

# Chapter Two

## Review of literature relating to the conceptual theoretical framework

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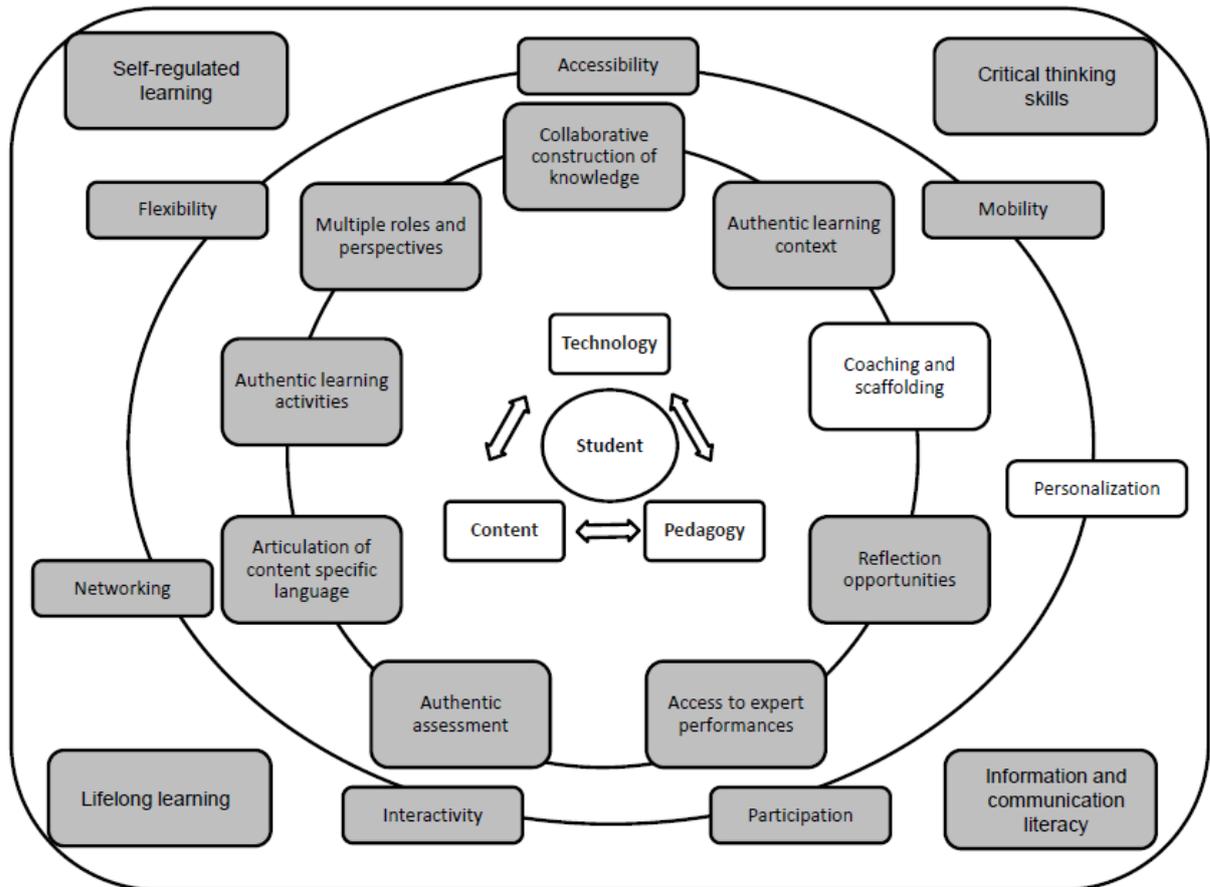
### 2.1 Introduction

This chapter reviews the literature regarding the misconceptions in DC resistive circuits, and the use of screencasts to address these misconceptions. The selection of the literature for this review is based on an adaption of the conceptual-theoretical framework for the implementation of educational technologies of Barker, Capece, and Rouch (2010). As this study forms part of a bigger project on the implementation of educational technologies, the review comprises the following aspects: (a) the student in his/her specific context; (b) the interconnection and interrelation between *content*, *pedagogy* and *technology*, focused on the *student*; (c) specific design principles related to the implementation of screencasts as learning and teaching tools; and (d) *personalisation* as a criterion for excellence.

The literature study disclosed a gap in the literature regarding the specific use of screencasts as learning and teaching tools in engineering courses within the context of FET colleges. Therefore the focus of the study was on the evolvement of design principles necessary for the implementation of screencasts in this regard.

### 2.2 Conceptual-theoretical framework

A conceptual framework is an interrelated set of thoughts (philosophies) around how a specific singularity is connected to its parts. The framework assists as the foundation for understanding, the underlying patterns of inter relations across actions, thoughts, annotations, theories, knowledge, understandings and supplementary components of know-how (Turro, Morcillo, & Busquets, 2010). A conceptual-theoretical framework is a plan or strategy guiding the literature review of the study (Stiles, 2013). The conceptual-theoretical framework used in this study is an adapted version of the framework suggested by Barker et al. (2010), and as part of this study forms part of a project aimed at the implementation of a number of ICTs. Figure 2.1 illustrates the conceptual-theoretical framework of Kruger and highlights the aspects applicable to this study.



**Figure 2.1: An adapted conceptual-theoretical framework for technology-enhanced learning** (Barker et al., 2010)

This conceptual-theoretical framework consists of five layers, namely the student in a specific context, the interconnection and interrelation between technology, pedagogy and content, focused on the student, design principles, criteria for excellence and higher level outcomes.

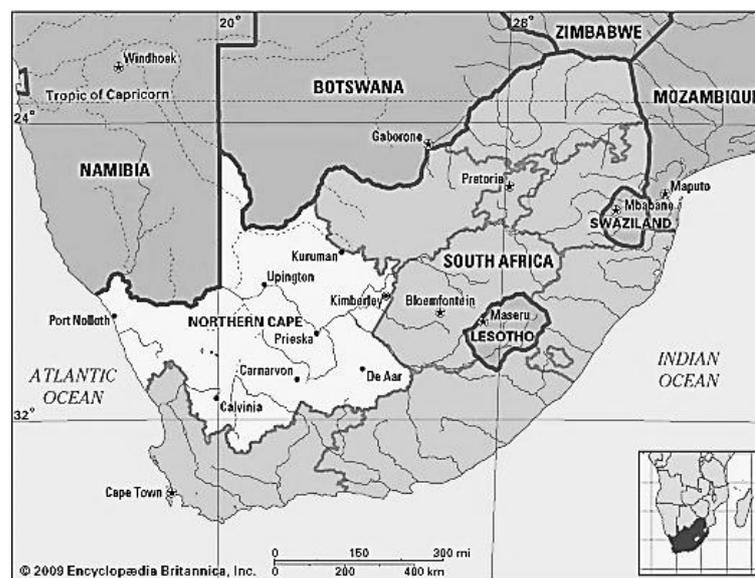
The adapted conceptual-theoretical framework that will guide this study is aimed at the implementation of screencasts as an Information and Communication Technology (ICT) in FET college programmes. The adapted framework consists of four aspects (from the centre outward): (a) the student in his/her specific context; (b) the interconnection and interrelation between content, pedagogy and technology, focused on the student; (c) specific design principles related to the implementation of screencasts as learning, teaching and scaffolding tool, and (d) personalisation as a criterion for excellence. Although higher level outcomes may be reached, it is not part of the focus of the study.

### 2.2.1 Student

Teaching and learning should be more than students sitting in lecture rooms, attaining skills and abilities that can be accurately assessed. It should be a process where a student acquires self-fulfilment in a process to acquire a better standard of living (Mukora, 2008). According to the South African Bill of Rights every child has the right to education (Sapa, 2012). However, after nearly two

decades into democracy, a large number of South African schools still have insufficient vital learning resources. This leads to students not receiving an effective education. The Human Sciences Research Council (HSRC) in South Africa reports that twelve million children live in poverty. Statistics reveal that 81% experience monetary and physical deprivation and many live in shacks. More than fifty per cent live in homes where nobody is working. Approximately 24% are in the wrong grade for their age and six per cent do not attend school. Of these children 24% live in households with a single parent and in some cases in child-headed households, being in charge of and responsible for their siblings (South Africa, 2013). Children are forced to leave school and start working for minimal wages. HIV/Aids also has a large impact on the school attendance of learners. Children drop out of school to support ill parents and offer care or assistance economically by doing poorly paid jobs (Mukora, 2008). Lecturers and teachers infected with HIV/Aids are often absent or too sick to deliver acceptable teaching. Auxiliary lecturers may not have the skills or qualifications to efficiently replace qualified lecturers (Mukora, 2008). HIV/Aids consequently influences not only the students but also the lecturers and teachers in the education system. Despite nationwide efforts to bring back a culture of education, events of robbery, defacement, vandalism, break-in, rape and even murder are reported on college and school grounds. Education should essentially begin at home, with a disciplined upbringing which could be developed in future years in schools and colleges. The college and school surroundings are tainted through criminality and violence which threaten the educational procedure (Mukora, 2008). In view of these influences on the academic development of some of the students enrolling for further education at our campus, interventions and guidance are vital in assisting these students to reach their full potential.

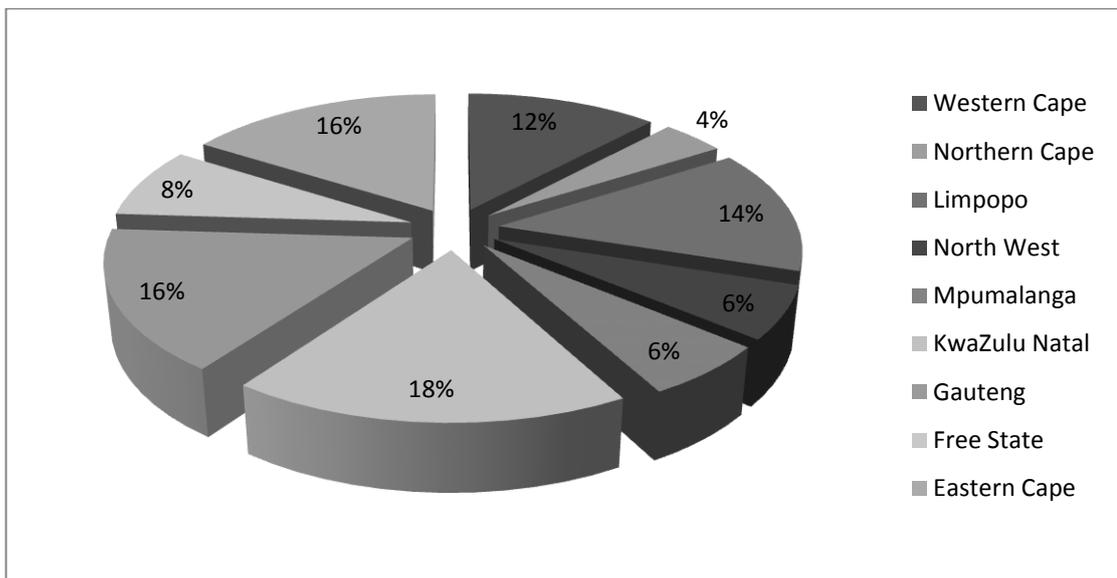
The Northern Cape is South Africa's largest province: 30,5% of South Africa's surface area. It is, however, also the most sporadically inhabited province in the country, with the concentration of its 1,1 million population (2,3% of the national population) that represents about three people per square kilometre (Figure 2.2).



**Figure 2.2: Map of South Africa showing the Northern Cape Province**

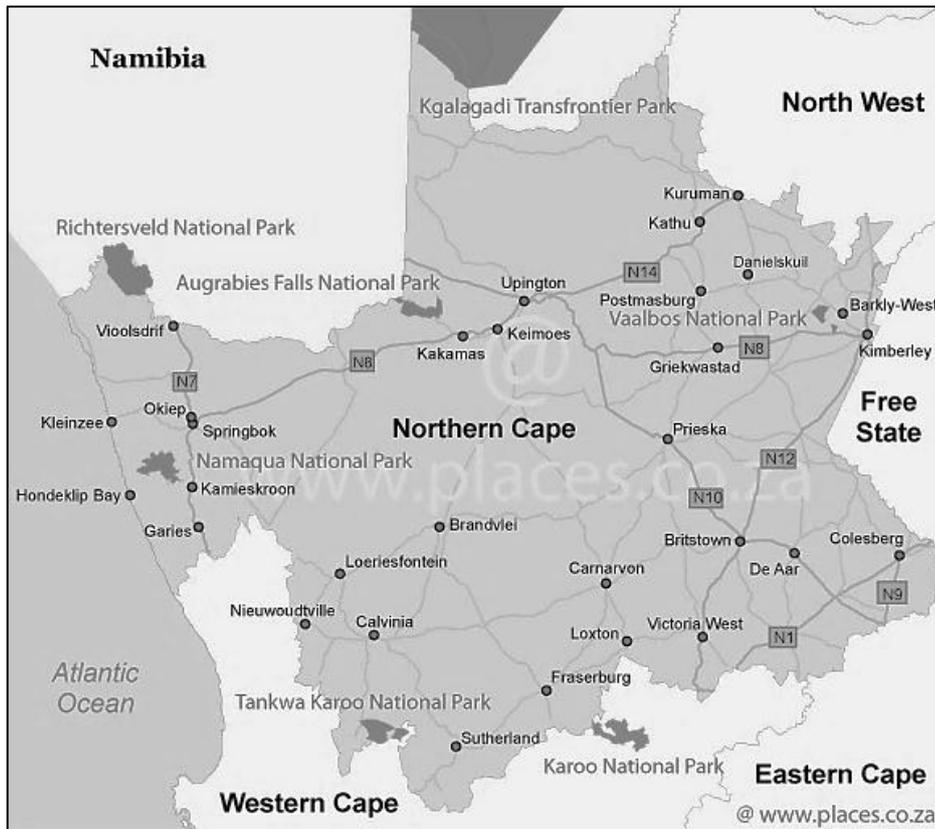
Much of this can be attributed to the natural environment of the Northern Cape. Apart from the narrow strip around the major rivers, which are widely used for irrigation, it is mostly semi-arid to the most dry Province, these irrigation areas forming a stark contrast with the adjacent Karoo, Kalahari and Namaqualand landscapes. Agriculture—which is one of the main industries in the province—consists typically of widespread stock farming due to the low carrying capacity of the land. At the same time though the Northern Cape has been blessed with some of the most extraordinary mineral prosperity in the world—the misuse of which has given rise to the foremost contributor to the provincial economy, ie the mining sector. The copper mines round Springbok and Okiep are the oldest mines of the colonial era in South Africa, going back to the late 17<sup>th</sup> Century. Then the Northern Cape, mainly the area between Kimberley and the Bushman land, is not only the origin of the modern diamond mining industry—which still continues to be a noteworthy contributor to the provincial economy to this day—but it is also known for some of the world’s largest limestone, iron ore and manganese mines (SouthAfrica.info, 2012).

The Northern Cape Rural Further Education and Training College (NCRFET College) is one of the fifty amalgamated colleges in the country and serves a part of the four per cent (Figure 2.3) of students attending Colleges in the Northern Cape.



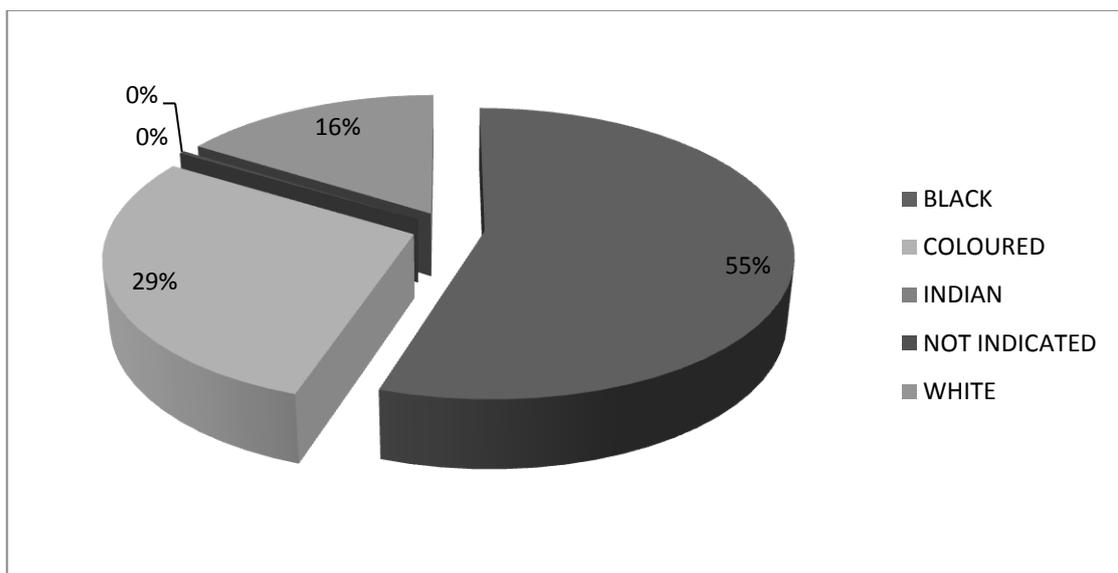
**Figure 2.3: Percentage distribution of FET Colleges per province (Jones, 2010)**

The NCRFET College consists of five campuses situated in the following towns: (a) Kuruman, (b) Kathu, (c) De Aar, (e) Upington and (f) Okiep. Only three of these campuses provide engineering courses namely: (1) Kathu, (2) Upington (3) Okiep. Figure 2.4 shows a map of the Northern Cape Province with the major towns.



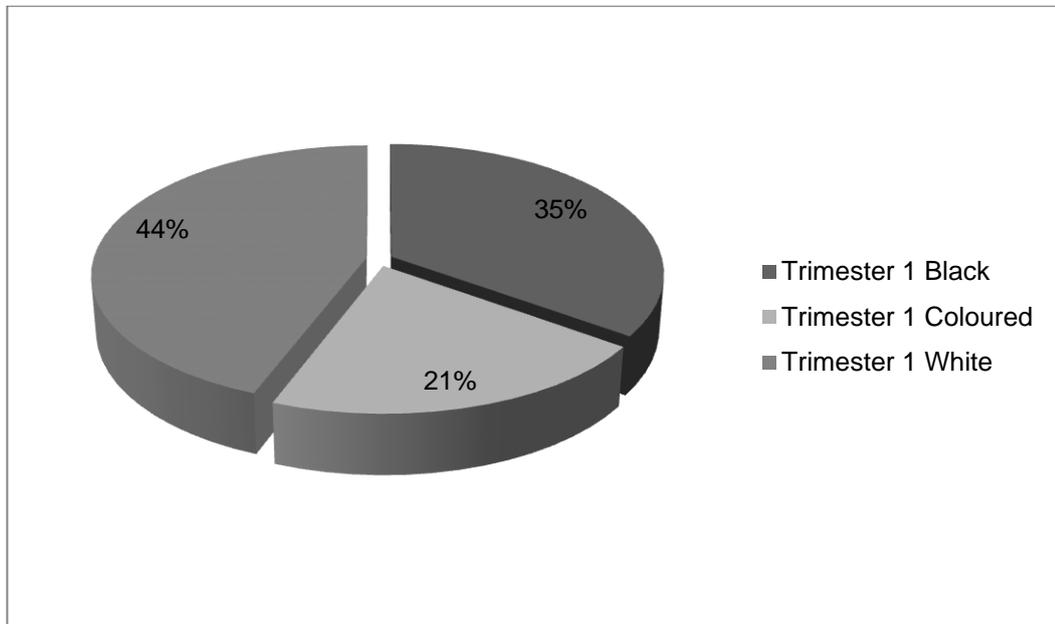
**Figure 2.4: Map of the Northern Cape Province indicating the major towns relating to this study**

The Kathu campus serves an area from Kuruman and its surrounding rural towns in the East, Blackrock/Hotazel in the North, Postmasburg/Daniëlskuil in the South and Olifantshoek in the West. Students attending courses at the campus are predominantly Black (55%) with 29% Coloured and 19% White students (Figure 2.5).



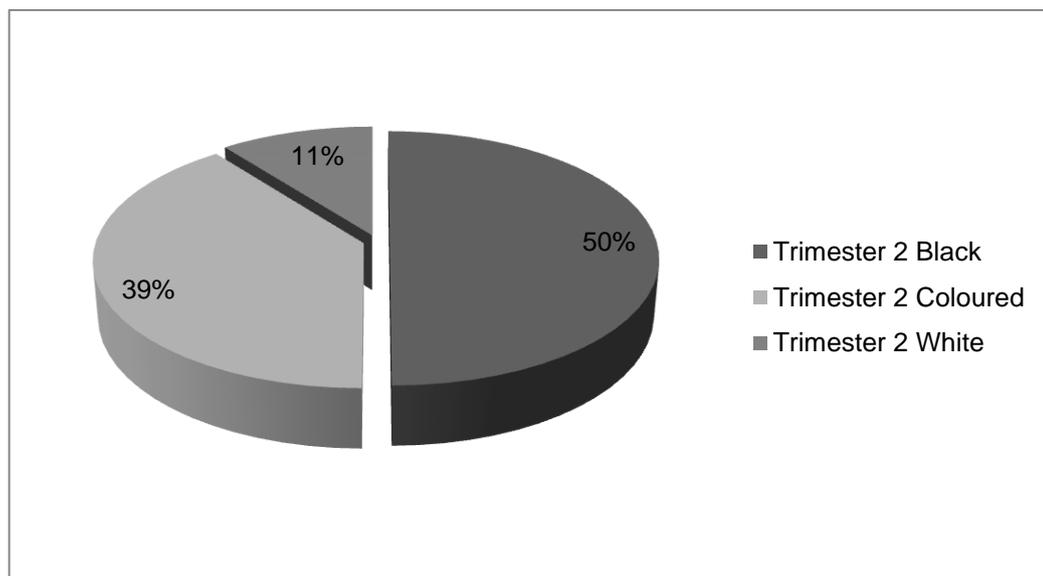
**Figure 2.5: Percentage distribution of ethnic groups at Kathu Campus 2013** (SAinfo reporter, 2012)

The students attending the Industrial Electronics course in the first trimester (n=43) resulted in a different representation where the white students were 44% the Black students 35% and the coloured students 21% (Figure 2.6).



**Figure 2.6: Percentage distribution of ethnic groups at Kathu Campus trimester 1 of 2013** (SAinfo reporter, 2012)

Figure 2.7 presents the ethnic representations of students in the second trimester, noteworthy in this case similarity of ethnical distribution nationally.



**Figure 2.7: Percentage distribution of ethnic groups at Kathu Campus trimester 2 of 2013**  
(SAinfo reporter, 2012)

The reason for these differences in the number of students enrolling is dependent on students that the mines and other employers send to the campus for further education and training (Figure 2.1). The population (n=38) consisted of fifty per cent Black students, 39% Coloured students and 11% White students.

Within the South African context and explicitly the context of FET colleges numerous students attended dysfunctional schools and it is vital to enhance these students' knowledge and skills so that they will be able to meet the demands of the society they will work and live in. Modern literature on pedagogy endorses pedagogical procedures using educational technologies to supplement the teaching and learning experience of students (Auerbach & Ferri, 2010; Wiig & Wiig, 1999).

### **2.2.2 Technology**

For lecturers to be effective in their profession, it is essential to improve pedagogy with the use of educational technologies in their specific subject fields. By means of ICTs lecturers can track improvements in their subject fields. They can convey the modern-day methods and uses concerning instruction approaches into their teaching, and keep themselves informed. For these reasons, TEL performs a significant part for lecturer knowledge development. In current years, computer and instructional expertise have developed in a vital portion of our lives by influencing our education and communication. Uses of these technologies in our day-to-day lives turn out to be extensive as these technologies offer persons with numerous advantages and chances (Figure 2.1). Screencasts is one of the aspects of TEL that we as lecturers can use to adapt to the contemporary way of teaching and learning (Oud, 2009; Perraton, 2010; Pinder-Grover et al., 2008).

#### **2.2.2.1 Screencasts**

There are different definitions for screencasts in the literature (Figure 2.1). In summary a screencast is a recording of actions on a monitor screen accompanied by audio explanations enhancing the procedure of instruction and learning. Thus screencasts can be used to employ two senses: seeing and hearing. Screencasts can be used to describe and clarify different concepts improving understanding of concepts. Screencasts provide lectures with the convenience of taking breaks at any time and the ability to repeat intellectually complex parts of a presentation (Herrington & Kervin, 2007; Mangieri, 2009; Wang & Hannafin, 2005).

From the literature the rationale for the use of screencasts comprises a wide range of whys and wherefores. Changing from teacher-centred to student-centred teaching have the advantage of stimulating the student's perceptive action and boosts the instructive value of the information learning

contextual. Screencasts allow lecturers to be more effective for example they do not have to repeat an explanation several times in lecture hours; instead they can refer a student to one or two screencasts and ask the student to return with queries. Students and lecturers can then add value to the lecturing hours to concentrate on resolving problems (Mohamad Ali, Samsudin, Hassan, & Sidek, 2011; Tredoux, 2011).

Oud (2009) concluded that screencasts are becoming a significant tool for education environments. When used properly and sensibly, screencasts being vibrant visual representations plays a prospective important role in complementary learning. Educational technologies can be used to take advantage of students' strong points and compensate for weaknesses. Screencasts can be used to supplement teaching materials to assist DE students in all academic disciplines (Jesus & Moreira, 2009; Periago & Bohigas, 2005; Toto, 2007).

### **2.2.2.2 Application of screencasts**

In my review of the literature focussing on the application of screencasts various authors reported interesting applications. Screencasts can be used not only as a tool to capture lecturing, but as a means to provide personalised feedback to students, or during peer-review where commented on their peers' work. Therefore screencasts can provide a simple means to enrich course content to DE students. Screencasting permits lecturers to provide learners with detailed response on questions and assessment explanations. Screencasts encourage an informal and inexpensive way of manufacturing audio-visual instructional material that could be used in various educational settings. Short explanations of core content can form part of reference material. Screencasting can be used to provide students with the means to revise and repeat the learning material for deep learning and understanding complex concepts. By using web-based media, presentation of material is independent of place, time and written text. Individuals can learn or revise their work according to their own needs. Communication can also be established between lecturers and students by means of screencasts. Students respond positively to the use of screencasts in their online classes for a more personalised approach to a course. Students are inspired to learn course material and theory because they can see the relevance in the real world (Alfaro et al., 2005; Bernhard & Carstensen, 2009; Bolliger, Supanakorn, & Boggs, 2010; Nichols, 2007; Oud, 2009; Periago & Bohigas, 2005; South Africa, 1996; Wang & Hannafin, 2005).

Birch and Sankey (2008) and Tredoux (2011) have categorised the use of screencasts as:

- *Example problems*: Screencasts that is solutions to numerical problems for example those found at the end of each module
- *Exam reviews*: Screencasts that present solutions to problems out of previous exam question papers
- *Software tutorials*: Screencasts explaining the use of software

- *Explanations of how to use tables or graphs:* Screencasts used to explain how to use RCL-vector diagrams
- *Explanations of confusing concepts:* Introduction to a new chapter or mini-lectures.

The use of screencasts fits well with the instruction of Industrial Electronics in that it offers digital video of how misconceptions in DC resistive circuits can be addressed. Screencasts with diagrams explaining the concepts in the lecturers own voice explaining the directions for a better understanding of the concept (Oud, 2009).

### 2.2.2.3 Advantages of screencasts

Table 2.1 summarises the advantages of screencasts to students.

**Table 2.1: Advantages of screencasts for students**

Advantages of screencasts to the student	
Screencasts offers students the freedom to choose when, what, where and how they study and increases learners access to laboratory experience, no time and place constraint	(Bernhard & Carstensen, 2009; Engelhart, 1997; Nichols, 2007; Oud, 2009; Periago & Bohigas, 2005)
Novice learners who have little domain-specific knowledge benefit most from screencasts and it is believed that this way of instruction enhances the encoding of information and increases learning speed and understanding of concepts	(Engelhart, 1997; Herrington & Kervin, 2007; Hoadley, 2004; McKenney, Nieveen, & Van den Akker, 2006; Toto, 2007)
With the use of screencasts, learners are better equipped for learning new topics that integrates the basics of a subject	(Bernhard & Carstensen, 2009; Engelhart, 1997; McKenney et al., 2006; Pretorius, 2011)
Screencasts are a method of observational tutoring subsequently they endorse learning by observing and repeating conduct by others and improves the learner's assimilation and memory, it stimulates more of the learner's senses	(Herrington & Kervin, 2007; Hoadley, 2004; McKenney et al., 2006; Toto, 2007)
Students understand that screencasts offered them an explicit relation amongst well-known tutoring purposes and the expected minimum time requirements for completing them and provides complete control to review the learning material at one's own pace	(Bernhard & Carstensen, 2009; Engelhart, 1997; Herrington & Kervin, 2007; Hoadley, 2004; McKenney et al., 2006; Toto, 2007)
Greater flexibility access	(Bernhard & Carstensen, 2009; Engelhart, 1997)
Material can be viewed on computers, iPods and mobile phones	(Bernhard & Carstensen, 2009; Engelhart, 1997)
One method for being more contemporary in e-learning, particularly in DE, is using screencasts through access anytime from any internet connection	(Bernhard & Carstensen, 2009; Engelhart, 1997; Herrington & Kervin, 2007; Hoadley, 2004; McKenney et al., 2006; SPSS, 2012; Toto, 2007)
Material can be played and rewind to recap multiple times	(Bernhard & Carstensen, 2009; Engelhart, 1997)

Table 2.2 lists the advantages of screencasts to lecturers.

**Tabel2.2: Advantages of screencasts for lecturers**

Advantages	
Minimising repetition of explanations	(Bernhard & Carstensen, 2009; Engelhart, 1997)
Additional screencasts can be given for high achievers	
Numerous examples can be created for reinforcement	
Providing digital resources	
Materials can be reused	

The following is a summary from my review of the literature regarding the advantages of screencasts. Authors reported that students in the engineering field of study found the homework solution and mini-lecture screencasts helpful. Combining sound and images in screencasts enhances learner's experiences in comparison to traditional text format. They used them most often as a study resource, particularly for exams. Screencasts can be used to complement education materials or as inquiries from distance education students. In contrast, the vast majority of students watched the mini-lecture screencasts from start to finish, most likely due to their brevity. Students who watched the screencasts completely (either homework solution or mini-lecture) were also significantly more likely to report gaining a deeper understanding of the material. Students appreciate the accessibility of education on the go and repetitive learning while colleges can use screencasts to offer education beyond the physical borders of the campus. Lecturers can use screencasts to enhance their instruction and to explain without boundaries in time or place. The use of screencast does not threaten the existence of the traditional lecture but expands its possibilities. Screencasts can enhance learning and they are more and more used for numerous purposes in higher education. They can be integrated into the instruction and learning process for supporting the student. Carefully manufactured detailed and spoken demonstrations through screencasts serve as a cognitive tool and a keen learning concept, which will improve the combination of learning material with the students present perceptual understanding and knowledge (Grotzer & Sudbury, 2000; Oud, 2009; Periago & Bohigas, 2005; TechSmith, 2013).

Sengupta and Wilensky (2009) determined that the screencast nature of their CLEO system offers learners a prized source to enhance their electrical circuit analysis course and that the learners found the greatest worth in the screencast explanations for self-teaching and exam preparation. From the review of the literature it is clear that screencasts in the engineering field have extensive applications, lecturers produce theoretical work on a screencast and DE students can use the screencasts to learn about the theory. Screencasts can be used to provide an extensive part of the theoretical material of a course, thus freeing lecturers' time for individual teaching, discussion sessions, and practical teaching. Online screencasts can support many students, who spend an increasing amount of time on the Internet. Combining sound and images in a screencast enhances learning experiences to a personal level in such a way that students can use it in their own time and a place of their choosing.

### **2.2.3 Pedagogy**

What constitutes pedagogy is multifaceted and cannot be demarcated without difficulty. Even the definition of pedagogy gives the impression of being somewhat ambiguous. Pedagogy is the act of teaching composed by its related dialogue. It is what one requires to know, and the abilities one requires to grasp in order to make and validate the numerous diverse varieties of choices on which education is founded (Figure 2.1). Pedagogy involves not only the advancement of education in a constricted sense but it also necessitates a procedure of negotiating personalities amongst lecturers and scholars (Department of Higher Education and Training, 2013; Sahin, 2011). Pedagogy is the skill and science of actual teaching. Pedagogy is conventionally comprehended to indicate the tutoring of students but it has gradually begun to be used in a more universal sense that encapsulates ideas of andragogy (Nichols, 2007).

#### **2.2.3.1 Pedagogy of Industrial Electronics**

Due to the abstract nature of Industrial Electronics' subject concepts, explanations often involve complex language of instruction. The traditional approach to teaching engineering subjects is deductive, beginning with the presentation of elementary principles in lectures and going on to the repetition and application of the lecture content by the students (Prince & Felder, 2006). The misconception with Industrial Electronics is the fact that the subject deals with abstract, unseen notions such as voltage, current and resistance. In complex electronic circuits, the grasping of variations in these concepts can be overwhelming for the student. Many students perceive the content and learning material initially not only as too difficult to understand, but also as being presented at too fast a pace (Aydin, Aydemir, Boz, Cetin-Dindar, & Bektas, 2009).

In order to address these challenges the use of visual representations could be introduced in teaching and learning at an early stage (Bernhard & Carstensen, 2009). Students often do not grasp abstract concepts relating to the microscopic world of electrical circuits as they cannot see the flow of electrons (South Africa, 1996). This is evident in research done by Pulé and McCradle (2010) who made use of the example of a pull-up resistor (a pull-up resistor is connected between the positive pole of the voltage source and the input of an operational amplifier to stabilise the input). These researchers asked learners to explain the function of the resistor and from the explanations the researchers deduced that the students did not understand the function of the resistor. They concluded that the way resistors were depicted in given diagrams confused students. In another study Mangieri (2009) made use of a batteries and bulbs circuit to determine the understanding of current flow in a circuit. The students had to rate the brightness of the bulbs in three circuits. Half of the students who were tested, rated the bulbs incorrectly. Furthermore, Smaill, Rowe, Godfrey, and Patton (2012) concluded that the misconceptions of students were on a deeper level than expected, for example many students could not differentiate whether a component was connected in series or in parallel in a circuit. From the above mentioned examples it can be concluded that there are some of the misconceptions

that are generic to electronics courses. Bolliger et al. (2010) list some ideas on assisting students to a better conceptualisation in electronics:

- The necessity for the circuit to be closed in order to work. Learners should see a circuit as a complete system in which all the components are interconnected.
- The battery is not a current source. It should be made clear that the potential difference is an independent variable and the current as the dependable variable.
- Discriminate between voltage source and power source. Analysing the differences between the two would help the learners to realise that a battery is a voltage source.
- Current is not synonymous with energy. Explanation on the conservation of electrical charge and power is necessary.
- Avoid sequential thought. The idea is to see a circuit as a whole, where one change can have a chain reaction.
- Maintain the theoretical control of potential and intensity. Prevent students from applying Ohm's law automatically and in a thoughtless manner.

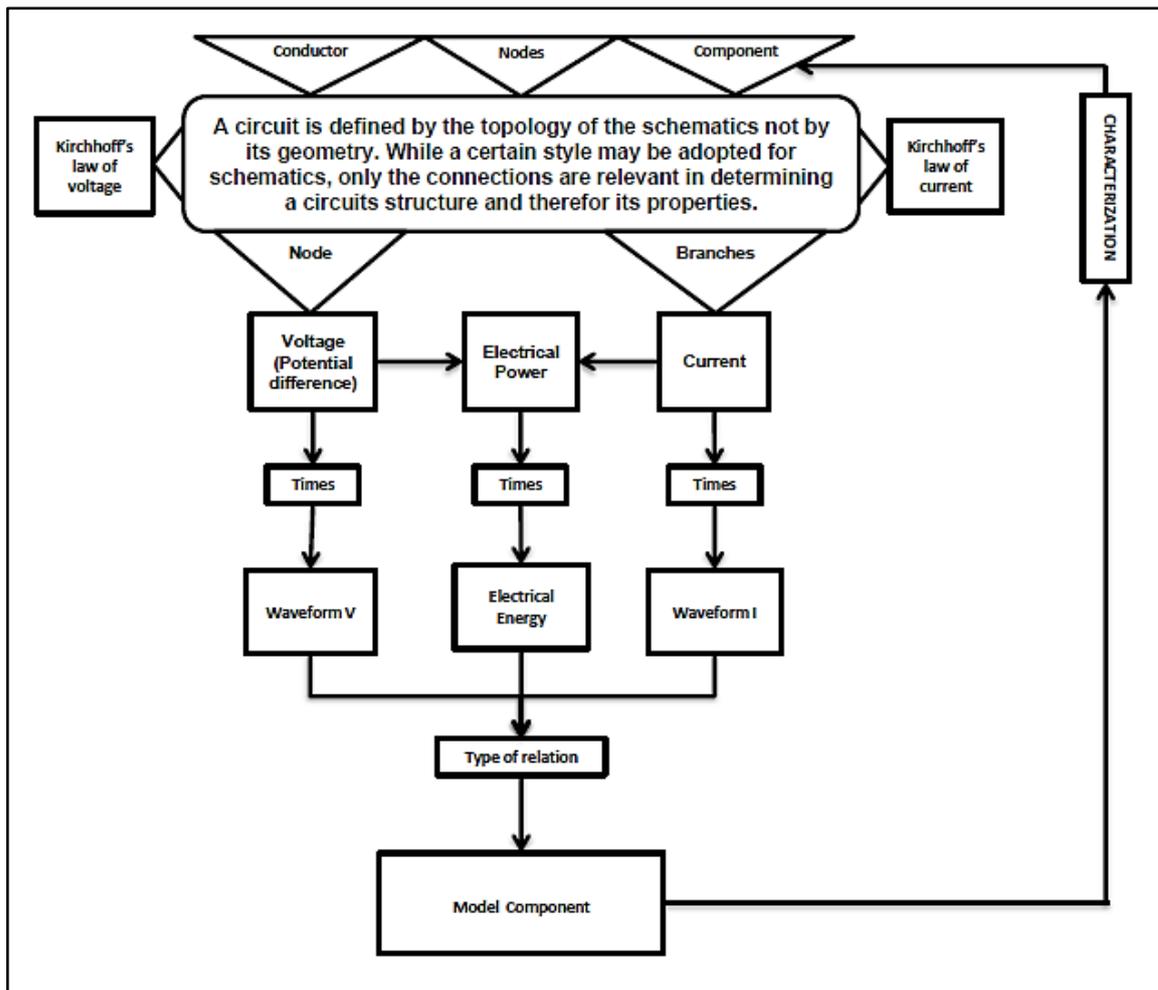
Electric circuits are critical in elementary Industrial Electronics curriculums and have applications in everyday life. Improper rational representations, which are intensely entrenched in daily knowledge, can meaningfully interrupt a students' knowledge. Before the lecturer can begin to resolve the misconceptions in Industrial Electronics, it is necessary to analyse what knowledge is essential to get a comprehensive understanding of resistive direct current circuits in Industrial Electronics. After the identification of the misconceptions, lecturers can use TEL like screencasts as a scaffolding method, not only to address the misconception but also to serve as basis for the next level of information.

#### **2.2.4 Content**

In the context of this study, the content relates to Industrial Electronics with specific referenece to DC resistive circuits (Figure 2.1). The understanding of electrical circuits can be divided into two main concepts:

- Circuit topology and Kirchhoff's laws. These deal with the spread of current and power in the series-parallel network. The purpose of series, parallel and series-parallel combinations of circuits is to reduce the current (parallel) or to reduce the voltage (series) in a circuit.
- The classification of components.

Because the syllabus only prescribes DC resistive circuits the second concept will not be addressed in this study. According to Métioui and Trudel (2012), the study of circuits and combinations of components within a circuit include more mathematics and less dynamics. A lecturer must keep in mind that the approach of concentrating on the circuit topology does not decrease the importance of the behaviour and working of a component such as a resistor. Figure 2.8 amalgamates the conceptual structure of electric circuits in a systemic approach (Métioui & Trudel, 2012).



**Figure 2.8:** Adapted conceptual structure of the electric circuits in a universal approach (Métoui & Trudel, 2012)

The following summary indicates the importance for a student to comprehend electrical circuits according to Métoui and Trudel (2012):

- Current is specific in a conductor and, by allowance, associates to the whole branch
- Voltage across the terminals of a part is definite between the two terminals
- Network examination is restricted to linear circuits; it is a precise procedure using fictitious miniscule currents
- Potentials are immobile. They change with time, but they do not move around. Within the frame of circuit concept, potentials are precise only on conductors and on the terminals of components
- To measure the voltage between two nodes, we must plug the voltmeter between these two nodes, the shared border-mark on the node position
- To measure the current in a branch, we must connect the ammeter wherever in the branch, the communal perimeter mark on the side of the end of the branch.

### **2.2.4.1 Misconceptions**

The term misconception refers to the understanding that students have of concepts that are not in line with accepted theory (Sencar et al., 2001). Incorrect pre-conceptions can influence the understanding of concepts that should be taught (Bull et al., 2012). Since Industrial Electronics comprises many abstract concepts, students may understand them in diverse ways. There are different reasons why students have misconceptions, e.g. instruction technique, preceding information, inadequate linking between concepts or between prior knowledge, and different textbooks. The challenge for the lecturer comprises the recognition of existing misconceptions and enhancing conceptual understanding to address these misconceptions.

### **2.2.4.2 Misconceptions in Industrial Electronics relating to direct current resistive circuits**

The study of Industrial Electronics, as an engineering discipline, consists of learning obstacles mainly caused by a lack of prior knowledge. Unlike other engineering courses such as Mechanical Engineering, Industrial Electronics offers fewer opportunities to develop a graphical sense of the subject. In Mechanical Engineering one can observe and touch a physical quantity. This physicality provides a scaffold for knowledge development. Research has shown that students find it challenging to view a circuit as a system and to comprehend those specific fluctuations in a circuit result in total fluctuations in the circuit. Therefore the use of circuit diagrams accompanied by graphs and mathematical equations is common practice. Industrial Electronics instruction is multi-layered since students need a solid understanding of the theoretic basis that leads the application of practical knowledge and problem-solving abilities (Auerbach & Ferri, 2010; Bernhard & Carstensen, 2009).

Insufficient conceptual knowledge combined with misconceptions relating to circuit theory is reported as causing learning problems with Industrial Electronics. In a recent study by Mangieri (2009) at Montana State University engineering students were given a simple test. From three circuits given to them, they had to predict the brightness of the bulbs. This study showed that fifty per cent of the students got the problem correct, and fifty per cent got it wrong due to misconceptions regarding basic electrical circuits. If the students' prior knowledge is not corrected, students build further knowledge on misconceptions and a snowball effect is created. Most typical misconceptions are failures to relate theoretical representations of electric circuits to the real circuits, restricted understanding of basic perceptions of electrical energy, and ineffectiveness to reason about the behaviour of electrical systems (Papadimitriou, 2012). Turgut, Gürbüz, and Turgut (2011) also witnessed that learners could not differentiate among some perceptions such as potential difference, current, power and energy since they were using these perceptions interchangeably. Emanating from the literature review the most common misconceptions of basic electronics can be summarised as follows:

- Concepts of current energy and potential difference are used interchangeably
- The battery is a power source that provides the charges moving in the circuit

- The power supply as constant current source, in which any power supply is believed to deliver an electrical circuit with a constant electrical current rather than electrical energy
- Current has been consumed by a close circuit's components. Therefore current reduces when it returns to the battery
- One pole connection. Merely one connection between a battery and a bulb is needed to give light
- The pooled current model, in which an electrical current is thought to be shared equally by electrical devices
- Current as impact. The current originates from both poles from the battery, when they bump into each other in the bulb, the bulb gives light
- Electrons carry a positive charge
- The consecutive model, in which it is presumed that a variation at a point in an electrical circuit affects the circuit forward in the direction of the current, not backward
- The short circuit misunderstanding, in which wires with no electrical devices are overlooked when examining an electrical circuit
- The parallel circuit misconception, in which resistors are thought of as a hindrance to current flow, supposing any escalation in number of resistors in parallel to raise the total resistance
- Limited reasoning, when a change in a portion of an electrical circuit, the local portion is focused on instead of overall examination
- The experiential rule model, in which the further away a bulb is from the battery, the dimmer the bulb would be
- Voltage across parallel branches is different for each branch
- Current can change in a branch
- The potential difference is a result of current flow, not its source
- Inappropriate use of Ohm's Law
- Light given off by a light bulb increases with the number of batteries connected to it (free from the kind of connection)
- Bulbs in series are always brighter (Bernhard & Carstensen, 2009; Bolliger et al., 2010; Bull et al., 2012; Küçüközer & Kocakulah, 2008; Peşman & Eryilmaz, 2010).

A particular external representation of a circuit could have positive as well as negative effects on conceptual understanding and could lead to certain misconceptions about electronic concepts. Conceptual knowledge is a result and not an initiator of learning activities, thus prior experiences of a student either promote or hinder intent concept formation. In an attempt to bypass conceptual difficulties, students resort to trivial and often incorrect interpretations, which lead to inappropriate reasoning (Mangieri, 2009; Von Aufschnaiter & Rogge, 2010; Wang & Hannafin, 2005).

Turgut et al. (2011) posit that the main features of misconceptions are the following:

- Misconceptions of learners who have different culture, faith and language are normally comparable to each other

- Misconceptions may deeply infiltrate into learners' minds and fight changing
- Everyday language, culture and belief can cause the development of misconceptions
- Misconceptions can be similar to the descriptions made by former researchers in understanding scientific occurrences
- Misconceptions may progress after an official education.

The misconceptions in Industrial Electronics outlined above were described in research conducted with students in different countries and with diverse age groups. The research emphasised a magnitude of student misconceptions, including the effort of differentiating amongst voltage and current. The misconception of current is used up by circuit components. What is recorded above is practically stated in entirely all the research about electronic circuits. The goal of effective Industrial Electronics teaching is to inspire the student to build an understanding that is usually dependable with recognised electronical theory. Once misconceptions in certain concepts emerge, the basis of the students' knowledge is not stable. The research above advocates the significance of education about the nature of interconnection, although education about specific examples of interconnection in aiding students is moving away from their misconceptions about the way in which electrical circuits operate. How to identify these misconceptions is vital to a student's education, as is teaching of simple electronic circuits to start with an effective teaching method for each individual student.

The didactic procedure in the hands of educators armed with modern technologies is moving in the direction of the rationalisation of education. Should the instruction material unconditionally back the learning procedure, it has to have evident qualitative features of which the most significant can be thought in particular to be the educational ones. The philosophy of pedagogy is not capable of offering an assessment structure according to which it would be likely to assess and, founded on detailed principles, obviously identify and recognise the quality of numerous instruction resources and their appropriateness (Herrington, McKenney, Reeves, & Oliver, 2007; Juuti & Lavonen, 2006; Küçüközer & Kocakulah, 2008; South Africa, 1996).

In current pedagogical procedure it is general to use the expression didactic technology in the background of physical didactic technology, while it is a limited perception of the outset of this expression in the pedagogical educational development, utilised in subsequent purposes:

- Motivational and simulative tools, i.e. technologies inducing an primary relation of the student to education, resolving misconceptions and thought-provoking conditions helpful to creative probing, learning, and accomplishment
- Sources of information conveying the subject matter closer to the student so that the process of attainment of info is made as informal as conceivable
- The instruction materials are planned to help the student—as the technology to understand the core of actions and influences through numerous means

- Technology for the systemisation of information making a linking with novel expressions and previously attained info, the education technologies are planned to make the student's organisation of subject content uncomplicated
- Technology helping for understanding operational procedures alongside with acquiring new procedures and outcomes
- Technology connecting college and real life
- Technology permitting the understanding of a differentiated method to the student (Dostá, Serafín, Havelka, & Minarčík, 2012).

The use of screencasts addressing misconceptions in relation to difficult concepts in DC resistive circuits may improve the conceptual understanding of students in this regard.

### 2.3 Coaching and scaffolding

Student-centered learning actions are planned to deliver students with chances to take a more dynamic role in their learning by moving the accountabilities of coordinating, examining, creating, and valuing content from lecturer to student. Starting from the student's viewpoint, followed by student-centered actions necessitate students to set significant aims for finishing the activity, presume more accountability for meeting those aims, and observe their development in order to decide if the approaches they are using to bring about their aims are successful. From the teacher's perception, the procedure of frequently observing student development during these undertakings and providing essential assistance and cooperation to students despite the fact that they are under pressure to conclude additional inquiry-orientated activities can be problematic, particularly if the lecturer has inadequate skill handling a student-centered lecture hall (Amiel & Reeves, 2008; Nichols, 2007; Van de Pol, Volman, & Beishuizen, 2010). These issues have led to the proposal that additional aids, or *scaffolds*, are needed to assist students and teachers engaged in this type of learning.

Scaffolding is interpreted as assistance provided by a lecturer to assist in the execution of a task that the learner might otherwise not be able to achieve. Van de Pol et al. (2010) summarised the numerous diverse descriptions of scaffolding encountered, as some evidently shared characteristics can be distinguished: The first shared characteristic in the numerous definitions of scaffolding is *contingency* frequently mentioned to as receptiveness, custom-made, accustomed, discriminated, or adjusted backing. The lecturer's assistance must be amended to the present level of the learner's performance and must either be at the same or a slightly higher level. The second shared characteristic is *fading* or the measured extraction of the scaffolding. The degree of declining assistance of the lecturer hinge upon the learner's level of progress and capability of the student. A lecturer is declining when the level and/or the magnitude of backing is diminished over time. Declining of the scaffolding is intensely linked to the third shared characteristic, namely the *handover of responsibility*. Through conditional declining, that is, accountability for the performance of a task is

progressively transferred to the student. Accountability is understood in this appraisal in a comprehensive sense: it can refer to learners' cognitive or metacognitive actions or to learners' affect. The accountability for knowledge is moved when a learner takes increasing control (Brush & Saye, 2002; Van de Pol et al., 2010).

From shadowing and collaboration with the varying aspects of the problem, students cultivate an inner depiction of articles, occasions and relations between them. As a student takes part in the problem resolving undertaking, conceptual images are fashioned or improved, and information transmission, if any, that appears is guided by the picture moulded in the mind of the student. The character and worth of the activities that take place in supplementary growth of a challenge solution will depend upon the fruitfulness of the conceptual illustrations that the student has fashioned. Conventionally lecturers have been the enablers of knowledge for their students. Whether this education has taken place through lecturer centred or student centred methods, the lecturer's part has been one of starting the education structure and scaffolding its expansion through numerous means of support. Scaffolding is commonly considered as backing for students though they are occupied in undertakings just outside their competences. It may range from supporting students while finishing a complete assignment to offering intermittent support. As the students' experiences develop, the lecturer progressively lessens the backing up until the student has grown to become self-sufficient with the allotted problem. Through frequently observing the development of all students, a more student centred method is adopted through engagement with multifaceted problems that include an analysis according to a grounded method to education (Brickell & Herrington, 2006; Brush & Saye, 2002). These shared characteristics are summarised in a theoretical model, portrayed in Figure 2.9.

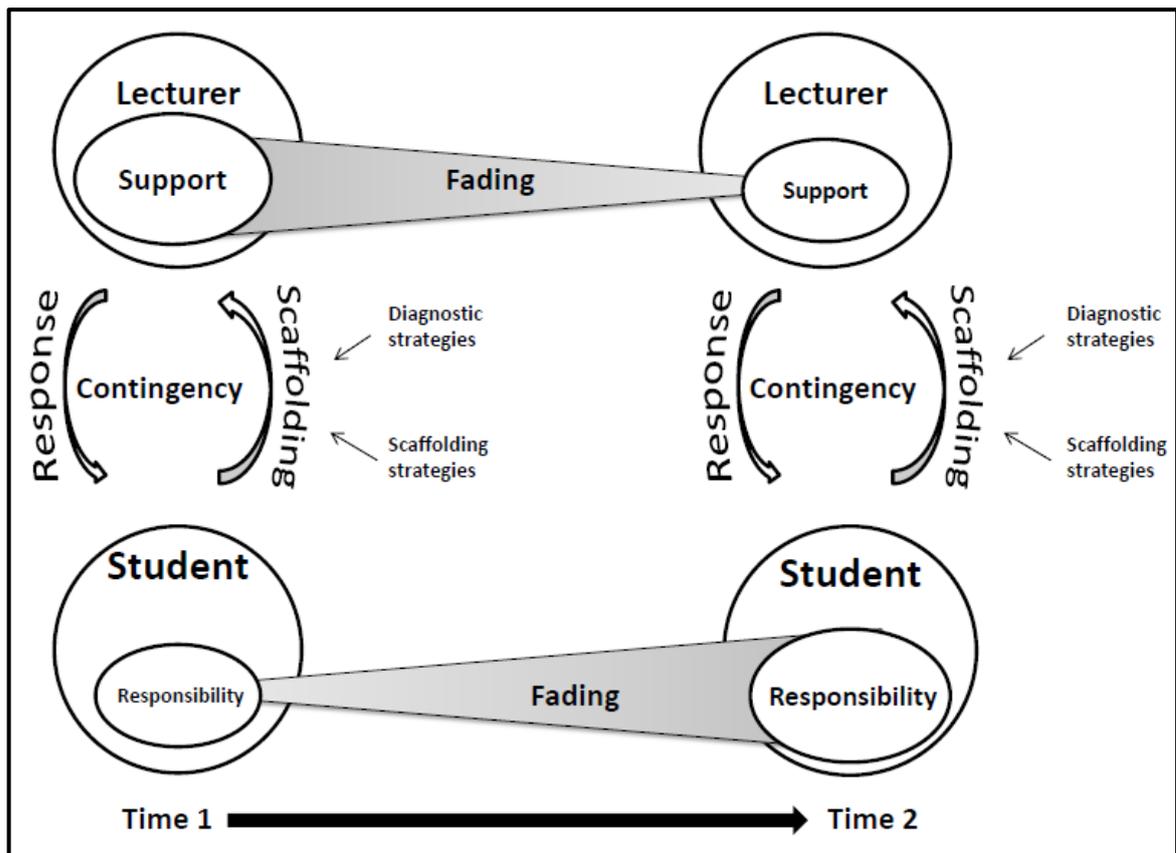


Figure 2.9: Adapted conceptual model of scaffolding (Van de Pol et al., 2010)

With the use of screencasts as initial backing and scaffolding the students' dependence on the screencasts will decline as they progressively take responsibility for their learning.

## 2.4 Personalisation

Up to the very recent, most theoretical learning and teaching structures have not been personalised. However, even today, personalisation structures are still mostly limited to practical teaching (Figure 2.1). In broad, to permit personalisation, prevailing structures use one or more categories of knowledge (learners' knowledge, education material knowledge, education process knowledge, etc.). Script by itself is not all the time the favoured method of communiqué, as web-based hypermedia construction and delivery tools including auditory (podcasting, Skype), photograph (Flickr) and audio-visual (screencasting, YouTube, Stickam) proficiencies are increasing. In general, personalisation in theoretical learning and teaching structures concerns adaptive communication, adaptive course conveyance, content discovery and gathering, and adaptive association backing. The classification of adaptive course conveyance represents the most collective and extensively used gathering of alteration procedures applied in theoretical learning and teaching structures. Characteristic examples include active course rearrangement and adaptive selection of learning objects, as well as adaptive course-plotting maintenance, which have all endorsed from the rise of using commendation policies to create new and applicable associations and items. In fact, one of the new procedures of

personalisation in learning and teaching environment is to give commendations to learners in order to support and help them through the learning and teaching process. Personalisation of learning provisions means that learning practices will be increasingly more adapted permitting the inclinations of the student. Personalisation of learning can contain the adapting of apparatuses, workstations, infrastructures, content, etc. to the requirements of the individual student (Alfaro et al., 2005; Khribi, Jemni, & Nasraoui, 2009; McLoughlin & Lee, 2008).

Personalised learning is a teaching and learning methodology which is positioned on the requests, abilities, and welfares of individual learners. Personalised learning is a distinctive learner-centred methodology to education that is progressively being used to guarantee that learners are able to meet their objectives and their potential. The abstract description for the consequence of personalisation is forthright: Using the person as an orientation point increases the student's attentiveness, which in turn inspires the student to use accessible perceptive capacity for active perceptive dispensation of the received material during education (Mayer, Fennell, Farmer, & Campbell, 2004)

Personalised learning necessitates an obligation to function cooperatively with learners to ascertain their individual learning requirements. Recognising the way an individual learner absorbs knowledge is critical to the procedure. If personalised learning is to be successfully applied in colleges, then educational institutions must likewise be dedicated to assist educators through applicable and actual on-going specialised improvement. Personalising education also obliges training organisations to have an obligation to lifelong learning and to arrange for learners with flexible education settings. Personalised learning ought not to be confused with individuals sitting unaided, learning and working through coursework. Personalised learning is about colleges encouraging a lifelong learning tactic which promotes sturdy relations between home, community, resident organisations and industries (Dostá et al., 2012).

In fact, the concept of personalisation is not completely new to educationalists, and it is frequently connected to the term learner-centred teaching, an anticipated state where students recognise in what way to select and make conclusions concerning their individual education requirements. However, notwithstanding the efforts of numerous constructivist lecturers, the controller philosophy of education triumphs and pre-packed content and pre-planned programmes remain to dictate, denying students choice and independence in determining their own education routes (McLoughlin & Lee, 2008).

Personalised learning changes the old-fashioned role of lecturers. Lecturers must transfer their emphasis from instructing learners as a collection of learners toward teaching learners according to their specific abilities and interests. Lecturers become facilitators and knowledge agents assisting learners to make the best appropriate choices. They must also react to the dissimilar behaviours of learners to achieve their best. An initial phase is for lecturers to recognise specific requirements, abilities, and preferred learning styles. This will enable them to modify their instruction and valuation exercise so that every single student has the chance to accomplish the highest conceivable standard.

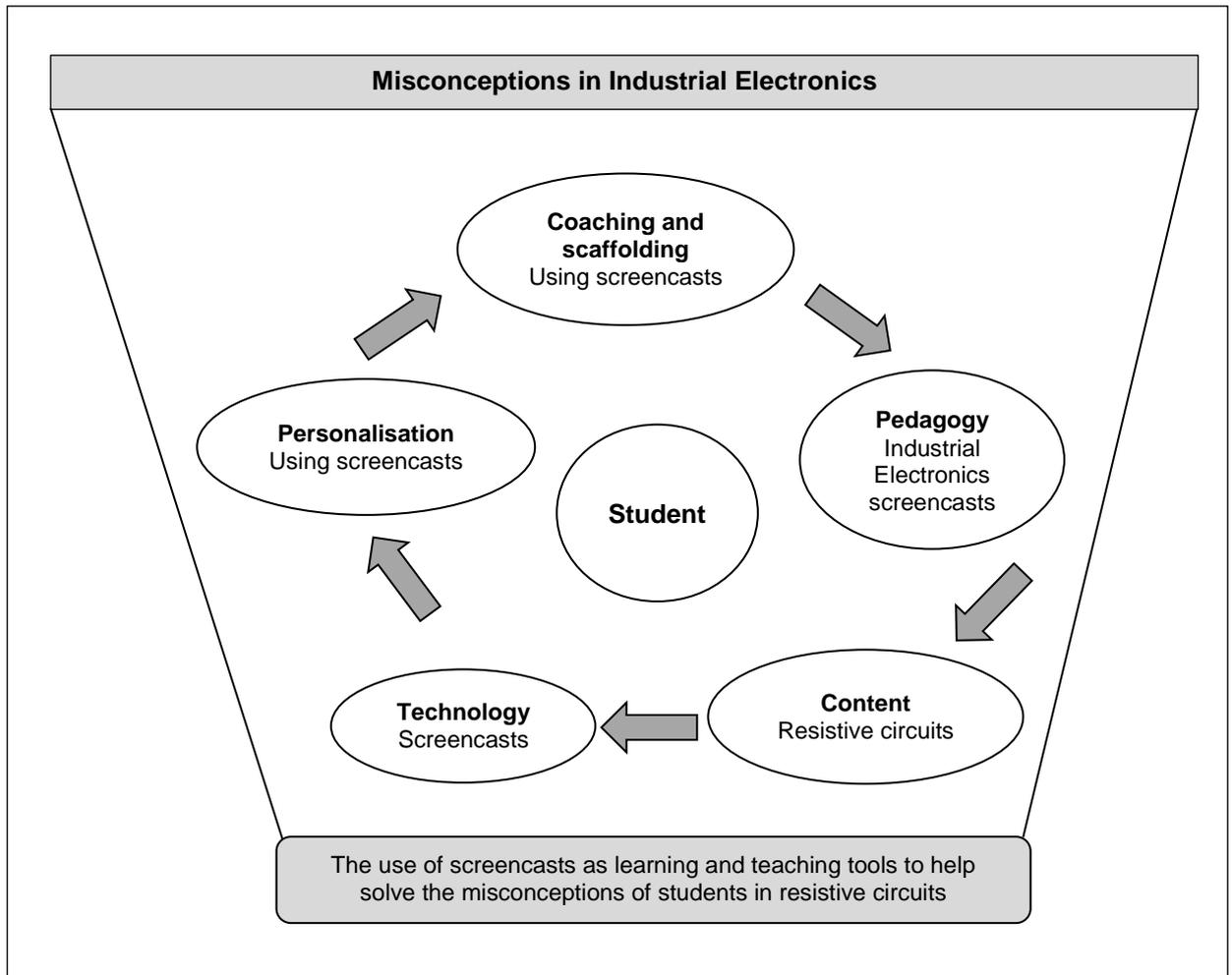
In personalised learning, lecturers customarily set distinct learning goals and frequently observe and analyse development toward these. They provide students with organised responses and demonstrate to them how to use these to improve their work. They also assist students to study by providing them with guidance on how to consolidate their learning and relate training abilities which have been established to be effective. They inspire students to participate in important self-assessment. In personalised learning, it is critical for lecturers to have high prospects for all students irrespective of background and capability levels, and monitor education requirements and development through continuing discussion and determinative valuation. Personalised learning necessitates students to use material on student development to adjust their learning. The grouping and availability of diverse media offer students a variety and accommodate dissimilarities such as character individualities, reasoning styles, inclinations, and education styles (Baylari & Montazer, 2009; Xu & Wang, 2006).

Personalisation increases the learner's curiosity; increased curiosity instigates the learner to apply more determination to involve in dynamic cognitive processing throughout learning, and a growth in dynamic cognitive processing throughout learning consequences in deeper learning, which is demonstrated in enhanced transmission functioning (Mayer et al., 2004). Adult students more and more anticipate an individual or tailored education environment. Students need education possibilities, selections, and personalisation.

By providing students independence of choice, lecturers can set the stage for student success (Bolliger et al., 2010). Further, the instructive use of TEL such as screencasts, permits more personalisation of the learning resources for students (Birch & Sankey, 2008). In terms of addressing misconceptions in DC resistive circuits, personalisation is vital to the acceptance of new technologies like screencasts.

## **2.5 Chapter summary**

In conclusion: to help the student become a fulfilled learner, the use of screencasts as a method to enhance the learning experience can have positive effects. Not only can the use of screencasts resolve some deep-rooted misconceptions, it can also be personalised to suit the individual student. Furthermore screencasts can form part of a *scaffold* of information to be used as a basis for new information.



**Figure 2.10: Summary of literature review in terms of misconceptions in direct current resistive circuits**

As seen in Figure 2.10, all the concepts (personalisation, coaching and scaffolding, pedagogy, content and technology) should interact with one another in order to improve the learning experience of the student by addressing the misconceptions in Industrial Electronics regarding DC resistive circuits.