ask questions at the end of a lesson. Teachers talk most of the time without using any teaching aids, though some of them use a blackboard.

2) The Demonstration Method

This method differs from the Lecture Method in the sense that teachers in addition show and illustrate certain phenomena and applications of abstract principles through demonstrations of experiments, providing concrete experiences to learners. Teachers utilize a greater array of teaching aids such as films, slides, overhead projectors, etcetera. Learners are more involved in the lesson than is the case in the Lecture Method, yet it is still considered to be teacher-centred.

3) The Lecture-cum-Demonstration Method

In this method, demonstrations are combined with well-directed lectures. Lectures are based upon concrete experiences of the students' environment, and a demonstration focuses them on scientific phenomena. Discussions between teachers and learners are encouraged, and take place in a permissive atmosphere.

4) The Project Method (also known as The Problem-Solving Method)

This involves investigation, discovery and finding out something that is not known to the student. Students decide what experiments are necessary and how they will be carried out. Learners have to search for appropriate principles, laws and formulae, apparatus and data; and originate solutions to a specific problem. Learners may have to design their own apparatus, if not available in the classroom. Learners act as scientists, following the steps of scientific method, namely:

i. Problem
ii. Hypothesis
iii. Testing of hypothesis by experiments
iv. Collection of data
v. Interpretation of data
vi. Conclusion

5) The Conceptual Method

Sensory-motor experiences are used, as it is believed that senses shape and influence perceptions. This process continues with awareness of a total situation, breaking the situation down into separate parts, and then reconstructing these separate parts back into a clear pattern. Scientific theory and learning of scientific facts are stressed. Learning depends on the learners' own experiences.

6) The Process Method

Emphasis is placed on the processes involved in science. These processes include observation, hypotheses, testing (experimenting), collecting data and reaching conclusions. It is believed that when learners are confronted with a problem and presented with an opportunity to explore, they will discover a need for certain processes. The processes involve different actions, which are linked to arrive at logical conclusions at a later stage.

7) The Integrated Method

This method embraces both the Concept Approach as well as the Process Method, as it is believed that science constitutes both concepts and processes. A lesson about temperature therefore will entail teaching the concept of temperature as well as how to measure it (the process).

8) The Child-Centred Method

This method accentuates the involvement and participation of learners. Learners are regarded as active agents in creating their own learning experiences and meaning-making. Strong emphasis is placed on creating an environment for learners that is realistic, relevant, and meaningful to them.

9) Problem-solving Method

Following this approach, it is believed that children are by nature inquisitive and have the tendency to explore. Learners are therefore encouraged to pose certain questions (problems) to the teacher themselves. In turn, the teacher does not give the solution to the problem but guides the learners in finding the solutions themselves by means of self-study, experiments and discussions.

10) The Environmental Studies Method

It is believed that using materials (our own bodies, food items, gasses, etcetera), and phenomena (fog, rain, thunder, etcetera.) found in the local (familiar) environment of learners will result in a rich learning situation and promote joyful learning experiences. Environmental studies as a teaching method may be integrated with any method of instruction in the science and technology field.

11) The Activity Approach

This method focuses on building upon learners' recent prior activities. Learners are exposed to contextually relevant activities in order to relate to the activities at hand. Learners thus experience these activities by actively using all or most of their senses.

12) The Scientific Method

This method is also known as the Discovery Method. Learners are involved in finding out (discovering) the solutions of problems instead of merely verifying known facts. According to the Scientific Method, learners follow the steps of 1) problem, 2) hypotheses, 3) experiment and 4) conclusion. This method is a child-centred method.

13) The Teacher-Centred Method

This method is effective for teaching skills (processes). It is believed that until a child has perfected a skill, the teacher plays a crucial part in informing the learner what to do and how to do it. However, teacher-learner interaction is almost non-existent in practice.

14) The Inquiry Approach

According to this approach, learners focus on questions about the natural world, collect data through their own investigation activities, and with the teacher's assistance use their data as evidence to answer their questions. Thus, learners not only construct science knowledge, but also learn how to investigate and solve problems.

As is the case with teaching in general, methods of instruction pertaining to the science and technology field come in many forms. Treagust (2007) notes that any attempt to keep up with the vast array of methods of instruction pertaining to the science and technology field (as described above), or even the different names by which they are known, is quite a confusing and daunting task. It is therefore deemed necessary to organise the multiplicity of instructional methods in terms of the degree of control that teachers have regarding the learning process of the learner. Methods of instruction could therefore be viewed on a continuum[9] that distinguishes between the degree of teacher-centeredness (traditional approach) and learner-centeredness (constructivist approach) (Treagust, 2007).

In Table 2.2 (on the next page) I present the different methods of instruction on the aforementioned continuum:

[9] This continuum presents **teacher-centredness** on the one side of the continuum, and **learner-centredness** on the other.

Table 2.2: Different Methods of Instruction in the Science and Technology fields (Appleton, 2006; Treagust, 2007 & Zaidi, 2004)

Traditional Approach				**Constructivist Approach**						
				Scientific Method			Environmental Method		Combination: Scientific and Environmental Method	
Teacher-centred method	Lecture method	Lecture and Demonstration method	Demonstration method	Project method	Process method	Problem-solving method	Activity method	Environmental method	Conceptual method	Integrated method
				EXPERIENTIAL LEARNING						

According to the literature studied, the term experiential learning/constructivist learning can be applied as an umbrella term for the above-mentioned methods which form part of the constructivist approach (Kirschner, Sweller & Clark, 2006). When looking at contemporary literature on science and technology, it is evident that constructivism plays a fundamental role in current methods of instruction in the science and technology field; both practised and proposed (Bennett, 2003; Driver *et al*., 1994; Tobin, 1993 & White, 1988). Different methods of instruction, based on the theory of constructivism, are described by Kirschner, Sweller and Clark (2006:75) as bearing different names, but meaning the same thing:

> *The minimally guided approach* [*child-centredness*] *has been called by various names, including discovery learning; problem-based learning, inquiry learning, experiential learning, and constructivist learning.*

These constructivist methods in the science and technology field are essentially pedagogically equivalent to each other (Kirschner *et al*., 2006). For the purposes of this research study, the umbrella term experiential learning will be used to refer to the constructivist methods of instruction[10] that the TekkiKids Programme used. In this regard, De Villiers (2002:197) notes that:

> *Constructivism incorporates aspects and strategies that co-exists with other approaches; in particular it is in harmony with cognitive learning…[and is] founded on the tenet of personal experiential learning*.

[10] TekkiKids followed a constructivist approach, where emphasis was placed on problem-based learning, learning by doing, and self-directed learning as methods of instruction.

A discussion on experiential learning and its effects on learners will therefore be presented next.

2.5 EXPERIENTIAL LEARNING THEORY

In this section, experiential learning as a method of instruction based on the constructivist approach will be discussed. The latter part of this section will be devoted to explaining the effects of this method of instruction on learners.

According to The Theory into Practice Database (2008, Retrieved from http://tip.psychology.org/rogers.html), experiential learning is equivalent to personal change and growth. The aforementioned database summarises Rogers' view on human nature and learning as follows:

> *Rogers feels that all human beings have a natural propensity to learn; the role of the teacher is to facilitate such learning. This includes: (1) setting a positive climate for learning, (2) clarifying the purposes of the learner(s), (3) organizing and making available learning resources, (4) balancing intellectual and emotional components of learning, and (5) sharing feelings and thoughts with learners, but not dominating.*

According to Smith (2004), the value of Rogers' view lies in the fact that it accentuates the importance of the learner-teacher relationship in the facilitation of learning. In accordance with this notion, the Theory into Practice Database (2008) also states that learning is facilitated when (1) the student actively takes part in controlling the nature and direction of the learning process, (2) it is based on the direct confrontation of problems of a practical, social, personal or research nature, and (3) when self-evaluation is used as an assessment method to measure progress or success. In the process of facilitating learning, the importance of learning how to learn, and an openness to change, is emphasised.

Learners are therefore regarded as active participants in experiential learning. Crucial to this learning process, students have to take responsibility for their learning as they themselves ultimately hold the key to their learning experiences (Slavin, 2000). In this respect, teachers should regard themselves as facilitators rather than teachers, aiding and guiding learners to actualise their learning potential. This minimises the role of the facilitator in experiential learning. Experiential learning therefore can be described as learner-centred, and not teacher-centred.

Furthermore, the notion that people process experiences, in particular their critical reflection of experiences, originated in the 1980's and can be traced back to Mezirow, Freire and others, who viewed learning as a cycle (Rogers, 1996). This cyclic process starts with experience, continues with reflection and later leads to action, which in part becomes a concrete experience for reflection. This cycle of learning will be dealt with later in this section.

According to Kolb and Boyatzis (2000), experiential learning provides a holistic model of learning and emphasises the central role that experience plays in the learning process. This differentiates experiential learning from cognitive learning theories and behavioural learning theories, as these learning theories deny any role for subjective experience in the learning process. Kolb (1984) pays homage to Dewy, Lewin and Piaget, as he states that experiential learning is a holistic integrative perspective on learning that combines experience, perception, cognition and behaviour with its intellectual origins in the experiential models of learning of Dewy, Lewin and Piaget.

In summarising the characteristics of experiential learning, Kolb (1984) places emphasis on the process of adaptation and learning, instead of content and outcomes. He furthermore views knowledge as a transformation process in which the creation and recreation of learning experiences exist in both its objective and subjective forms. Kolb finally emphasises the importance of understanding knowledge, as this will contribute to the understanding of the learner in this process. In accordance with Kolb, Warren *et al*. (2008) name learner-empowerment as an essential characteristic of the experiential learning process, as this will support the learner in developing responsibility towards his/her own learning process.

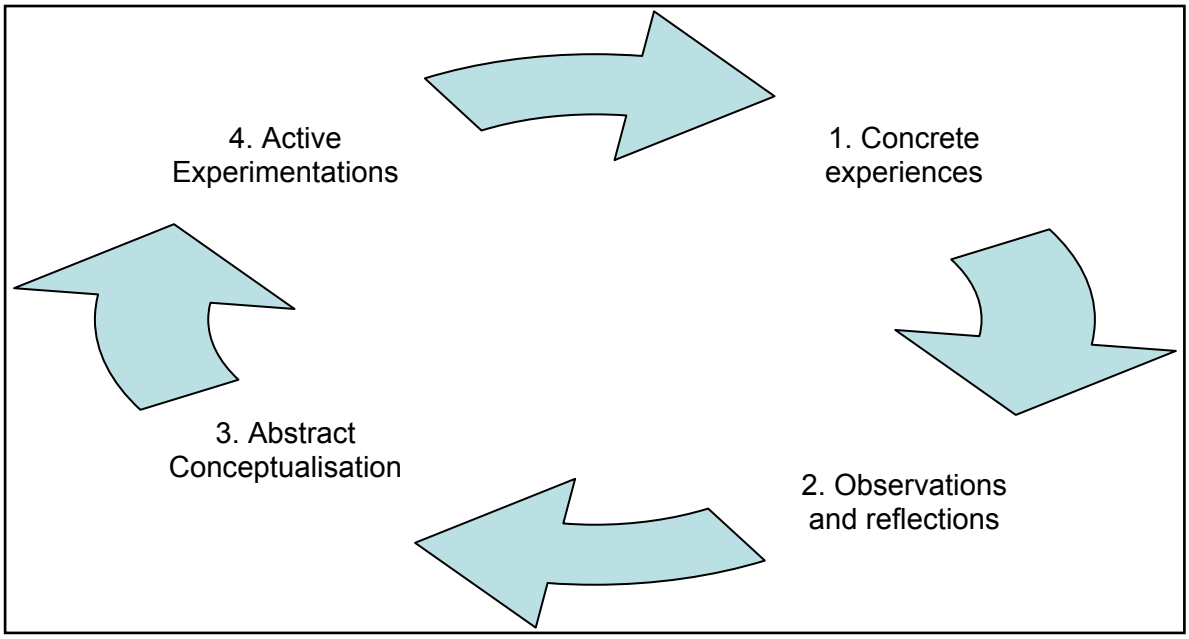
Finally, Moon's (2004) comment on the diversity of definitions regarding experiential learning as having different flavours, confirms the difficulty researchers face in defining experiential learning. According to Moon (2004), most definitions of experiential learning comprised of the following four aspects:

- In contrast with traditional learning methods, experiential learning is mostly unstructured in the sense that the learner is actively responsible for the application of knowledge gained from the teaching, and not the teacher. Emphasis is therefore placed on the concrete experiences of the learner in directing the learning process. These experiences include the learner's judgements, feelings or skills gained by the concrete learning experiences.

- By restructuring his perceptions of what is happening (experiences), the learner's experiences build upon his past experiences or knowledge by the process of internalisation and abstract conceptualisation.
- Meaningful-discovery is rooted in the learner's actions and his experiences; it centres around gaining insight by using observation and reflection of his actions and experiences.
- Experiential learning as a teaching method is concerned with the learner's application of the knowledge gained, leading to active experimenting by the learner. This in turn may lead to a new concrete experience – placing the learner and teacher in the position of setting the stage for more learning to be actualised.

The above summary regarding experiential learning serves as an explanation of the following figure. Figure 4.1 shows how these four aspects of experiential learning can be viewed as four stages pertaining to the cyclical nature of the experiential learning process.

Figure 4.1: The Cycle of Experiential learning (Dennison & Kirk, 1990)



2.5.1 EXPERIENCES OF LEARNERS BEING INSTRUCTED THROUGH EXPERIENTIAL LEARNING

This section will discuss the manner in which different taxonomies of various learning activities (methods of instruction) influence the learning experiences of learners. In order to fully understand the learners' experiences, one should first look at the different taxonomies as identified in relevant literature.

Vermunt and Verloop (1999, p.261-263) categorise several taxonomies of learning into three modes of processing, such as: cognitive, affective and meta-cognitve (regulative) processing. Firstly, cognitive processing refers to the way that a learner processes subject matter that would lead directly to a change in the learner's knowledge base. Secondly, affective processing refers to the learner's employment of different coping strategies in order to deal with emotional responses during learning. The learner's emotional responses may lead to a mood that may either be conducive to the learning process, or have a detrimental effect on the learning process. Finally, meta-cognitive regulation refers to the way in which cognitive processes are employed by the learner in order to decide on his learning content. Meta-cognitive regulation also refers to the learner exercising control over his processing of the learning content, and the affective strategies he/she uses to steer the course and outcomes of learning. The following table (Table 2.3) illustrates the three categories of taxonomy as described by Vermunt and Verloop (1999).

Table 2.3: A categorization of different taxonomies pertaining to experiential learning activities (Vermunt & Verloop, 1999)

Cognitive	Affective	Regulative
Relating/ structuring Analyzing Concretizing/ applying Memorizing/ rehearsing Critical processing Selecting	Motivation/ expecting Concentrating/ exerting effort Attributing/ judging oneself Appraising Dealing with emotions	Orientating/ planning Monitoring/ testing/ diagnosing Adjusting Evaluating/ reflecting

The attitude and interest of a learner in the science and technology field is predominantly based on affective processing (Schunk, 1991), and therefore a discussion of the effects of a learners affective processing during experiential learning will be presented next.

2.5.1.1 The Effects of Affective Processing in an Experiential Learning Environment

Different aspects of affective processing during experiential learning can be grouped according to the effects they have on motivation, concentration, attribution/judging (oneself in this process), appraisal and coping strategies pertaining to emotions.

Vermunt and Verloop (1999) and Dorman, Fisher and Waldrip (2006) found that when it comes to motivation, experiential learning evokes and maintains a willingness to learn within a learner. This willingness to learn is based on the formation of expectations about

the learning experience and the outcomes thereof. Expectations of failure may influence a learner to experience learning activities as too difficult and learning goals as unattainable. In contrast with this, expectations of success may influence a learner to experience learning activities as easy, and goals as easily attainable. Motivation finds expression in: self-rewards, fearing negative consequences, or having a natural interest in the learning activities. This may influence a learner to find a subject either interesting or uninteresting (Hidi, 1990). According to Schunk (1991), the relationship between academic efficacy and both motivation and effort is mutually dependent. When motivated, learners' attitude towards progress in acquiring skills and gaining knowledge improves. Thus, experiencing success generates success, provided that the task at hand is sufficiently difficult. This leads to the manner in which a learner appraises the learning experience.

In addition to motivation, the way in which learners appraise the relevancy of the learning activity, and the time and mental effort needed to perform the learning activities, depends on their willingness to take responsibility for their own learning process (Vermunt & Verloop, 1999).

Furthermore, Vermunt and Verloop (1999) also find that concentration may be negatively or positively affected by experiential learning activities, depending on the level of mental energy, relevancy of the activity, learning materials and relevancy of thoughts and emotions. This means that a learner who eliminates his desire to do other things, increases the intensity of attention. A persistently strenuous task execution will be maintained, should the learner choose to focus his attention on the task (Reynolds & Shirey, 1988).

Vermunt and Verloop (1999) further state that experiential learning has an effect on the way in which a learner judges himself as a learner, his/her capacity for learning, and his/her subjective perception of his competency level. This is in accordance with Zimmerman and Bandura (1994), who found that a learner's judgement with regard to his capacity to take responsibility for his own learning process, may influence his self-concept. Experiences of success or failure may contribute to either a negative or a positive self-concept (Weiner, 1994). Vermunt and Verloop (1999) are of the opinion that learners may ascribe failing a learning activity to either a lack of effort, or a lack of ability. Similarly, success experiences may be attributed to the quality of instruction, chance, or the required learning activity. These authors do not however mention the attribution of success due to superior intellectual capabilities.

Dealing with emotions pertains to the evoking, maintenance and restoring of positive feelings, as well as to coping with negative feelings such as anxiety, stress, fear, anger,

etcetera (Snow, Corno & Jackson, 1996). Positive self-talk regarding one's feelings towards the learning activities plays an important role.

In addition to the findings of Vermunt and Verloop, Dorman, Fisher and Waldrip (2006:7) found that the learning environment, with the emphasis on the teacher-learner relationship, has a profound effect on the attitude of learners regarding their learning processes:

> *Successful implementation of teaching strategies to teach science is likely to result in the establishment and maintenance of positive student attitudes to science and consequently, achievement.*

In accordance with the findings of Dorman *et al*., Fraser (1998) find a positive correlation between the classroom environment and a learner's attitudinal outcomes, especially his/her attitude towards science. Although experiential learning is learner-centred, Dorman *et al*. (2006) find evidence that learners express a need to have teachers who provide support, demonstrate equity in the classroom, ensure that students complete learning activities, and engender learner cohesion in science classrooms. This may enhance a learner's academic efficacy regarding science as well as his attitude toward science.

2.5.1.2 Strengths and Weaknesses of Experiential Learning

One of the weaknesses pointed out by Wilson (1995) relates to the high level of uncertainty accompanying experiential learning experiences, which may appear chaotic to the learners themselves, possibly leading to learners experiencing negative emotions. Furthermore, a lack of direction from teachers may lead to a lessened coverage of subject matter, as well as a lack of demonstration of specific skill mastery (Wilson, Teslow & Osman-Jouchoux,1995).

Mergel (1998) is however of the opinion that the possible strengths of experiential learning activities enable the learners to practise the interpretation of multiple realities, equipping them to deal with real life situations. In addition to this, Wilson *et al.* (1995) found that learners will experience meaningful participation regarding the learning process. Good independent problem-solving capabilities may contribute to a learner experiencing success. This may lead to a higher level of motivation as well as adding to a learner's social experiences.

2.6 THE TEKKIKIDS PROGRAMME

2.6.1 GENERAL BACKGROUND

The University of Joensuu (UoJ) started an extra-mural technology club, called Kids' Club, for children, based on the epistemological beliefs of constructivism, and preliminary reports suggests that the approach followed indeed seems to be a good fit (Eronen *et al*., 2002). Subsequently, this project inspired the CSIR, and, in conjunction with the University of Joensuu and the University of Pretoria, TekkiKids was born.

TekkiKids is an extra-mural technology club for children aged 9-12 years, and aims to promote the field of science and technology, by facilitating the necessary interest and involvement of young learners. TekkiKids is part of The Young Engineers of South Africa (YESA), an initiative of the CSIR.

TekkiKids is based on a similar project (Kids' club) in Finland, and the methodology is mainly being replicated in South Africa and adapted to local conditions. Learners from well-resourced and less well-resourced schools were selected and exposed to science and technology via challenges and other activities. The research project is sponsored by the Department of Science and Technology and the Finnish Embassy (Marais, Smith & Duveskog, 2007).

2.6.2 OBJECTIVES

According to Marais, Smith and Duveskog (2007:2), the broad developmental objectives that are supported by the project are:

- To provide all young learners, especially those in disadvantaged areas, with the opportunity to engage in technology in a hands-on fashion;
- To improve the performance of all these learners, both at a school level and at a tertiary level, in the fields of science, engineering and technology, i.e., to increase the number of science, engineering and technology graduates and postgraduates, and thus the national competitiveness of the country;
- To provide researchers with an open, living laboratory, where research results can be tested, or, more interestingly, innovations can be discovered in collaboration with the learners;
- To create a system of technological innovation within which learners are empowered and exposed to a problem-solving approach, while capitalizing on the power of group work;

- To expose these learners to different environments and contexts – specifically with regard to other countries and cultures; and
- To support a national network of innovation and learning, for learners to share in the power of collaboration.

The objectives of the project were:

- To implement and adapt the Kids' Club model in South Africa as a means to get learners interested in science, engineering and technology, in a developing country context;
- To foster collaboration between researchers and participants in Finland and South Africa;
- To investigate how to implement a technology club, so as to stimulate and encourage interest and innovation;
- To investigate gender issues;
- To investigate how technology clubs can assist in bridging digital and cultural divides;
- To investigate ways in which teaching methodologies can be packaged and aligned with the national curriculum, so that relevant findings can either be integrated into schools, or made available via clubs as an extra-curricular school activity (on a national scale);
- To test and develop the technology club model in well-resourced and under-resourced schools, in order to gain experience for massification;
- To function as a test bed/living laboratory for our own educational technology development, focussing on appropriate, viable and affordable technologies for massification; and
- To investigate potential massification and sustainability models for the clubs in a developmental context.

Since this project is a pilot study, many challenges arose and resulted in the aforementioned goals being prioritised. The key role players in the programme are of the opinion that, even though the project will still be guided by these goals, *ironing out some wrinkles with regard to some practical issues* will have to take precedence of long term goals, in order to realise them (M. Marais, personal communication, May 15, 2009).

2.6.3 SELECTION OF PARTICIPANTS

The selection of participants varied. Presentations were made to learners at two of the five schools, after which the learners could indicate their interest to a designated teacher. With

regard to the other schools, teachers provided candidates for the programme, based on set criteria of the CSIR, being: 1) groups should be gender-neutral, 2) a commitment by the parents to a two-to-three year participation on a regular basis (two hours every fortnight during the school term, 3) interest in science and technology, and 4) performance levels at school (both poor and good performers were required)

A profiling questionnaire was also administered to the prospective participants, in order to obtain information about their interests, academic performances and exposure to Information and Communication Technology.

2.6.4 METHOD OF INSTRUCTION

Based on and inspired by the Kids' Club project in Finland, the CSIR consulted a number of specialists in the field of education in order to develop lesson plans with specific learning activities. This was done in accordance with the Revised National Curriculum Statement (RNCS) for grades R to 9. Similar to the Kids Club project, TekkiKids follows a constructivist approach where emphasis is placed on problem-based learning, learning-by-doing, experiential learning and self-directed learning.

Technical tutors were available to provide assistance, but the main objective was *to facilitate a shift from being passive consumers of technology to being designers and developers of technology* (Marais, Smith, & Duveskog, 2007, p.4). In order to stimulate innovation and problem-solving skills, learners were exposed to science and technology via challenges and other activities. These activities ranged from building and designing simple structures to the programming of robots that competed against one another.

In each of the terms the focus was:

Term 1:

- Introduction to Lego Mindstorms: The basic mechanical components (beams, plates, gears, pulleys, etc.) and the engines. The construction of simple machines from plans.
- Basic computer skills: using a mouse, keyboard, opening and closing files. Doing a basic presentation using photos.

Term 2:

- Introducing challenges where they have to design their own simple machines (e.g. a catapult).
- Introducing the use of non-Lego materials such as cardboard, wire and wood.

Term 3:

- Introduction to the concept of programming, using technology developed at the Meraka Institute.
- Introduction to the Lego programming environment.
- Building programmable robots to plan.
- Programming the robots.

Term 4:

- Engage in and complete the entire design cycle (design, make, evaluate, communicate) using the Fab Lab at the Innovation Hub in Pretoria, to manufacture their designs in cardboard and acrylic materials.

Based on the information set forth in this chapter, one can most certainly argue that the theoretical foundation on which the Kids' Club and TekkiKids programmes are based is in accordance with contemporary literature on science and technology. In Chapter 4 I intend to explore and describe the participants' experiences of the TekkiKids programme, in so doing exploring possible discrepancies between theory and practice.

2.7 CONCLUDING REMARKS

This chapter set out to orientate the reader towards understanding how the development of learners' curiosity plays an important role in the science and technology field. Curiosity furthermore plays a crucial role in the development of an interest in the science and technology field. A rationale for using a constructivist approach pertaining to the science and technology field was given. Furthermore the constructivist approach was discussed by indicating the main differences between a constructivist (learner-centred) and a traditional (teacher-centred) approach to learning. The use of the term experiential learning as an umbrella concept for constructivist methods of instruction was explained. In addition to a discussion of the nature of experiential learning, the experiential learning cycle was described. The latter part of this chapter focused on the impact of experiential learning on a learner's learning processes.

As this research study sets out to understand and explore the learning experiences of science and technology learners, the next chapter will focus on the research methodology pertaining to this research study. The research questions will be presented, as well as the most suitable research approach for answering these questions.

CHAPTER 3
INTRODUCTION AND ORIENTATION

3.1 INTRODUCTION

In this chapter I explain the manner in which I planned and conducted the empirical part of this study. This chapter commences with a description and justification of the paradigmatic perspective, the underlying methodological approach, and documentary analysis as research design. Particular attention is given to the origin and context of the documents that were analysed, as well as the process of facilitation that led to the existence of the documents, since this is a very important aspect of documentary research. The selection of documents as well as document analysis and interpretation are outlined within the framework of this study. I conclude this chapter by addressing the credibility and dependability of the findings of this study, possible limitations, possible contributions, as well as ethical considerations adhered to during this research process.

3.2 PARADIGMATIC PERSPECTIVE: CONSTRUCTIVISM AND INTERPRETIVISM

In research, the methodology of a study should be viewed within the paradigmatic perspective from which the study was approached. In this context the concept *paradigm* refers to the broad theoretical orientation to which a particular study belongs. Various paradigms exist that underlie research, each with its own unique epistemology, ontology and methodology (Guba & Lincoln, 2000; Terre Blanche & Durrheim, 1999). According to Addams, Collair, Oswald & Perold (2004), epistemology refers to belief about the nature of knowledge, ontology is regarded as the view about the nature of reality, whilst methodology refers to the method(s) used during the process of obtaining knowledge within a certain paradigm.

In this study the researcher attempted to identify and describe the experiences of grade 6 learners of the TekkiKids Programme as they had been documented. Each learner's reality was nonetheless regarded as unique and multiple, as reflected in the documents. It should also be noted that I documented these realities and experiences as they were communicated to me by the learners during the facilitation process. Knowledge was viewed as context-dependent, due to the subjective realities of learners. Immersing myself in the context of the learners as it emerged from the documents that were analysed, was crucial to constructing a better understanding of the learners' experiences of the TekkiKids programme. Therefore I regarded their testimonies, as documented/recorded in the

documents, as real, authentic and meaningful. Due to this stance, I have a direct experience of the learners' experiences, confirming the richness of the findings as described in their own voices.

This study was anchored in the interpretive/constructivist paradigm. It is my belief that, even though interpretivism and constructivism are paradigms that are often followed as independent entities, the theoretical orientation that I followed lent itself to a combination of the aforementioned paradigms.

According to the constructivist philosophy, knowledge is viewed as actively constructed by individuals, groups and society, and not merely transferred (Donald *et al.*, 2002). Brooks and Brooks (1993) define knowledge as an internal representation of the world that is mediated through temporary, developmental, social and cultural experiences. Constructivists believe that realities are not universal and absolute, and place strong emphasis on individual perspectives and constructions of reality (Hatch, 2002). The participants in the TekkiKids Programme experienced a unique reality and shared unique experiences of this programme. These experiences were well-documented during the facilitation process of the programme.

From within the realm of interpretivism, strong emphasis is placed on understanding the experiences and contexts of people by means of interaction. Interpretivist researchers acknowledge and respect people's subjective experiences as their own realities, that are just as valid and significant as any other (Terre Blanche *et al.,* 2006). Interpretivists seek to describe, explain and understand (interpret) social phenomena (De Vos, 2002). Jansen (2003) explains that, in order for one to achieve some level of understanding of reality, subjective meanings that are associated with a specific experience are forefronted when following this paradigm. In this sense, reality is seen as experiences that can be interpreted, but not controlled or predicted (Cohen, Manion & Morrison, 2007).

On the matter of how constructivism and interpretivism relate to one another, Schwandt (1998:222) states that:

> *The constructivist or interpretivist believes that, to understand this world of meaning, one must interpret it. The inquirer must elucidate the process of meaning construction and clarify what and how meanings are embodied in the language and actions of social actors. To prepare an interpretation is itself to construct a reading of these meanings; it is to offer the inquirer's construction of the constructions of the actors one studies.*

However, it should be kept in mind that the analysis of documents and artefact collections is a non-interactive strategy for obtaining data, with little or no reciprocity between the researcher and the participant (McMillan & Schumacher, 1993). This is contradictory to the above statement that reciprocity between the inquirer and actors is needed in a constructivist or interpretivist approach. However, the researcher, who was also the author of these documents, consulted the learners while compiling these documents, and, in the process of creating the documents that were studied in this research, documented real human experiences and interactions.

In spite of the similarities between constructivism and interpretivism, Terre Blanche and Durrheim (1999) distinguish between these two paradigms. Even though both paradigms acknowledge reality, as seen by participants, as subjective, reality in constructivism is regarded as constructed via direct and personal experience, whereas reality, according to the interpretivist, is understood through interpretation.

Thus, following a constructivist/interpretivist paradigm, I believe that, due to the uniqueness of each individual and context, diversity among individual realities (socially constructed) will be found. The ontology of this study required that I analyse multiple statements and responses of the learners who participated in the TekkiKids programme, as well as multiple sources of documentation pertaining to observational notes that were accumulated during my involvement as a consultant to the facilitators of the TekkiKids programme. The epistemology of this paradigm predisposes that knowledge is constructed through interaction and is contextually bound (Adams *et al.,* 2004). From an educational-psychological perspective, I engaged in this study, believing that psychological processes and the act of learning (*per se*) are inseparable. Accordingly, this study set out to describe, explain and understand the subjective experiences of the participants with regard to the TekkiKids programme in general, with particular reference to their experiences of an experiential learning environment, the level of enjoyment and motivation of the learners, the expectations of the learners regarding their learning experiences, and, finally, the social context in which these learning experiences were actualised.

In an attempt to understand and make sense of the learners' experiences of the TekkiKids Programme, particular attention was given to the context in which these experiences came to light. Mertens (1998) posits that qualitative research techniques best befit this approach, and, in accordance with this notion, I believe that following a qualitative methodological approach in this study will enrich the quality of this research. By reporting on the findings of this study, I act as a voice or medium for the grade 6 learners in relating their experiences to the reader.

3.3 DOCUMENTARY RESEARCH AS RESEARCH DESIGN

3.3.1 DOCUMENTARY RESEARCH

As I explained in Chapter 1, documents are rarely written with the intention of using them in research. However, according to De Vos *et al.* (2002), they could be used at a later stage as research method and as a means of data collection if it is regarded as operative and warranted. Kotzé (2005:40) agrees with this and states that: *Document analysis has been defined as a research technique used to make replicable and valid inferences from data to their context.* Bowling (1997) states that the upsurge of interest in phenomenological perspectives during the 1960's eventually led to the legitimisation of this method of research.

According to Cohen *et al.* (2007), Bowling (1997) and Bailey (1994), the advantages and disadvantages of documentary research can be summarised as follows:

Advantages	Disadvantages
• Allows access to inaccessible subjects. • Little or no reactivity with the investigator. • Particularly useful in longitudinal analysis. • Spontaneity: documents such as journals and observational notes often include spontaneously recorded actions or feelings. • Confessions: a person may be more willing to share personal information in a document as apposed to face-to-face interaction. • Convenience: Documents may be easily accessible in archives. • Low cost: Large samples can be addressed with minimal cost and time involved. • Documents of high quality may have been written by skilled professionals.	• Documents, even if they exist, may also be inaccessible to the researcher. • Documents may be too subjective, impressionistic and biased. • May present an incomplete record of the situation under investigation. • Sampling bias: making generaliseable statements may prove to be problematic. • Limited to verbal behaviour: the researcher may have limited information about respondents' non-verbal behaviour. • Coding difficulties: quantifying the data can be very difficult and sometimes even impossible. • Selective survival: even though documents of important people are more likely to be preserved than day-to-day documents of so-called ordinary people.

Documents take a multitude of forms and may include: field notes, diaries, journals, records, biographies, autobiographies, formal records, timesheets/time tables, technical documents, minutes of meetings, samples of students' work, memos, e-mails, reports, statistics, correspondence, plans, archives, photos, advertisements, maps, video and audio recordings, etc. (Cohen, Manion & Morrison, 2007; Bogdan & Biklen, 2003; Bell, 1993).

Whilst engaging in the literature on documentary research, it became clear to me that the context in which the documents originated needs to be considered, as it plays an important role with regard to the credibility and dependability of document analysis. In particular, the purpose and the author of the document, the relationships between the researcher, document, and institution, as well as the social and cultural background, need to be taken into account (Cohen, Manion & Morrison, 2007; Kotze, 2005; Bogdan & Biklen, 2003; Bowling, 1997; Bell, 1993).

The documentary research for this study will be done qualitatively. Subsequently, the next section will elaborate on the origin and context of the documents that were used in this study.

The researcher who uses qualitative methodology acknowledges the fact that there is no single reality. Qualitative research philosophically assumes that reality and meaning are constructed through interactions, as people attribute meanings to situations and events, constituted by beliefs, feelings, ideas, thoughts and actions (McMillan & Schumacher, 2001). Following a qualitative research methodology, researchers usually aim to create a rich and holistic description of events occurring in a natural setting, acknowledging and simultaneously stressing the importance of the context within which these events took place (Key, 1997).

Creswell (2007) refers to the descriptiveness of a qualitative study, stating that it is particularly useful when a researcher wants to reflect a detailed understanding of a phenomenon, especially if little is known about the particular phenomenon. In Chapter 2 of this study it became evident that there are extensive research reports and literature available on effective teaching strategies relating to science and technology education. However, extra-mural programmes that aim to promote the development of skills and knowledge in this field, seem to be scarce. TekkiKids therefore presented me with the opportunity to answer some of the burning questions pertaining to this void in the science and technology field: How did the learners actually experience this programme? What are the experiences of grade 6 science and technology learners of experiential learning as method of instruction? What learning experiences of a group of grade 6 learners in the TekkiKids Programme were encouraging to them? How does the method of instruction in the TekkiKids Programme influence the learning experiences of grade 6 children? These were the questions that I aimed to answer.

Hence, when keeping in mind the aim of this study, it is apparent that this study would best be served by means of a qualitative research methodology.

3.3.2 ORIGIN OF THE DOCUMENTS

As stated in the introduction of this chapter, I was involved in the TekkiKids Programme in 2007. I was approached by the facilitators of the programme to act as a consultant to them. This entailed that I had to attend the TekkiKids sessions and had to observe the dynamics between the facilitators, the learners, the method of instruction and the learning and teaching processes that took place. In order to structure my feedback to the facilitators regarding educational matters relating to the experiential learning sessions, I made use of field notes, notes of individual interviews with the children and the facilitators, observational notes pertaining to the tuition sessions, a structured questionnaire aimed at understanding the children's experiences of the sessions, and notes made during focus group discussions with the children. The aforementioned documents therefore originated during the TekkiKids sessions and recorded, among others, information regarding the learners' experiences during the sessions. It is the aforementioned experiences of the learners that will be explored in the various documents that will be the focus of this study.

The origin and history of documents used in documentary research is of paramount importance regarding the authenticity of any subsequent study that is based on these documents. The following section aims to describe the process that was followed during the creation phase of the documents. This study is, however, exploratory by nature, and, due to the limited scope of this study, there are certain limitations regarding the depth of the collected data.

3.3.3 SELECTION OF DOCUMENTS

According to Bailey (1994), most documents are written for purposes other than research. However, Mason (2002) states that the analysis of documentary sources is an acknowledged method in social research, and one which many qualitative researchers see as meaningful and appropriate in the context of their research. In accordance with this notion, Marshall and Rossman (1999:116) state that:

> *Minutes of meetings, logs, announcements, formal policy statements, letters, and so on are all useful in developing an understanding of the setting or group studied. Similarly, research journals and samples of free writing about the topic can be quite informative.*

For the purpose of this study, the following documents were selected and analysed:

- A feedback report regarding the sessions to the facilitators;

- General field notes of the consultant pertaining to observations made during lessons;
- Notes of individual unstructured interviews;
- A questionnaire that explored learners' experiences of TekkiKids; and
- Notes of a focus group discussion.

The aforementioned documents came into existence in a process that was aimed at addressing issues relating to didactical aspects. They were written with the purpose of providing structured feedback to the facilitators of the TekkiKids programme, to assist them in enhancing their teaching strategies. The documents were furthermore selected for this research after I had worked through them and found that clear themes emerged about the children's experiences in an experiential learning environment. This provided me with rich sources of data for coming to a better understanding of the said experiences.

Due to my prior involvement in the TekkiKids programme and the subsequent availability of the documents, I used convenience sampling. However, Babbie and Mouton (2001:100) warn about generalisation of findings when using convenience sampling. They are of the opinion that this type of study can be better applied in identifying and describing phenomena, than to generalise the findings. Furthermore, convenience sampling *could provide a springboard for future research or allow links to be forged with existing findings in an area.* This means that document analysis may be used for identifying and clarifying areas of growth, rather than to generalise findings.

3.3.4 DATA COLLECTION

Documentation regarding the feedback reports, field notes, notes of individual interviews with the children, observational notes pertaining to the tuition sessions, a structured questionnaire compiled and implemented, and notes made during focus group discussions with the children will be discussed in this section. The data collection therefore produced the following documents[11] and was conducted over a period of 8 months, two to three times per week:

- **DOCUMENT A: The feedback report**

The purpose of the feedback report was to relate to the facilitators the findings of the field notes pertaining to the observations, interviews, questionnaires and focus group discussions regarding the learners' experiences of the experiential method of instruction, as

[11] Annexure A, B, C, D and E contain excerpts of Documents A-E respectively.

implemented by TekkiKids. This document was written by myself, as the consultant, at the end of my involvement in TekkiKids.

- **DOCUMENT B: General field notes**

By observing the learners and the facilitators throughout the sessions, as well as during interviews, I was able to note points of inquiry that I then clarified with the learners during interviews. These notations were documented as general field notes.

- **DOCUMENT C: Notes of individual unstructured interviews**

Face-to-face unstructured interviews were conducted with learners on an individual basis. Notes of these interviews were documented in notes of individual unstructured interviews. This document also contains several verbatim quotations of some learners.

- **DOCUMENT D: Questionnaires**

A group-administered questionnaire was given to the learners. The questionnaire consisted of open questions, completion questions, Likert-type questions as well as follow-up questions. This questionnaire focused primarily on the learners' experiences, attitudes, views, and preferences pertaining to the sessions as presented by the TekkiKids programme. The questionnaire was introduced towards the end of my involvement as consultant in the TekkiKids Programme.

- **DOCUMENT E: Notes of a focus group**

Field notes were made during the focus group discussion which was conducted in an informal and interactive way. All the children present at that particular session participated in the focus group.

3.3 ENGAGEMENT WITH DATA

According to Creswell (2007), qualitative researchers often follow a generic process of data analysis, which generally entails 1) preparing the data for analysis by organising and managing the data, 2) conducting different types of analysis (i.e. inductive analysis) in order to move deeper and deeper into understanding the data, and 3) synthesizing the data by means of interpretation. He furthermore encourages the researcher to blend these generic steps with a specific approach on analysis. In this study I made use of inductive analysis in conjunction with the steps as described by Cresswell (2007). According to McMillan and Schumacher (1993), qualitative data analysis is primarily an inductive process of organizing data into categories and identifying relationships and patterns among categories. *Qualitative analysis… is a systematic process of selecting, categorizing, comparing, synthesizing and*

interpreting to provide explanations of the single phenomenon of interest (McMillan & Schumacher, 1993:480). The authors, however, distinguish inductive analysis from other qualitative analysis strategies by stating that *categories and patterns emerge from the data rather than being imposed on data prior to data collection* (McMillan & Schumacher, 1993:480).

3.3.1 DATA MANAGEMENT

The inductive analysis process commenced by categorising and ordering the data. This took place after I had obtained the relevant handwritten notes and questionnaires. These notes were typed and ordered into different documents. These documents (with the exception of the questionnaires) were numbered alphanumerical as Document A, B, C, D, and E respectively. After each document had been named, each line of the documents were coded from 1 and up, from top to bottom. For example, the code **A:5, 24-26** represents:

- **A**:5, 24-26, in which **A** represents document A
- A:**5**, 24-26, in which **5** represents page 5 of document A
- A:5, **24-26**, in which **24-26** represents lines 24-26 of page 5, document A.

The questionnaires (document D) were based on Lickert-scale type, numbered questions measuring levels of motivation, levels of interest, and levels of task difficulty. Open-ended, numbered questions were designed to elicit written expressions pertaining to the learning experiences of the learners. Subsequently, each questionnaire represented a learner, and each learner was assigned a number (respondent numbers). The code **D21:3** represents:

- **D**21:3, in which **D** represents document D
- D**21**:3, in which **21** represents the number of the respondent
- D21:**3**, in which **3** represents the 3rd question of a document

This coding process assisted me in generating themes of the learners' experiences of an experiential learning environment, and simplified my understanding of the data. It also facilitated the process of thematic analysis. A discussion on data analysis will follow.

3.3.2 DOCUMENT ANALYSIS AND INTERPRETATION

After this process, I followed the second step of data analysis as suggested by McMillan and Schumacher (1993) and Cresswell (2007), which involved that I read the data in order to obtain an overview of the information. At times notes were written in the margins of documents in order to aid me in recording general thoughts about the data for future reference. The notes were later organised into categories, themes, and sub-themes.

From the coded data, 16 sub-themes emerged. These sub-themes were identified and clustered together as five main themes. This process repeated itself, as it soon became apparent that the identified main themes could be categorised into three categories. An explanation of this process can be summarised as follows:

The sub-themes Teaching Style of Teacher, Support and Structure were clustered as the main theme Teacher/Learner-Interaction). Multi-Cultural Issues, Conflict and Cognitive load distribution were clustered into the main theme Group work. These two main themes were categorised as Social Interaction. Subsequently, the same procedure was implemented in the remaining ten sub-themes, three main themes and two categories. A thorough discussion of the sub-themes, main themes and categories will be presented in Chapter 4. The following section will deal with the interpretation of the data, which represents the third step of inductive data analysis.

3.3.3 DATA INTERPRETATION

The sub-themes, main themes, and categories were interpreted against the backdrop of an interpretivistic-constructivist paradigm. Knowledge was viewed as context-dependent, due to the subjective realities of learners. Immersing myself in the context of the learners, as it emerged from the documents that were analysed, was crucial to constructing a better understanding of the learners' experiences of the TekkiKids Programme. The data that emerged from the research process were synthesised into larger coherent wholes and interpreted by formulating hypotheses and theories that accounted for the observed patterns and trends in the data (Mouton, 2001). Experiential learning theory, as conceptualised in Chapter 2, was used to explore the findings of the analysis. This process will be discussed in Chapter 5.

3.4 ROLE OF THE RESEARCHER

Due to the nature of documentary research, the researcher assumed a limited number of roles in comparison with other research methods. My primary role was that of analyst, to enter into interaction with the documents, and to immerse myself in the documents to gain a better understanding and insight into the experiences of the learners. Documents were analysed by means of inductive analysis, as discussed in section 3.10. Further roles of the researcher were to integrate and present the results, as well as to provide the CSIR with feedback regarding the findings of this study. The role of the researcher is to constantly reflect on the research process, in order to be thoroughly aware of any bias.

3.5 CREDIBILITY AND DEPENDABILITY

Patton (2002) argues that credibility depends less on sample size than on richness of the information gathered, and on the analytical abilities of the researcher. According to De Vos (2002), it is crucial that the researcher evaluate the authenticity, or validity and reliability of documents, when conducting document studies. Therefore, the credibility and dependability of this study will causally be linked to and be dependent on the degree of credibility and dependability of the documents analysed in this study. As mentioned earlier, the documents stemmed from a consultative process in which I was the consultant.

Due to the importance of the context of documents, the research that might have created the particular documents, as well as the role of the author of the documents, the process of investigation, and the documentation thereof, is deemed vital and subsequently described in detail in section 3.3.2 (Kotze, 2005; Bogdan & Biklen, 2003).

With regard to qualitative research, Creswell (2007) identifies eight validation strategies that are frequently used in qualitative research, of which at least two of the proposed strategies should be used. This study used the following three strategies:

- Triangulation: During this study multiple sources of data (documents) were used in order to derive preliminary conclusions from common themes, by converging the different data sources.
- Clarifying researcher bias: My prior involvement in the TekkiKids Programme is transparently acknowledged and clarified.
- Peer review: The analysis of the documents and the subsequent findings (interpretations) that will result from this process will be monitored and checked by an esteemed peer.

Due to the fact that I was the compiler of the selected documents, as well as the fact that I revisited and analysed the documents with vigour, a different focus and purpose can arguably represent two sides of a coin. According to Babbie and Mouton (2001), when a researcher consults with the author of documents, the researcher promotes validity and reliability. Thus, in a sense this consultation can be regarded as *member checking* (Creswell, 2007:208). On the other hand, bias will be anticipated and duly dealt with through constant reflection and peer review.

3.6 ETHICAL CONSIDERATIONS

As previously set out in Chapter 1, permission pertaining to the analysis and presentation of the findings of this research study was granted by the parties involved in the TekkiKids Programme. The Faculty of Education's Research and Ethics Committee of the University of Pretoria also granted permission to conduct this documentary analysis. For a detailed discussion of ethical considerations, the reader is referred to Chapter 1.

3.7 CONCLUDING REMARKS

As indicated during this chapter, documentary research may be regarded as controversial by some. However, when the purpose of the research, the paradigmatic perspective, and the context of the documents are properly engaged in, and if they are all suitably aligned, documentary research constitutes a recognised formal design.

In this chapter the research process was described. Particular attention was given to the origin and context of the documents, as well as the process of consultation that led to the development of the documents. As indicated, taking cognisance of the aforementioned is synonymous with and critical to conducting documentary research.

The results of the data analysis and an explanation of the evidence trail will be presented in Chapter 4. The data will be discussed in Chapter 5.

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CHAPTER 4
THEMATIC DISCUSSION OF LEARNERS' EXPERIENCES OF A TECHNOLOGY CLUB

4.1 CHAPTER OVERVIEW

Chapter 4 presents a detailed discussion of the results of the inductive analysis of the data that was used during this study, and supporting evidence from the documents studied is also provided for an effective data audit trail. The results will be presented in table format, after which a discussion will follow to enhance the reader's understanding of the experiences of the grade 6 learners, as reported in the various documents that were analysed in this study.

4.2 RESULTS OF THE DOCUMENT ANALYSIS

The data that emerged pertaining to the learners' experiences was divided into three categories, five main themes, and 16 sub-themes. The three main categories, namely **social interaction**, **motivation**, and **language** were the thematic results of an inductive analysis of the documents (see Chapter 3, Data Management). Each main category presented its own set of main themes and respective sub-themes, as can be seen in Table 4.1. This table also illustrates the manner in which the feedback report (document A) guided the researcher to divide the data into these identifiable categories, main themes and sub-themes:

Table 4.1: Results of the inductive analysis, indicating the categories, main themes, and sub-themes

Emerging themes as identified by document A[12]			
Category	**Main Themes**	**Sub-Themes**	**Codes**
Social Interaction	Teacher-child interaction	Teaching style of teacher	A:5, 1-5 A:6, 32-34
		Support	A:7, 17-19
		Structure	A:6, 7-11

[12] Document A refers to the feedback report as discussed in Chapter 3: Data management.

Emerging themes as identified by document A[13]			
Category	**Main Themes**	**Sub-Themes**	**Codes**
	Group work	Multi-cultural differences	A:7, 21-24; A:8, 1-2
		Negative experiences: conflict	A:7, 18-20
		Positive experiences: cognitive load distribution	A:7, 21-24
Motivation	Level of interest	Preference of/for activities	A:5, 26-31 A:6, 18-22
		Extra-mural commitments	A:5, 26-31
		Expectations	A:6, 4-6
	Level of task difficulty	Challenging activities	A:5, 15-20
		Teaching aids	A:6, 32-34 A:7, 3-8
		Feelings of distress	A:5, 17-20 A:7, 9-11
		Sense of accomplishment	A:5, 21-24
Language	Language barriers	Language of instruction as opposed to mother tongue of learner	A:7, 9-11
		Proficiency of learners	A:7, 25-27
		Level of language usage	A:7, 1-2 A:7, 25-26

The next section will focus on a discussion and presentation of the results of the inductive thematic analysis regarding the documents (as described in Chapter 3: Data Management), supplementary to Document A, as described in the above table (Table 4.1). Social interaction, Motivation and Language will each be discussed on its own, with its respective main themes and sub-themes.

[13] Document A refers to the feedback report as discussed in Chapter 3: Data management.

4.3 RESULTS OF INDUCTIVE THEMATIC ANALYSIS

4.3.1 SOCIAL INTERACTION

Social interaction can be defined as reciprocal action or influence relating to a society or community or its organisation (The Dictionary Unit for South African English, 2008). For the purposes of this study, **social interaction** will be defined as the reciprocal interaction or influence between a teacher and a learner, or amongst the learners, relating to the classroom setting of the TekkiKids technology club. From the analysis of the documents (all the data relating to a reciprocal interaction or influence between the teacher and the learner(s), and to the learners with each other – group work), the following main themes emerged: **teacher/learner-interaction** and **group work**. The sub-themes of ***teacher/learner-interaction*** relate to how the learners experience the **teaching style** of the teacher, the **support** offered by the teacher, and the level of control (**structure**) provided by the teacher. The main theme ***group work*** relates to the sub-themes pertaining to the way in which the learners experienced **multi-cultural differences**, **conflict** and the **cognitive distribution** that exists amongst the members in the groups.

The following table[14] (Table 4.2) presents the learners' experiences pertaining to the first category (Social Interaction) and its related main themes and sub-themes.

Table 4.2: Social Interaction

Main Themes	Sub-Themes	Codes & Quotes
Teacher-Child-interaction	**Teaching style of teacher** [A:5, 1-5] & [A:6, 32-34]	E22:1 *I had to build a moving robot with [Paul[15]]*
	Support [A:7, 17-19]	E22:2 *[Paul] did Help me & that was very Sweet of him*
	Structure [A:6, 7-11]	E24:4 *It was easy because we had plans and we followed them and typing is easy*

[14] Please note that the learners' language mistakes were not corrected in the reporting of their experiences, as the learners' difficulties pertaining to language are best illustrated this way. Also, as it is the intention of the researcher to present the data in the most authentic way, references to the documents may seem cryptic at times.

[15] Paul is a pseudonym for one of the facilitators.

Main Themes	Sub-Themes	Codes & Quotes
Group work	**Multi-Cultural Differences** [A:7, 21-24] & [A:8, 1-2]	E4:2 *Todays session was fun* [Agree] *The other school didn't arrive* *B2: 13-16 Limited interaction: Multicultural issue: Learners from privileged school seem to 'take over' the group. Learners from previously disadvantaged school appear more reserved….taking a back seat.*
	Negative Experiences: Conflict [A:7, 18-20]	E20:1 *People were fighting* E21:6 [felt neutral/happy] *because I get to c*[16] *my friends and sad bcqz theirs sum ppl I can't stand who are here* E22:1 *My group listened to me for the first time* E22:8 *When we had an argument* E24:1 *Because I dont like it wen some 1 Bothers me for something I did not do* *E25:2 I had I fight with some 1* E27:1 *There were too much sad people and people were being mean too each other* E27:2 *I had people bossing me around and when I tried to suggest something they kept shouting at me* E28:2 *No I didn't coz we had nothing 2 do coz children hogged every job (I hardly did anything)* E28:6 *….bored…its never much fun* E28:8 *Every 1 was depressed, crying and fighting* E4:5 *Every group I have worked in has never helped* E5:5 *I would like to work in pairs(2)* E21:8 *People were fighting. I think next time we should choose our own group.*

[16] Please note that the learners' language mistakes were not corrected in the reporting of their experiences, as the learners' difficulties pertaining to language are best illustrated this way. Also, as it is the intention of the researcher to present the data in the most authentic way, references to the documents may seem cryptic at times.

Main Themes	Sub-Themes	Codes & Quotes
(continued) **Group work**	**Positive Experiences: Cognitive load distribution** [A:7, 21-24]	E1:5 *It was nice and easyer with one doing that and the other doing something different* E2:5 *Some people in the group work well but others do nothing* E3:5 *Coz you can get help and ather ideas from your team mates* E6:5 *Its fun and interesting espiacially working with Mary*[17] *its cool* E7:5 *You can listen to others ideas* E14:5 *Because we need some person ideas* E14:7 *I enjoy working together as a group and giving my group some ideas* E16:1 *Because we are working well with our group. And we discus all together* E22:5 *…u don't have to think hard & do all the work so its very nice working in group* E24:6 *…happy…its nice 2 build, discover, invent, and being with friends as nice and cool* E28:5 *there are some things I don't know so my group members can teach me* E29:5 *More fun!!*

4.3.1.1 Teacher-Learner-Interaction

- **Teaching style of the teacher, support, and structure**

Learners were primarily left to their own devices and the facilitators regularly reminded the learners of the importance of engaging with the challenges (problems) on their own. Even though it is noted that the learners enjoyed this child-centred approach, as well as the informal academic atmosphere, it is evident that they preferred so-called 'one-on-one' attention and assistance from the facilitators. The learners particularly expressed the need for assistance regarding solving problems.

4.3.1.2 Group work

- **Positive experiences, negative experiences, and multicultural differences**

It is evident that the learners' experiences of the group work aspect of the TekkiKids Programme were ambiguous, as the learners described both positive and negative

[17] Mary is a pseudonym for a participant

experiences regarding group work. Positive experiences particularly related to the distribution of the cognitive load as learners stated that by working together, challenges (problems) were solved with greater ease. From the data, it appears that learners were more confident and optimistic when confronted with the challenges, as they knew they could rely on one another to solve the problems collectively. These learners also stated that they found the social aspect (social interaction) of working in groups enjoyable. Learners, who experienced the group work as positive, often cited working in groups as a major highlight of their TekkiKids experience as a whole.

However, conflict also appears to be a central theme. Learners experienced conflict amongst their own group as well as with members of other groups. Learners indicated that domineering members of the group excluded them during group activities. It was observed that previously disadvantaged learners in general did not actively partake in group-activities as much as learners from privileged communities did. Learners from previously disadvantaged communities often just sat in silence or formed a sub-group. These learners often kept themselves busy with activities not related to the problem-based process. Being able to work/play with the laptops particularly seemed to be a matter of fascination for these learners.

4.3.2 MOTIVATION

Motivation can be defined as having a motive, or to be enthusiastic. To motivate means to provide someone with a motive, or to stimulate the interest of something (Kavanagh, 2008). Therefore, for the purposes of this study, **motivation** refers to a learner's experience of enthusiasm regarding the learning activities that evokes his/her interest in the science and technology field. Pertaining to this definition of motivation, the main themes **level of interest** and **level of task difficulty** emerged from the document analysis. Regarding **level of interest** the main themes **preference of/for activities**, **extra-mural commitments,** and the learner's **expectations** regarding TekkiKids emerged. Pertaining to the main theme **level of task difficulty**, the following sub-themes emerged: **challenging activities, teaching aids, feelings of distress,** and **sense of accomplishment**. The learners' experiences regarding the category **motivation**, are indicated in Table 4.3 on the next page.

Table 4.3: Motivation

Main Themes	Sub-Themes	Codes & Quotes
Level of Interest	**Preference of/for activities** [A:5, 26-31]	E1:3 *To use the com[puter] and load pictures* E1:2 *Going on the internet* E2:7 *I enjoyed programming the robot and the 5min Break* E2:6 *Sad, sometimes it can be difficult and boring* E3:1 *Coz thay wasn't aney thing interesting happening* E3:2 *Coz we weren't doing any thing exiting of dfferent* E3:6 *Playing games nd rebuilding our modle and correting our mistakes* E3:8 *They was no new challenge for us 2day we were doing wat we did last week* E4:3 *We've been doing the same thing for 3 weeks* E5:2 *It was fun throwing the Ball in the tower it was Like a Boomb* E7:3 *The programming was interesting* E10:1 *[today's session] was vervelig* E13:7 *going to the moodle website and going up and down* E14:9 *[Today session was interesting] because Ididn't built today* E15:2 *Todays session was not fun for me it was boring* E15:7 *What I enjoy about todays session is to work with laptop* E16: 3 *Yes because it was fun and I learnt things today* E24:2 *Because the interesting we built and discovered I Like it here it's COOL/FUN* E24:3 *Working on the Laptop, Sending pictures and learning about lego's and stuff*

Main Themes	Sub-Themes	Codes & Quotes
		E24:6 *Its nice to build, discover, invent and being with friends as nice and cool* *B4:7-11 Implemented break. Fun-filled activity: something totally different to the 'mission'. Kids reacted more 'rejuvenated'/ spirited/ motivated. Attention span: keep age appropriateness in mind.* E8:1 *Its fun but it gets boring to work with legos all the time*
	Extra-Mural Commitments [A:6, 24-30]	E7:6 *I felt disappointed because I wanted to go play at a friends house because its Friday!! :(* E10:6 *…I felt not so good because I had better stuff to do* E11:6 *…I felt stresvol because Ek het krieket* E13:6 *…I felt Angry…I need to prepare something for tomorrow* E23:6 *…normal…I was not up 4 dis becous I tierd of swimming* C:8 *It clashes with English*
	Expectations [A:6, 4-6]	E8:3 *Dit was lekker om te doen maar dit sal lekker wees om so 'n bietjie rond te hardloop* E20:6 *…exited…I thought we were going to finish the model* E23:2 *they did not show us new stuff* E25:6 *…Sad…Ok, Im being honest, I dislyk Tekkikids* E26:6 *…happy…I knew I would have a lot of fun* E27:4 *…everything was not new it was stuff we did befor* E29:6 *…disipointed…It's Boring* B2:8 *Seems not inetersted (?) "we have been doing the same thing now for ever…"* B3:2 *"They came to our school and gave a presentation…it looked cool"* B3:3-4 *"Some high schools look at your extramural activities when you apply to go to that school. I thought it would look good."* *B3:5-6 "Sir just picked me and it sounded like a good idea. I guess he picked children that does okay in technology. Well, that's what I think anyway."*

Main Themes	Sub-Themes	Codes & Quotes
Level of Task Difficulty	**Challenging Activities** [A:5, 15-20]	E7:4 *We couldn't attach the box to the driving base and the box is standing up* E8:4 *[dif level:Neutral] Jes it was but it is fun to have a challenge* E10:8 *The building and programming. I couldn't get it right* E21:3 *Its complicated!* E29:1 *It was to Complicated* E29:4 *Don't' know what was going on.* ***TO DIFFICULT!!***[18] B1: 6 *Takes a long time to complete tasks!* B1:14 *Challenges too difficult? Currently needs intensive facilitation…feasible??* E:2 *2hours was too long: rather 1h/week* E:5 *Maze: bit frustrating: was too hard (level), "we needed to go back and do it over and over and over and over and over…Calculate all the distances!"*
	Teaching Aids [A:6, 32-34] & [A:7, 3-8]	A:6, 32-34 *The learners struggled to follow long verbal instructions as well as lengthy (solely) verbal explanations of concepts they needed to understand (master) in order to complete session goals.* B1:16 [Need] *Autonomy: steb-by-step worksheets, tips, guidelines.* B1:18-24 *Note: Challenge/ mission: break it down into every small sub mission…give tips. When explaining/facilitating: use visual aids- eg. Black board. Quickly discuss the criteria- brainstorm + (oral) facilitator writes it on board…then hand out/ turn page in manual…* *Evaluation matrix: provide evaluating design worksheet: make more learner friendly…learners know what they will be assessed on…guides them.*

[18] The learner wrote these words in big, thick capital letters

Main Themes	Sub-Themes	Codes & Quotes
continue **Level of Task Difficulty**	**Feelings of Distress** [A:5, 17-20] & [A:7, 9-11]	E2:2 *There were too many problems with our robot* E6:2 *I disagree because I didn't have enough break time* E6:6 *I felt tired/Adgetated because I wanted to chill at school with my friends, but I came here for my school record and I wanted to sleep* E25:1 *I hate building ans technology and It was very complicated* A:5, 10-14 *Establishing the zone of proximal development…proved challenging. The learners experienced the level of the tasks to be particularly difficult at times. This in turn seemed to have led to despair and most learners feeling overwhelmed at one point or another.* A:7, 9-11 *In complying with these recommendations the subsequent effects became significantly noticeable. Levels of apparent agitation and distractibility seemed to decrease and the learners appeared to be more focused and task orientated.* B1:27-28 *Distractions: learners seem overwhelmed by stimuli: not use to PC and blocks…preoccupied with recourses.* E:5 *Maze: bit frustrating: was too hard (level), "we needed to go back and do it over and over and over and over and over…Calculate all the distances!"*
	Sense of Accomplishment [A:5, 21-24]	E4:6 *I felt happy because we would finish our robot* E8:2 *Ja dit is lekker om nuwe goed te leer* E8:6 *I felt glad because we were piced out of our howl skool to do this* E20:7 *We r that much closer to finishing it* E21:2 *[Was fun:Aggree] Because we finished our robot* E21:7 *I learnt somtin new!!* E24:7 *[Enjoyed what?] The sturdy wheels and motor I build 2day* E26:1 *I got to programme the R.C.X. It really enjoyed solving building problems* E26:2 *I got to see the mistakes I made*

4.3.2.1 Level of interest

- **Preference of/for activities**

The learners clearly preferred some activities to others. The computer-related activities (i.e. uploading pictures, browsing the internet, preparing presentations, and playing computer games) were particularly enjoyed by learners from previously disadvantaged communities. It was noted that these learners were in some instances more preoccupied with the laptops than with the actual building activities of the sessions. Learners from privileged communities also enjoyed these computer-related activities, but to a lesser extent.

Over all, learners also showed intense interest in the discovery process, expressing the fact that they enjoyed inventing, designing and solving problems related to the particular challenges. However, exceptions to this notion will be dealt with in the discussion on the sub-theme **Expectations**.

- **Extra-mural commitments**

Extra-mural activities proved to be somewhat of a dilemma. Learners indicated that they wanted to, or were expected to participate in after-school activities such as sport, extra classes, and even spending more time on homework and/or forthcoming assignments. Learners who stated that they had other extra-mural commitments almost always expressed a negative attitude towards that particular day's challenge. In accordance with this, they also expressed the fact that they did not have fun during that day's session.

In addition, four learners indicated that they did not enrol for Tekkikids themselves. These learners indicated that they were chosen by their educators due to their good marks in technology in relation to their peers. It was also noted that they felt obligated to join the programme due to the fact that the fear of not complying with the request/suggestion of their educators might be held against them in future. These learners expressed intense dissatisfaction with their general experience as member of TekkiKids, and were notably demotivated to partake in the programme.

- **Expectations**

A discrepancy between the learners' expectations of the programme and their actual lived-experiences was evident. Learners stated that a presentation, aimed at introducing and promoting the programme at their schools, painted a picture different to what they experienced. It is evident that some learners were disappointed, stating that they expected a wider variety of activities. Learners in general, but especially the aforementioned learners, indicated that the programme became boring to them. In this regard, the learners indicated

that they thoroughly enjoyed their visit to the Fab-Lab, as well as the five-minute breaks they had towards the end of the TekkiKids project. The 'silly' nature of activities during break time, as implemented by the facilitators, proved to be very enjoyable for the learners.

4.3.2.2 Level of task difficulty

- **Challenging activities**

Over all, almost all the learners expressed the feeling that the challenges were too difficult a times. Learners particularly struggled with the problem-solving process. At times, designing, building and programming their robots proved to be too complex. It was observed that learners presented with increased levels of distractibility when they seemingly struggled with a particular problem for too long.

- **Teaching aids**

Verbal instruction seems to have been somewhat problematic. Learners struggled to follow lengthy verbal instructions and often did not remember what was expected of them. Instructions were primarily given solely in verbal form, and no other teaching aids were utilised. After this observation was shared with the facilitators and subsequently addressed, the level of distractibility of learners seemed to diminish. Facilitators provided stimuli which involved more senses when giving instruction to the learners. The facilitators used a white board (visual) whilst explaining (auditory) certain concepts to the learners. The goals (learning outcomes) of the particular sessions were also indicated to the learners by means of a worksheet, or written on the white board in front of the classroom. In so doing, learners were also able to revisit what was expected of them.

- **Feelings of distress**

Some learners expressed feelings of despair, frustration, agitation, and anger. These learners were often de-motivated and visibly demoralised. It is evident that these individuals particularly struggled with the difficulty-level of some challenges, tasks, and problems. Their attitudes towards the TekkiKids programme were also negatively influenced. The observer noted that, when the learners were focused and task-orientated and when they perceived the immediate task to be manageable, levels of agitation, frustration, anger, and despair seemed to subside.

- **Sense of accomplishment**

Even though the learners expressed the fact that they experienced the challenges to be too difficult at times, when they indeed perceived the challenge to be manageable and/or solved some of the problems, it is evident that this instilled a sense of pride in them. These learners, in general, conveyed a more positive attitude towards the programme as a whole. A significant change regarding mood was noted when learners, especially those who struggled more than their peers, successfully dealt with a challenge or solved a problem.

4.3.3 LANGUAGE

From the main theme **language barriers**, several sub-themes emerged from the data-analysis pertaining to the learners' experiencing English as language of instruction. These sub-themes were named; **language of instruction as opposed to mother tongue of learner, language proficiency of the learners,** and **the level of language usage by the teachers.**

Table 4.4: Language

Main Themes	Sub-Themes	Codes & Quotes
Language Barrier	**Language of instruction as opposed to mother tongue of learner** [A:6, 32-24]	E13:5 *There is a communication problem. Between the* [school1[19]] *learners and the* [school2] *learners*
		A:6, 32-34 *The learners struggled to follow long verbal instructions as well as lengthy (solely) verbal explanations of concepts they needed to understand (master) in order to complete session goals.*
	Proficiency of Learners [A:7, 25-27]	E8:6 *I felt glad because we were piced out of our howl skool to do this* E8:2 *Ja dit is lekker om nuwe goed te leer*

[19] For the sake of anonymity, the names of the schools were omitted. School 1 and School 2 were used respectively as substitute names for these schools.

Main Themes	Sub-Themes	Codes & Quotes
	Level of language usage [A: 1-2]	B1:7 *too complicated: too many big words. Age appropriate?* A:7, 1-2 *This was brought to the attention of the facilitators and recommended to 1) try (as far as possible) use language on a Grade 4 level*

4.3.3.1 Language barrier

- **Language of instruction as opposed to mother tongue of learner**

A language barrier seems to be evident. Learners expressed the finding that they struggled to communicate with their group members. It was noted that many of the learners resorted to their first language (mother tongue), effectively excluding learners that could not understand them, whilst engaging in the problem-solving process as well as general social conversations (interaction). However, regarding instructions and explanations, the facilitators used the first language of the learners when they moved between the groups to assist them.

- **Proficiency of Learners**

It was noted that learners, at times, struggled to understand explanations of S&T concepts.

- **Level of Language usage**

The facilitators struggled to simplify and explain these concepts and scientific processes on a level deemed appropriate for grade 6 learners.

4.4 CONCLUDING REMARKS

This chapter discussed in detail the experiences of grade 6 learners regarding five main themes and 16 sub-themes that emerged from the data analysis. These main themes and sub-themes were grouped into three categories presented alongside supporting quotes from the documents.

The next chapter, Chapter 5, will present the findings of this research study as guided by the research questions. The chapter will also deal with the limitations and benefits of this study, as well as the contributions and recommendations concerning research, practice, and training.

CHAPTER 5
SYNOPSIS OF FINDINGS, LITERATURE CONTROL, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter sets out to report on the findings of this study, as well as to answer the research questions as formulated in Chapter 1. In addition to this, the findings in Chapter 4 will be presented in the context of the literature study, as set out in Chapter 2.

In the latter part of this chapter I shall discuss the limitations and gains of this study as well as the contributions and recommendations regarding research and practice.

5.2 SYNOPSIS OF FINDINGS AND LITERATURE CONTROL

In this section, I shall discuss the findings of the study that emerged from the document analysis. In addition to the thematic discussion of the document analysis, the findings will be presented against the backdrop of relevant literature content.

5.2.1 EXPERIENCES REGARDING SOCIAL INTERACTION

It was found that the learners who participated in the TekkiKids Programme experienced enjoyment regarding the learner-centred approach of the experiential learning method, as implemented by TekkiKids. Although the learners in general experienced encouragement from the facilitators to take responsibility for their own learning, some experienced a need for structure by their facilitators pertaining to problem-solving. This is in accordance with the findings of Wilson *et al*. (1995) who state that learners might experience negative emotions when a lack of direction from the teachers as well as a lack of demonstration inhibits mastering of the learning content.

With regard to how they experienced group work (learner-learner interaction), positive experiences such as sharing the cognitive load, being able to rely on group members , and enjoyment of the socialising aspect of group work, were reported by the learners. This corresponds with the findings of Mergel (1998) regarding the social aspect of experiential learning. This may contribute to the learners' development in dealing with real life situations, such as conflict, and to learn social skills while mastering the learning content. Group work furthermore contributes to the experience of meaningful participation regarding the learning process (Wilson *et al.,* 1995).

Some negative experiences were linked to the existence of conflict between group members, and to experiencing social isolation caused by domineering group members. Experiences of conflict may lead to feelings of anger. Anger, according to Vermunt and Verloop (1999) as well as Snow *et al*. (1996), needs to be addressed with the learners in order to foster positive attitudes towards learning. Learners from previously disadvantaged communities seemed to experience isolation and/or a preference for interaction with learners of the same cultural background. It seemed as if the learners experienced the multicultural differences among the group members as negative. In some instances, this had a negative influence on the previously disadvantaged learners' learning experiences, as they sometimes avoided partaking in some of the learning activities. It should be noted that the presence of negative experiences such as conflict, social isolation, and multicultural differences, might indicate important differences between the findings of this research project and findings as reported in relevant literature, as described in Chapter 2.

Prinsloo (2005:37) describes the influence of cultural differences on learners' learning experiences as follows:

> *…children whose own language, traditions, values, norms, customs and so on differed from those of the school culture might have underachieved because the existing curriculum had nothing in common with their own cultural milieu.*

From the foregoing excerpt one can see how the language barrier experienced by unprivileged learners functions as a fundamental cultural difference that negatively influences learning experiences. Learners from an underprivileged milieu avoided participating in some of the activities. This may indicate cultural differences between the children's milieu and the milieu the TekkiKids Program created.

5.2.2 EXPERIENCES AS INFLUENCED BY MOTIVATION

It is evident that the learners' level of interest in the learning process, as facilitated by TekkiKids, was influenced by their preferences with regard to activities, by their extra-mural commitments, and by their expectations regarding TekkiKids. It seemed as if the experience of an activity as positive and interesting motivated the learner to enhance his own learning activities. This is in accordance with the findings of Vermunt and Verloop (1999), who state that willingness to learn is directly linked to the formation of expectations about the learning experience, and to the outcomes thereof.

It was found that some learners expected to experience a wider variety of learning activities. Learners indicated that the opportunities to socialise informally (implemented towards the

end of the programme) served as an additional motivational factor for participating in the TekkiKids Programme. This was true for most learners, except for those whose extra-mural commitments seemed to be overwhelming to them. The matters of extra-mural commitments of learners, and informal socialization among group members, as motivation for participation in a science and technology club, indicate another important difference between the findings of this research study and findings as reported in relevant literature.

Concerning the level of task difficulty, the learners found challenging activities particularly demotivating, due to a lack of guidance in the problem-solving process. Some learners therefore experienced a need for supplementary teaching aids, as verbal instruction alone seemed to be ineffective. It was also found that teaching aids that draw on the learners' senses provided them with a positive learning experience, motivating them to engage in the learning material. This relates to the findings of several studies that found that the relevancy of the activity and the learning material determined the learner's level of attention to the task at hand (Vermunt & Verloop, 1999; Reynolds & Shire, 1988). Experiencing distress seemed to have a negative influence on their levels of motivation, as well as on their attitudes towards the learning process. These findings are supplementary to the findings of Vermunt and Verloop (1999), and of Dorman *et al*. (2006), who state that negative feelings such as fear of failure, anxiety and distress, as well as a high level of task difficulty, might demotivate learners with regard to taking responsibility for the learning process.

The research study also found that learners, who had a more positive attitude towards the programme, were motivated to participate in the learning activities – especially when the learners experienced a sense of accomplishment. This is in accordance with Schunk (1991), who emphasises the relationship between the learning experience and the appraisal of the immediate task's level of difficulty. It could therefore be concluded that their own level of interest in the TekkiKids Programme, and the level of task difficulty in the TekkiKids Programme, influenced the learners' experiences regarding motivation.

5.2.3 LANGUAGE

The document analysis revealed that some of the learners experienced a language barrier, due to the facilitators' use of English as the language of instruction, as opposed to the mother tongue of the learners. It was also found that the learners' proficiency in the language of instruction influenced their learning experiences, as they struggled to understand the instructions and explanations pertaining to the learning activities. It could therefore be concluded that the learners' learning experiences were negatively influenced by the facilitators' difficulty in relating the complicated scientific language and constructs to

the level of learners' language abilities. Since the matter of language barriers was not addressed during my literature study, a brief referral to the effect of language barriers on learners' learning experiences will now be presented.

According to Prinsloo (2005:37), learners need to be instructed in their mother tongue in order to enhance the learners' learning experiences. Due to learners' lack of experience in English, which is the language of instruction in most South African schools, learners may underachieve due to poor language proficiency: *Teachers should be aware that this usually leads to learning problems and underachievement in learners.*

This may be particularly true for this study, as can be seen by the direct quotes pertaining to the findings in Chapter 4.

The next section is a summative overview of research findings pertaining to the experiences of the grade 6 TekkiKids-learners.

5.3 CONCLUSIONS OF THIS STUDY

This research study aimed to explore the learning experiences of grade 6 learners participating in a science and technology club. It was found that the learner-centred approach the facilitators followed had a positive effect on the learning experiences of the grade 6 learners. It was also found that the shared cognitive load among group members influenced their learning experiences positively. It was, however, evident that their learning experiences were negatively influenced by the multicultural differences and conflict among groups.

Regarding the learners' experiences as influenced by their levels of motivation, learning experiences seemed to be influenced positively when the level of interest in the learning activities was high. Learning activities that were experienced as difficult by the learners demotivated them, while learning activities during which they experienced a sense of accomplishment contributed to their positive learning experiences.

Some learners experienced English (as the language of instruction) as a barrier to learning. The language proficiency of the learners was not always compatible with the complicated language usage of the facilitators. These factors had a negative influence on the learners' learning experiences.

This concludes the summary of the findings as presented above. In the next section, the

primary research question and the secondary research questions will be addressed.

5.4 ADDRESSING THE RESEARCH QUESTIONS

5.4.1 PRIMARY RESEARCH QUESTION

The primary research question of the study was: *What are the experiences of grade 6 science and technology learners of experiential learning as method of instruction?*

It was found that the learners experienced the method of instruction, namely experiential learning, to be supportive and encouraging by nature. The one-on-one experiences were particularly enjoyed by them. The facilitators' learner-centred approach therefore had a positive influence on their learning experiences.

The learners also experienced a need for structure pertaining to problem-solving. Therefore the lack of support in the experiential learning process proved to have a negative influence on their experiences.

Concerning the learners' experiences of group work, multicultural differences pertaining to English being a language barrier, as well as milieu differences, proved to have a negative influence on their learning experiences. The experience of conflict between group members also had a negative impact on their learning experiences.

In contrast to this, the learners experienced the cognitive load distribution as having a positive influence on their learning experiences. Furthermore, it was found that the learners regarded the levels of interest and task difficulty as an influence on their levels of motivation regarding participation in the programme.

In instance where learners expressed concern about additional commitments in the form of extra-mural activities they experienced more negative feelings regarding the TekkiKids Program. Some learners expressed negative feelings because they felt obliged to attend the Program because they felt an obligation towards the adult who initiated their participation.

5.4.2 SECONDARY RESEARCH QUESTIONS

The first secondary research question pertaining to this research study was: *How does the method of instruction in the TekkiKids science and technology programme influence the learning experiences of grade 6 learners?*

Firstly, the experiences of the grade 6 science and technology learners (of experiential learning as a method of instruction) were found to relate to the quality of social interaction with their facilitators and their group members. The teaching style of the facilitators, the level of support, and the structural guidance provided by the facilitators therefore influenced their experiences. Multicultural differences and conflict seemed to have a negative influence on their experiences, while the sharing of cognitive load had a positive influence on their experiences.

Secondly, it was found that the learners' levels of motivation were linked to their levels of interest in the learning processes, as well as to the level of task difficulty. Learners' learning experiences were positively influenced when their learning activities were more important to them. Their experiences were influenced negatively when the high level of task difficulty de-motivated them. Also, their experiences presented positive when they experienced a sense of accomplishment.

Finally, the learners, who experienced English as a barrier to learning, reported more negative experiences than those whose mother tongue was English. Those learners who experience a need for more support and structure also reported negative experiences of the TekkiKids Program.

In the following section I shall deal with the second secondary research question, namely: *What learning experiences of grade 6 learners in the TekkiKids programme were encouraging to them?*

The following learning experiences of the grade 6 learners in the TekkiKids programme were encouraging to them:

- One-on-one contact with the facilitator
- Feeling supported by the facilitator
- Sharing the cognitive load with group members
- Interesting learning activities
- Experiencing a sense of accomplishment
- Facilitators using a variety of teaching aids
- Understanding the learning material

5.5 LIMITATIONS OF THIS RESEARCH STUDY

The limitations of this research study can be summarised as follows:

The transfer of the findings to other similar situations is not feasible. It should also be kept in mind that South Africa's educational and cultural settings contributed to the uniqueness of this study. It should, however, be kept in mind that it was not the intention of this researcher to generalise the case, but rather attempt to provide sufficient information that may enhance the reader's understanding of how the grade 6 TekkiKids-learners experienced experiential learning as a method of instruction.

Also, my prolonged involvement with the TekkiKids Programme (as consultant) may have opened the door to bias at some level, as I supported the cause of the initiative. Even though I constantly reflected about this matter, and subsequently strived to be as objective as possible, this too needs to be acknowledged. However, my personal involvement with the learners might have contributed to the richness of the analysis of the documents, as well as the understanding of the learners.

Another limitation of this study pertains to the fact that the results of the document analysis could not be discussed with the grade 6 TekkiKids-learners. It should be noted, however, that in the creation phase of the documents, observations and notes were discussed with the learners, and this activity could be regarded as a form of member checking.

5.6 CONTRIBUTIONS AND RECOMMENDATIONS OF THIS RESEARCH STUDY

By exploring possible discrepancies between theory and practice, this research study might contribute to the existing body of knowledge on the subject of effective instructional practices pertaining to the science and technology field. This means that an awareness of the learners' need for more guidance should be incorporated in practice by the facilitators. It also means that the facilitators should be aware of the difference between their own goals pertaining to learning activities, and the learners' personal goals pertaining to their learning experiences. By being aware of the possible pitfalls and successes of a science and technology programme, as described in this study, future success of similar programme could be achieved. In doing this, learners might be encouraged to develop an interest in the science and technology field. The findings might especially contribute to the TekkiKids Programme. Addressing the programme's shortcomings and improving on its strengths might prove to be a more effective way of evoking the interest of the learners in the field.

In addition to this, a major contribution of this study pertains to the field of educational psychology, as it may prove helpful in addressing possible barriers to learning in an experiential learning environment, on a pedagogical level. Regarding the role of the

educational psychologist as a consultant it would seem that educational psychologists' have specialised knowledge and skills which could contribute significantly to the development and improvement of services rendered to learners and that their contribution to the development, evaluation and improvement of programmes such as TekkiKids could improve the development of scarce skills in the fields of science and technology. This awareness might assist educational psychologists to broaden their clients' prospects concerning career choice. Referrals to science and technology clubs might contribute to the support structure of educational psychologists and their clients, especially regarding learning support.

Regarding teacher guidance, educational psychologists might find it useful to guide teachers toward using an effective method of instruction pertaining to the development of learners' interest in the science and technology field. Teachers should be made aware of the importance of guidance pertaining to problem-solving, as a sense of accomplishment seemed to enhance the learners' learning processes. Teacher guidance regarding the science and technology field, especially when addressing cultural and language barriers, might also contribute to the learners' learning processes. Teacher guidance pertaining to the way teachers address group dynamics in a multicultural setting might influence the learners' learning experiences positively. Teachers might also be guided to improve their teacher-learner interaction skills, as this seems to be a crucial factor in the learners' development of responsibility in an experiential learning setting. Finally, this study contributes to providing facilitators and educational psychologists with insight into the manner in which learners experience teaching practices.

5.7 RECOMMENDATIONS FOR RESEARCH

The following recommendations are suggested pertaining to future research:

- A comparative case study of various science and technology programmes in South Africa within various school contexts.
- A study about the impact of socio-economic circumstances, culture and language on the self-efficacy beliefs of learners who participate in a programme such as TekkiKids.
- A study on the experiences of teachers/facilitators using experiential learning as a method of instruction.
- A study on the exploration of experiential learning as a method of instruction, with emphasis on additional structure pertaining to problem-solving.
- A study exploring learners' attitudes towards and level of interest in the science and technology field, before and after implementing experiential learning as a method of instruction.

- A comparative study of a learner-centred approach and a teacher-centred approach regarding the development of learners' interest in the science and technology field.
- A longitudinal study comparing learners' self-efficacy beliefs before and after experiencing experiential learning as a method of instruction. It would also be suggested that a similar study be conducted at the same time, with the only variable being a teacher-centred method of instruction. A comparison between these two studies might reveal which method of instruction had a positive (or negative) effect on the self-efficacy beliefs of learners.
- Programme evaluation of the TekkiKids Programme.

5.8 CLOSING REMARKS

This research attempted to explore and describe the learning experiences of grade 6 science and technology learners pertaining to experiential learning as a method of instruction. It investigated the manner in which this method of instruction influenced the grade 6 TekkiKids-learners' learning experiences. The study revealed learning experiences that were encouraging to the learners.

It is the hope of the researcher that this research study will contribute to a meaningful improvement of current science and technology programmes. Also, that it will provide educational psychologists as well as teachers with guidance concerning enhancement of the learning processes of learners.

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FACULTY OF EDUCATION

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	**CLEARANCE NUMBER :** EP/09/06/01
DEGREE AND PROJECT	MEd Educational Psychology The experiences of grade 6 science and technology learners of experiential learning as method of instruction.
INVESTIGATOR(S)	Domenico Balsamo
DEPARTMENT	Educational Psychology
DATE CONSIDERED	31 August 2009
DECISION OF THE COMMITTEE	APPROVED

Please note:

For Masters applications, ethical clearance is valid for 2 years

For PhD applications, ethical clearnace is valid for 3 years.

ACTING CHAIRPERSON OF ETHICS COMMITTEE	Dr K Mohangi
DATE	26 August 2009
CC	Dr S Bester Ms Jeannie Beukes

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

APPENDICES

DOCUMENTS A
Feedback Report

DOCUMENTS B
General Fieldnotes

DOCUMENTS C
Individual interviews (Notes)

DOCUMENTS D
Questionnaire

DOCUMENTS E
Focusgroup (Notes)

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preoccupied with the laptops. However, differences in the nature of the computer related activities (of particular interest) were noticed.

3) Learners indicated that there was a discrepancy between what they expected to do as a TekkiKid and what they experienced to be the case. They expressed disappointment in this regard. → expectations. — led to. → neg emos.

4) Some learners eventually admitted that they did not enrol for Tekkikids themselves. These learners indicated that they were chosen by their educators due to their good marks in technology in relation to their peers. They apparently felt obligated to sign up; fearing that to not comply with the request/ suggestion of their educators might be held against them by the relevant educator. Subsequently, it came as no surprise that these particular learners (eventually) expressed the most dissatisfaction with their general experience as a TekkiKid; as was evident by their general conduct (including observable and reported negative attitude and subsequent lack of motivation pertaining to the program.

neg-

5) Learners reported substantially that the programme became boring, expressing the need to have more fun. Further investigation towards this notion yielded that the learners preferred a greater variety of smaller, yet diverse tasks. The learners also suggested that they would enjoy activities such as outings, guest speakers as well as small (friendly competitive) games. Preferred activities → need.

6) Extra mural activities proved to be somewhat of a dilemma. Learners wanted to, or were expected to participate in after-school activities such as sport, extra classes and even spending more time on homework and/or forthcoming assignments. However, one should ask oneself to what extent the reported negative responses (stating extra mural activities as problematic) can be ascribed to those particular learners not actually wanting to be a part of TekkieKids or feeling overwhelmed is truly the case? Evidence seems to suggest that it might be a bit of both.

Language

7) The learners struggled to follow long verbal instructions as well as lengthy (solely) verbal explanations of concepts they needed to understand (master) in order to complete session goals.

Date 31/08/07

Upon arrival: Chilren are emediately dramn to PC

Observerd need: children from previously disadvantaged school in particular

Due to limited exposure to PC's...limited rescources?

Note: Link fun and Technology...things that learners aren't used to

Will keep their attention, well motivated...goal directedness

Distractibility issue: Learners do not seem focused. Some work, others play on the PC (solitaire), some bicker. Why?

(?) Seems: Not interested... "we have been doing the same thing now for ever..."

"It's always the same"

Observations:

Distractibility

Limmited interaction:

Mutlicaltural issue: Learners from the privalidged school seem to 'take over' the groupwork. Learners from previously disadvanted school appear more reserved...taking a back seat.

Pesonality tipes? Extraverted learners takes charge

Learners frown (instructions were just given to them: verbally)

(?) "No idea, we lost him after the first sentence"

Note:

At very first session: Implicitly encourage healthy competition (groupwork skills and getting to know each other)

Group then selects its own members, each with different roles

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Date: 3 Sept 07

Venue: Arcadia

Individual interviews

3 learners wanting to quite

Scored 0.5, 0,5 and 0.25 (respectively) out of 10 with regards to "favorable attitude towards the program".

1) (Girl) Nothing- "Cause the name sounded fun"...games
"Sir chose me"
"we just building things, like you do in technology": (eg)pullies, gears, cranes..."
"Clashes with English"

2) (Girl) Nothing- "Gonna be laptops, not programming"
"Sounded more fun"
(Thought) "play games on the laptop...play on the internet"
"The boys like robots, we don't"
Would have liked it to be more like arts and crafts:
eg. Paint, glitter, clay, drawing
Clashes with English

3) (Boy) Nothing- "Sir just chose me" : feels guilty if said no
Just took it for extra-mural points: for high school
Mom also wanted him to join
Expected more of a thrill, more creativity
"They showed us models we didn't even build"

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B

Date: 2007-10-11

3

TekkiKids

Dear TekkiKid

Please answer the questions below using the following codes:

1= I **totally disagree** with the statement
2= I **disagree** with the statement
3= I feel **neutral** (I do not agree but I also do not disagree)
4= I **agree** with the statement
5= I **totally agree** with the statement

Please circle the relevant number

	Totally disagree	Disagree	Neutral	Agree	Totally agree
I enjoyed today's session	(1)	2	3	4	5
Why/why not? Motivation ↳ lack of interest	coz it they wasn't any thing interesting happening.				
	Totally disagree	Disagree	Neutral	Agree	Totally agree
Today's session was fun	1	2	(3)	4	5
Why/why not? • Need for variety	coz we wern't doing any thing (exciting) or (different)				
	Totally disagree	Disagree	Neutral	Agree	Totally agree
Today's session was interesting	1	2	(3)	4	5
Why/why not? • challenging (good) ↳ level = ✓	coz we hade to think carefully how we were going make our mode work				

	Totally disagree	Disagree	Neutral	Agree	Totally agree
Today's tasks were difficult	1	2	3	(4)	5
If you answered yes, what in particular did you find difficult? challenging (+ neg) → diff	our bump sencer wasn't working so we hade to figer out wat was wrong.				
	Totally disagree	Disagree	Neutral	Agree	Totally agree
I like working in groups	1	2	3	(4)	5
Why/why not? pos-towards groupwork → cognitive load distr.	coz you can get help and ather ideas from your team mates.				

Section 2

2.1) When I woke up this morning and realized that I had to go to TekkiKids I felt (Intrested) / bored / happy because I was wondering what we are gona do today and I was (happy) coz I knw dat we were gona finish off our model. (Motivation)

2.2) What did you enjoy about today's session?

Playing games nd ~~bui~~ rebuilding our moole and correcting our mastakes. (talk orientated / challeng = good)

2.3) What did you not enjoy about today's session?

They was no new chalenge for us 2day we were doing wat we did last week. (need variety)

Thanx!

U R a ★

Focus Group:

Liked the robots they build

2hours was to long: rather 1h/week

Maze: bit frustrating: was to hard (level), "we needed to go back and do it over and over and over and over...

Calculate all the distances!

"Fab lab" was nice. Liked the outing

Frustrating: do work at school, work at TekkiKids for 2hrs!, then work at home again.

"We can like, go places and people can come and talk to us about technology and stuff. Like a guest speaker.

"The building part is cool"

"Taking photos"

"working on the laptop"

Drawing