How does the perception of science subject leaders’ roles influence effective technology integration in project based learning?

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Abstract
This paper explores the perceptions of science subject leaders (SSL) of their roles in technology integration in science projects. The research was carried out as a qualitative case study which was exploratory and interpretative in nature. The study covered a project cycle in an IGCSE School. It emerged that the perception of both the science subject leader and the other teachers she worked with influenced the effectiveness of the technology integration. The integration was further influenced by the SSL’s own perception of the integration. The perception covered three areas: students’ experiences; teaching, learning and assessment, and proficiency aptitude.

Key words
Leadership, Perception, technology Integration; Project Based Learning (PBL); Science Subject leader (SSL)

INTRODUCTION
In the educational system, it is clear that leadership plays an important role in the global trend for technology integration. Fullan (2005) has argued that with the increasingly diverse nature of societies, the revolution in communication technologies and the new attitudes to learning have ensured that complexity and change are unavoidable and are part of life in schools. According to Harris (2003), these global trends of enormous change have established that leadership needs to be based around notions of building a climate for change and being able to articulate, share and build a clear vision for good teaching and learning in subject areas. To build effective administrative leadership and use of technology, Hughes and Zachariah (2001) argue that successful leaders need not only to challenge the existing educational process and inspire a vision for meaningful change, but they also to provide the necessary support and modelling strategies to enable teachers to become part of a learning community.

Consistent with many other developing countries, Kenya has used ICT only to enhance the effectiveness of information presentation and to stimulate student interest using active multimedia (Yuen, Law & Wong, 2003; Malaba, 2005). However, ICT has not been used much in enhancing the teaching and learning processes. Yet, Kenya in its Vision 2030 endeavour sees ICT as a key aspect in enhancing teaching and learning. One way to accomplish this objective could be the development of selection criteria for the training of personnel. Thus, instead of random selection of participants, it is important to consider the participants’ beliefs, knowledge and experience (Calendar & Gates, 1993). These factors could influence the teachers’ understanding and subsequent adoption and implementation of change.

Currently, the initiation of such complexity has been managed only by the Head teacher who is considered the change agent. However, Burton and Brundrett (2005) have observed that head teachers have realized the need of assistance and thus the distribution of power and responsibility to the middle managers needs to be implemented. In such
circumstances the next in line managers are the Science Subject leaders (SSls), who assume the role of change agents and are expected to influence the enhancement of ICT integration in projects (ICT∫P). While looking at effective subject leadership, Bell and Ritchie (2002) advocate that subject leaders need to react to opportunities and their responsibilities. SSls often shy away from providing the necessary ICT leadership, thereby allowing the technical personnel to assume ICT leadership without the necessary administrative powers and understanding of teaching and learning of science. Apart from being computer literate, it is observed that most SSls also lack the technological pedagogical knowledge; hence they do not advocate the integration for PBL. The leadership dimension in this aspect has been either less emphasized or not discussed at all in the available literature on leadership. ICT∫P in science will remain poorly adopted unless strong leadership is provided to ICT initiatives (Michael, 1998).

Leithwood and Steinbach (2002) allege that effective leaders exercise an indirect but powerful influence on the effectiveness of the school and on the achievement of students. Hence, if we are to influence the effectiveness of a school and impact student achievements we need to target the leaders. The government is increasing the emphasis of the use of ICT in education. However, SSls are closer to the bottom end of the ‘league’ in terms of applying ICT in science education, when compared to other subject teachers (Michael, 2000).

There is a need for research to explore the effect of perception on SSls’ roles towards effective technology integration on projects. The insight gained from this study will inform head teachers, SSls and other teachers on the effect of perception on technology integration. The outcome could be used to identify and nurture perceptions that facilitate the integration process.

LITERATURE REVIEW

Key Players Perceptions on SSL roles in ICT∫P

A link between leadership and culture was established in a research study by Busher and Harris (2001) who established that leadership structures a culture and in some instances the culture nurtures leadership. Interestingly, the SSL has developed within a culture where leadership has been associated with the head teachers and a clear hierarchy situation (Hammersley-Fletchers, 2002). It is the belief that such an experience may have had an influence on how the SSls perceive their roles. As argued by Busher and Harris, there is a need to reconceptualise this notion to one which brings to realization the SSls’ perception of their leadership responsibilities and the enactment of their roles.

For effectiveness, Webb (2005) argues that the SSls need to believe that ICT∫P can support the students learning and that they have a role in planning and managing the learning experiences so that its implementation can match learning needs and enable students to apply it. Condie & Munro, (2007) maintain that change in education is influenced by the actor’s perception of their jurisdictions. On the other hand practice influences perception, Harris (2003) declares that a SSL who has an increasing focus on integration will be perceived as simply a teacher with additional responsibility. This clearly shows a dual relationship on perception and practices.

Unfortunately, SSL roles have been perceived in a very limited way - as subject specialists alone. Subsequently, (Bennett, 1995) the SSls see themselves as ‘specialists’, with a narrowly defined set of responsibilities. Harris (2003) labels such a balkanized approach “federal department” as witnessed in the science department. The SSL specialization may however, extend to other subjects. Bennett warns such an attempt might oppose “directions from the specialists in that field concerning both content and method” (p. 52). In such a situation Turner and Bolam (1998) reckon any attempts to improve the quality of teaching and learning in the department are likely to be seriously undermined. In light of
these perceptions, Harris (2002) identifies a contrasting case where “only one or two of the departments under her study were ones where the SSL was seen by teachers and pupils as a good and outstanding teacher” (p. 9). Such a scenario could have implications in the implementation on ICT\|P.

The senior management team of the school including the Head teacher have a crucial responsibility in determining the roles of an SSL. In their research on the roles of SSLs, Burton and Brundrett (2005) advise that the SSLs should take into consideration that the extent to which they are given responsibility depends very much on the attitudes and philosophies of the head teacher. This implies that level and nature of decision making regarding ICT\|P will depend on the extent of the delegated responsibilities and authority to the SSL and will be influenced by the Head teacher perceptions of the roles of the SSL.

**Perceptions of ICT\|P**

Many researchers have suggested that for the use of ICT-rich environments, teachers need to believe not only in affordances but also in themselves, because they have a crucial role in planning and managing the learning experiences so that affordances match students’ learning needs and their perception of them (Webb, 2005). The perception that ICT enables things to be done differently in schools may influence integration. Mwalongo (2004) explored teachers’ knowledge, beliefs and practices on ICT integration and found that they were interconnected. He established a dialectical relationship amongst the three attributes and argued that these influenced the integration of ICT in curriculum areas. He cautioned however, that in some cases it was difficult to identify the relationships to any degree of certainty. Hence, in this context further study in the specific area such as projects might establish a different perspective.

Furthermore, the nature of the curriculum could also influence the extent to which ICT is integrated. While reviewing the role of ICT in science education, Osborne and Hennessy (2003) found that as a result of the failure of the curriculum to incorporate exploration of the nature of scientific knowledge, ‘the pedagogy of school science has tended to be didactic, authoritarian and non-discursive’ (p. 3). Such tendencies should be considered, as Mumtaz (2000) found that teachers’ own theories about teaching and learning are central to integration, otherwise change will be limited. Although the SSLs might not be in a position to change the entire curriculum, they could influence teachers through their own practices of ICT\|P. It is likely that an adoption of the innovation would reflect an education philosophy different from their colleagues and might assist in changing their beliefs and practices.

La Velle, McFarlane, John and Brawn (2004) found that teachers shared a concern over the attention deficit in their students. The concern was brought up as the teachers tried to compare technology which is fast and interactive with traditional skills of listening, watching, and thinking and considering. It is likely that teachers with such a mind-set will find it very challenging to use ICT as Condie & Munro, (2007) found that ICT integration demands changes in their pedagogy so that ICT is integrated in teaching processes. Consistent to this, Condie and Munro’s finding emphasized that integration required changes in teachers’ orientation to classroom organization, activities and interaction with students, which is indeed difficult to achieve.

Selwyn (1999) found that the dominant construction of educational computing was indeed technocentric and coercive, limiting integration and educational effectiveness. The differences underestimate the degree of change required in teachers’ understanding and beliefs (McCormick & Scrimshaw 2001). However, if ICT is viewed as a part of the system, like the blackboard, gradual influences of its use upon pedagogy will change teachers’ practices, thinking, attitudes, roles, and approaches to using the technology over time. Kerr
(1991) warns that these influences are more complicated and significant than the concern about the degree of 'take-up' in schools.

Perceptions have been seen to have implication on the practice and vice versa. In a multilayered approach such as projects, ICT integration and leadership, perceptions of all the layers are important to consider as they interlink in ICT\P. This study will try to establish dialectical relationships between perceptions and practices. A critical review of the literature on SSL for ICT\P suggests that SSL are in a position where they could influence ICT\P. However there is a need to consider perceptions of the people involved on their roles and on ICT\P. Furthermore, the SSL need to understand the process of integration in light of student learning and the requirement for integration.

This literature review reveals that although the SSL role is important it is noticeably absent in research on perception on the roles of SSLs in ICT\P. However, apart from recent small scale research studies which demonstrate that ICT is having a huge impact on the ways in which SSL’s work (Schiller, 1997), and exploration of possible relationships between administrative leadership styles and uses of technology (Hughes & Zachariah, 2001), the ICT research literature has tended to overlook the role of the SSL (Michael, 1998). This review has tried to relate the perceptions on SSL roles and on ICT\P by exploring the connection to actual practice. There is a gap in literature, which is rather odd, as there is substantial literature relating to school effectiveness, school improvement and change which identifies the SSL as a key factor in bringing about successful change in schools (Fullan, 2005). However, the important aspect of the perception of the SSLs' own roles in enhancing ICT\P as middle management could not be located. This implies that as leaders of school development, including integrated use of ICT, there is a need to understand SSLs' perception on their roles and on technology integration.

METHODOLOGY

An explorative, interpretive, case study methodology was used to examine the enactment of the SSLs’ roles and how they are perceived in integrating ICT in PBL. Leadership was approached from a dialectical perspective. Both the person in her context, and the enactment of roles and responsibilities were also taken into consideration. The data in the study was collected in a school in which ICT integration was taking place.

This study was an instrumental case study: It examined this particular case with the intention of providing an insight into issues of science subject leadership in ICT. It included an in-depth exploration of the case, and studied the leadership in ICT contents and action in detail. All were used to develop a holistic understanding of the case. The guiding question was: How does the perception of science subject leaders’ roles and of technology integration influence effective technology integration in project based learning?

The study strived to achieve rigour in the research by triangulation through methodology (Cohen & Manion, 2000), pilot testing, constantly analysing the data in the process, seeking participants’ views on the interpretations, and using a variety of methods to understand the phenomenon. Therefore, the study had to adopt a grounded approach (Glaser & Strauss cited in Lunn & Bishop, 2002). That is, what was obtained for analysis should be the voices of the participants. This approach was more concerned with the type of reliability, which Stake (1994) views as “the purpose is not to represent the world, but the case” (p. 245).

FINDINGS AND DISCUSSION

Perceptions of Fatuma’s Roles

The administration requires the SSL to be a dedicated, committed, and organized person. The interviews and observation data revealed that Fatuma fitted the criteria. This will
be evident in the sections where Fatuma’s roles are discussed. Arguably Bush (1995) points out those teachers who carry a curriculum responsibility such as Fatuma are in a unique position within the school to set an example of good practice, initiate and develop policy, and to instigate subject related activities. Hence, Fatuma’s efforts were reflected in how she perceived her roles. The analysis of the data identified in Fatuma’s roles can be seen under three categories: creating working relationships, supporting teachers and students, leading and modelling.

It was evident that Fatuma both identified herself and was perceived in the role of establishing a working relation amongst staff. This was an important role as integration requires teamwork and consensus building. Fatuma believed her role included a responsibility to establish partnership among the teachers as well as the administration. The administration regarded Fatuma’s role as an important one, in bridging the gap between the administrative team and teachers. The teachers also saw Fatuma’s role as that of building good working relationships as she involved them whenever there was an issue as reported:

...she takes everyone’s consent in that way I think it is a mutual, democratic it is not enforced….you have to do things very tactfully and it had to be done I don’t mean iron fist or take a whip everyone but in a more friendly way… (Interview3, March 8, 2007)

Fatuma saw her role as a guide who was able to build partnership through motivation, listening, discussing and providing solutions towards problems. Fatuma also perceived herself as a supporter and provider of resources and assumed the stance of attending to others needs, offering assistance and guidance.

We support each other….I felt that if I provide them with support at the initial stages it will be beneficial and effective… this is my hope [that later on they will] start making things on their own and doing things on their own. (Interview1, February 12, 2007)

Fatuma’s ICT expertise was an ever available resource which was available to all the teachers and students at all times. Similarly, Fatuma’s perception was echoed by the teachers as they also viewed her “as a very good organizer and a helper of staff who has expertise”. (Interview2, February, 19, 2007).

Fatuma identified a crucial role for herself, beyond managing the department. This included policy discussions and their implementation. This was evident in the headteacher expectation that she would manage as well as initiate new ideas and plans. Fatuma’s headteacher also believed that Fatuma was capable of contextualizing science and helping the students develop ideas about science as a discipline for improving quality of life. However, teachers viewed Fatuma’s role in a very different way as being answerable to the administration and hence under official influence. These notions could be associated with her recent appointment as SSL; thus it was not possible for her colleagues to describe her leadership role as separate from that of the administration, nor to describe it with much conviction as she was a new appointee.

Fatuma was seen as a role model by her colleagues and she also shared the same view. According to Fatuma “they have to see the integration of ICT as practical; otherwise they will not believe it” (Interview1, February 12, 2007). She believed in doing rather than just saying, as she explained “…I think I should be a kind of perfect role model for them. Role model in terms of whenever whatever they ask for help I should be aware of that” (Interview3, February 22, 2007). Demonstration is a practical method of passing on the information (Simpson, Payne & Condie, 2005) nevertheless some learning requires more hand on experiences beyond the demonstrations.
The perception from the team members and Fatuma herself characterized her leadership role as an expert who would demonstrate, tell and guide the followers.

**Perception on ICT∫P**

The data from all the participants identified enrichment of students’ learning experiences as an essential output of the ICT∫P process. Fatuma observed that students enjoyed the ICT integrated projects that had experiential learning. With the absence of technology, they complained. She shared:

“PBL is very effective and I feel more fun, so when I am doing a project I feel it’s fun, Projects is Fun, Real fun, the fun is for both teachers and students” (Interview1, February, 12, 2007).

The perception of experiential learning was also shared by the teachers as they argued that with the students doing the inquiry independently, they established a sense of ownership and responsibility and thus self learning. Fatma further added that learning should be from experience “we should be doing it instead of talking about it” (Interview1, February, 19, 2007). According to a Year 10A teacher, ICT∫P provides students with independent learning opportunities to acquire knowledge and she considers it to be extremely important as it: “allows the students to do independent search where they get more information and they have to select. This gives them more knowledge. Which is the importance giving more knowledge and being informative” (Interview1, February, 19, 2007).

The Deputy Headteacher felt that the ICT∫P was good and provided the users with information through a variety of sources. In addition she observed that the variety enabled the students to establish the thread of truth. However, there were concerns regarding downloading information without reading and understanding as student’s responses to downloaded information indicated that they did not comprehend their own downloaded material (Interview2, March 1, 2007). Hence, there was concern that ICT promoted a negative experience on the students as they may collect a lot of information but cannot truly process it.

Fatuma saw integration as an opportunity for the students to access more information. However, Fatuma and the teachers collectively considered ICT as a way of catering for multiple intelligences through thorough lesson planning and preparation.

“It extends the lessons so that the smart ones are given challenging tasks, we make sure we teach the standard but we also reach out to the smart ones. ICT provides a challenge to the smart ones. The teachers do the ground work for the websites that could be relevant and all are engaged for a long time”. (Interview3, March 8, 2007)

Fatuma observed that the current situations were impeding easy access to technology, but was optimistic that in the future a point will come when teachers and students will depend on ICT integration a lot. ICT∫P was also seen to provide opportunity to present information in a variety of formats to promote learning. The Year 10B teacher found ICT∫P uses, especially animations very clear for imparting information. She viewed that 3D presentations made understanding clear and reduced the time explaining to the student (Yuen et al., 2003). Fatuma, who termed the text book as limiting, shared what she observed as diversity to learning due to ICT∫P: “I had this lesson about cell tissues and the organization in the human body [for grade seven] … Even the information which we presented in grade nine was presented with a very good understanding”(Interview1, February 12, 2007). Moreover, the librarian found out that because of the projects, the students were reading a lot in the library due to the project-subject connectivity. The diversity of learning was also seen as developing skills beyond researching and learning. According
to the deputy headteacher, students had a variety of abilities hence there was need to offer opportunities to cater for the variety.

“Step by step process skills involve a team effort if done in a group even when not done in a group. The students learn to meet other people to get information put it together. I mean just a whole lot of skills involved. And I think that is good for the children to do that…” (Interview, February 27, 2007)

Although ICT integrated projects were seen to have benefits, not all teachers felt the same way. As the Year 10C teacher posed a question: “Do you think ICT is good for higher level, because for juniors I can understand but if you look at my classes I am not clear about how to use it?” (Interview2, March 1, 2007). There was also a comment that ICT required close guidance by the teachers. It was perceived as an approach that stretched the teachers’ capacities. On the contrary these were different views on ICT∫P; further probing, a Year 10C teacher saw ICT as not relevant to children at this stage. The Year 10C teacher was one person who thought science should be taught through practicals and she was sceptical about using ICT (Kallick & Wilson, 2001). Hence, Fatuma’s leadership was needed in terms of being aware of, and accommodating mixed perceptions and allocating duties accordingly.

Fatuma was confident and competent in the use of the computer. However, her reference to technology is seen in the statement: “I have no information on how other ICT devices apart from the computer benefit the students?” (Interview1, February 12, 2007). Such a narrow view may impact the activities planned in the projects. Moreover Fatuma and the other participants felt that integration was causing challenges for the teachers as they lacked skills to integrate. The teachers attributed the fears on integration to proficiency as they reported “I think I can write faster than typing, typing my God you have to look for that Q sometimes it is very frustrating I am typing one page and I take one hour” (Interview2, March 1, 2007). Observations confirmed the digital divide expressed by the team, on the other hand there was evidence of basic ICT expertise (FN, February 20, 2007).

DISCUSSION

The perceptions related to the enhancement of ICT∫P are threefold; on projects, ICT integration and Fatuma’s leadership as presented in Table 1.

**TABLE 1 SUMMARY OF PARTICIPANTS PERCEPTIONS**

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<tr>
<th>PERCEPTIONS</th>
<th>ICT integration in PBL</th>
<th>PBL</th>
<th>Fatuma’s’ Roles</th>
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<td>Student skills enhancement</td>
<td>Student Experiences</td>
<td>Develop Working Relationship</td>
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<tr>
<td>Teaching and Learning</td>
<td>Diversified Learning</td>
<td>Support Students and teachers as colleagues</td>
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<td>Proficiency in ICT</td>
<td></td>
<td>Managing learning not only resources</td>
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<td>Role modelling</td>
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The perceptions are important as they enable teachers to build the meaning they bring to innovation such as technology integration (Van den Berg, 2002). In addition, according to Turner (2003), leadership of a subject leader will be influenced by her perceptions on her role and task as well as how the implementers (teachers) perceive the task and the SSL roles. Fatuma would engender team spirit and ensured its enhancement as most of the participants appreciated Fatuma’s leadership, teaching and ICT∫P.

Fatuma’s’ perception on integration as well as on projects was very instrumental as
she was spearheading the integration through modelling that influenced the teachers’ beliefs and practices thus leading by example (Ritchie & Rigano, 2003). Teachers were implementers of the innovation and from their perceptive it was evident that they believed that teaching and learning could be done differently through ICT/P. Mumtaz (2000) concluded that it was teachers’ theories about teaching that are central in influencing their use of ICT as teachers were key to integration beyond organization and environmental barriers (Conlon & Simpson, 2003). The perceptions of the administration (headteacher and deputy headteacher) displayed a moral responsibility and personal values towards ICT/P integration. Such administrative goodwill was seen by Sergiovanni (2004) and Fullan (2005) as having a positive influence on change even in situations where there was an initial resistance.

The perceptions expressed by Fatuma about integration are focused both on experiences from the students as well as diversity of learning. Although there is a concern about the need of proficiency of integration, the SSL did not express other aspects of the importance of integration presented by research. The concepts of using integration to encourage the process of students’ own thinking for metacognition was also not evident. For Fatuma to lead the enhancement of ICT/P she has to realize more of the benefits of ICT for student learning than currently expressed. Such a realization will also influence the planning of the project so that there is room for the students to inquire. In addition, for her, ICT is only equated to computers. Yet ICT goes beyond the screen to include other devices such as data loggers, sensors and audio visual resources. This view limits its use and scope in teaching and learning.

Fatuma’s effectiveness was highly attributed to how she perceived her role, seeing herself as a role model and a supporter of teachers (Wildy & Wallace, 1997). She possessed power resources, including for example the ability to use PBL as well as to integrate ICT (Busher & Harris, 2000). This is consistent, with Dimmock and Walker’s (2002) research findings, that SSLs were committing themselves not only to personal professional learning but also to model their orientation to learning and practice for their colleagues. Such a perception and possession of power resources enabled her to influence teachers in their beliefs and practices on ICT/P. Fatuma also managed to scale up the capacity of the others in a short period and had support from the administration, who regarded her highly. She was empowered to participate in both the formulation of policy and implementation of ICT. This administration perspective enabled Fatuma to voice integration issues at the school policy level. It also enabled her to build in teacher’s voices in policy formulation, thus perceiving Fatuma as an SSL beyond the management. The findings were in contradiction with Turners’ (2003) who observed that SSLs saw themselves as only managers. Furthermore, the findings present a different dimension of the roles of SSLs in leadership.

CONCLUSION

Current literature has not addressed SSL leadership in the light of ICT leadership in project based teaching in the developing countries context. Therefore the question “How does perception of SSLs’ roles and of technology integration influence effective technology integration in PBL?” was the focus of the study, to contribute to the current body of knowledge in leadership. The finding of the study intended to illustrate the perceptions of leadership roles and on ICT/P.

There are interrelations between the themes that emerged. Perception on task and concept were revealed to influence Fatuma’s leadership. Fatuma’s roles were rooted in her beliefs about her roles and upon integration. An essential condition was identified: it was the perception both about integration and SSL roles, the administrative structure which empowered the SSL and the SSL roles which were executed in a dynamic leadership style.
that provided support, motivation and guidance to the teachers. The Perceptions that influenced SSL in ICT∫P were spread over three major areas (a) students' experiences, (b) teaching and learning and (c) proficiency aptitude.

Student experiences were observed as valuable in the form of the provision of a conducive learning environment and rich experiences to all learners. The provision of rich experiences required both thorough planning and teachers' proficiency to undertake ICT∫P integration. However Integration was seen as a mode of facilitating the project. It was very obvious that Integration was a concept that required skills and expertise to undertake.

Being in the middle management the Science Subject leadership was also influenced by the administration and the teachers' belief of her role as a key person for ICT integration, as she was highly regarded for her leadership, technical skills and management of learning. These perceptions influenced the practices of the SSL, hence all her roles were in relation to students learning such as; enjoying science and owning the knowledge, leadership; such as motivation, collaboration, team building and demonstration of ICT skills through modelling and presentations. Her proficiency in integration was her power of influence. Leadership practices in ICT∫P seem to be heavily dependent on the perception of the role as well as the task. Being an innovation, the interest for up-take will focus on those perceptions that link the innovation to students learning outcome. Indeed, it also includes the SSLs' views on their own capacity to make it happen.

In conclusion, it could be stated that the concerns from literature are to shift from adjunct use of ICT toward a more integral approach in science which is thought to be more beneficial to the students. Such a possibility, according to the study, will demand that the SSLs perceive:

- their roles as imperative in the integration of technology in project based learning.
- the integration of technology in project based learning facilitates teaching and learning.

Moreover, the perception of the other key players is imperative. The resonating perspective will facilitate effective integration of technology in project based learning. This finding of the study could be used to initiate ICT∫P by SSL. Moreover, successful implementation of ICT∫P is not about equipment or software but developing and empowering teachers; it is not about acquiring computer skills, but supporting teachers continuously in engaging students in the learning process. The appropriate leadership to ICT∫P will provide an affordance that enables students to gain a wider range of experiences relating science to the real world context.
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