

Tensions in the adoption of e-Learning in the mining industry of South Africa

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ABSTRACT

The mining industry in South Africa contributes significantly to the national economy. Training is an important component in these environments and e-Learning is often used to train the large workforce. In the face of current labour unrest and job cuts in this sector, it is foreseen that e-Learning might play an increasing important role to upskill the remaining work force. However, it appears that low motivation and resistance to e-Learning exist amongst learners. The aim of this research was to examine the factors that may contribute to this resistance and/or adoption as perceived by e-Learning managers and practitioners. An interpretive approach was used to conduct two case studies. Activity theory was used as the theoretical lens and its main elements (tools, subjects, rules, objects, community) were used to analyse interviews with participants from two mining companies. Potential contradictions or tensions were identified in order to explore resistance to e-Learning. The main findings indicate that:

1. proper communication of expectations by different stakeholders of e-Learning is imperative,
2. top management support for e-Learning should stem from integration into the organisational goals,
3. quality content is a necessary condition for successful adoption,
4. more attention should be given to interaction between learners and facilitators and also between learners,
5. a focus on people development rather than only compliance may lead to lower resistance, and
6. top management support and involvement should be made visible.

KEYWORDS: acceptance, activity theory, adoption, contradictions, e-Learning, mining industry

CATEGORIES: K.3.1

1 INTRODUCTION

The South African mining industry, the biggest in Africa, representing 20% of the GDP at R4018 million rand per year [1], plays a crucial role in the economy of the country. Despite having one of the world's largest mineral reserves, this industry has been facing many difficulties in the past few years. The industry is slowly declining, with job cuts plus sometimes poor working conditions within poverty stricken communities leading to discontent [2]. The Marikana massacre that took place on 16 August 2012, where 34 protesters died while striking for higher wages, is seen as the culmination of the recent unrest in the sector. Leon [2] ascribes many of the problems currently experienced to the uncertainty created by the implementation of the Mineral and Petroleum Resources Development Act 2002 (MPRDA). Through this act private ownership of mineral rights is replaced by state custodianship and conditional state licenses. The vagueness of the act's wording as well as flawed implementation of black economic empowerment (BEE) has led to licensing delays

and volatility in the mining industry [2].

The contribution of legislation and the complexity of the problem cannot be underestimated but other challenges have been identified over the past few years. One of these challenges is a reported skills shortage in the mining sector [3]. This is worsened by the recent labour unrest and lay off of workers. Stella Carthy, head of skills development at the Chamber of Mines (CoM), reported in early 2012 that the skills shortage is not a shortage in the number of workers but rather the number of skilled workers, despite the training they receive. She attributes this shortage to the time it takes to properly train a worker as well as the shortage of good lecturers and facilitators. Fred Cawood, Head of the School of Mining Engineering at the University of Witwatersrand, indicated that the use of technology to capture expertise and deliver it to a large number of learners is a clever way of addressing the shortage, despite the significant investment needed [3].

2 PROBLEM STATEMENT

E-Learning is already being used, mainly for safety training, at different mines in SA [4] [5]. This includes the use of Virtual Reality to simulate hazardous situations [6]. Given the low educational levels of a large part of this workforce, e-Learning has the potential to liberate, educate and transform learners.

However, the complexity of implementing e-Learning should not be underestimated. Newton, Hase and Ellis [7] noted that in order to be effective, implementing e-Learning in the mining industry needs to take into account external influences, existing corporate goals, learners' needs and support processes, to name but a few.

It appears that the effort invested in e-Learning, often supported by corporate marketing and information campaigns, does not have the intended result of cultivating interest among learners. As Tatnall and Davey [8] note, and Lee, Yoon and Lee [9] echo, learners first have to accept and adopt this mode of instruction before the benefits of e-Learning can be realised. Even when companies enforce training, as is typical in the mining industry, employees appear loath to participate and the acceptance of e-Learning is typically disappointing [10].

This study narrows its focus to a specific set of stakeholders (i.e., e-Learning managers and practitioners) and explores the perceived factors which influence learner acceptance and adoption of e-Learning in the South African mining industry. Activity theory is used as the theoretical lens and its main elements (i.e., tools, subjects, rules, objects, community) and contradictions between these elements are used to analyse interviews with participants from two mining companies.

The next section gives an overview of e-Learning adoption studies. Activity Theory is introduced showing how it is used in e-Learning studies. The research method and case studies are then discussed after which the findings and conclusions are presented.

3 STUDYING E-LEARNING ADOPTION

A single clear definition of e-Learning is apparently difficult to compile [9], but it typically involves the delivery of information plus some form of instruction using computer and communication technology [11].

Several factors that impact negatively on e-Learning have been documented, including a perception that e-Learning is impersonal, fear of technology, a craving for the socialising nature of traditional training courses [12, p. 257], lack of access to infrastructure [13] and confusing user interfaces [14]. Lee, Yoon and Lee [9] note several additional technological and administrative issues, from high upfront costs to the threat of cyber-attacks and the difficulties involved in authenticating users participating in online assessments.

These complex issues clearly have a negative impact on acceptance and adoption [15]. Acceptance and adoption have many facets, which include "marketing" or exposure [16, p. 695], diffusion [17], perceptions,

attitude and intention [16] [18] [9], satisfaction [19], motivation [20] and enjoyment [18]. In what many consider to be a landmark study in 1983, M. Lynne Markus [21] evaluated the resistance users exhibit towards a management information system using three acceptance models that were in use at that time. These and other studies sparked the development of many theories to analyse and predict technology acceptance from a social, technological and psychological perspective.

Common amongst such studies is the term 'adoption', which is more encompassing than 'acceptance' and describes more than just the initial acceptance of systems, but rather a longer-term commitment (Williams et al., 2009). For the sake of this study, the focus is on adoption but also includes acceptance studies. We thus refer to both the initial acceptance and continued use of e-Learning systems.

There is little consensus with regard to which models best predict and explain technology-related behaviour. Contemporary empirical and quantitative models include the following: Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), Technology-to-Performance Chain (TPC), Diffusion of Innovation Theory (DIT), Actor-network Theory (ANT) and Activity Theory (AT). These are by no means the only models used, but are perhaps the most relevant for the purposes of this study [22]. As will be explained in the next sections, AT appears to be an ideal tool for analysing the motives, powers and structures involved in the adoption of e-Learning in any environment, since it theoretically provides a mechanism to not only describe a person or a group's goals and individual or collective experiences, but also provides a framework to place and discuss these aspects from a social, organisational and cultural perspective. It will also show how the concept of "contradictions" in AT is particularly useful in understanding the complexity of e-Learning adoption.

4 ACTIVITY THEORY (AT)

Activity Theory (AT) has a long history starting with the work of Lev Vygotsky [25] first published in the 1920s, which was influenced by the theories of Karl Marx, and is currently considered to be in its third generation [26]. Vygotsky and Alexei Leont'ev [27], suggested that human "production" can, at its most basic level, be described by some kind of activity (i.e., work, which consists at lower levels of actions and operations), done by a subject (e.g., a learner or some form of consciousness), that transforms an object (i.e., learner using e-Learning) to produce an outcome (i.e., learner with skills). The object can be summarised as the central theme or ultimate goal of the activity (i.e., that which gives the activity meaning) and the outcome can be seen as the result of the transformation of the object or the product of the activity [26].

AT further incorporates the concept of mediated

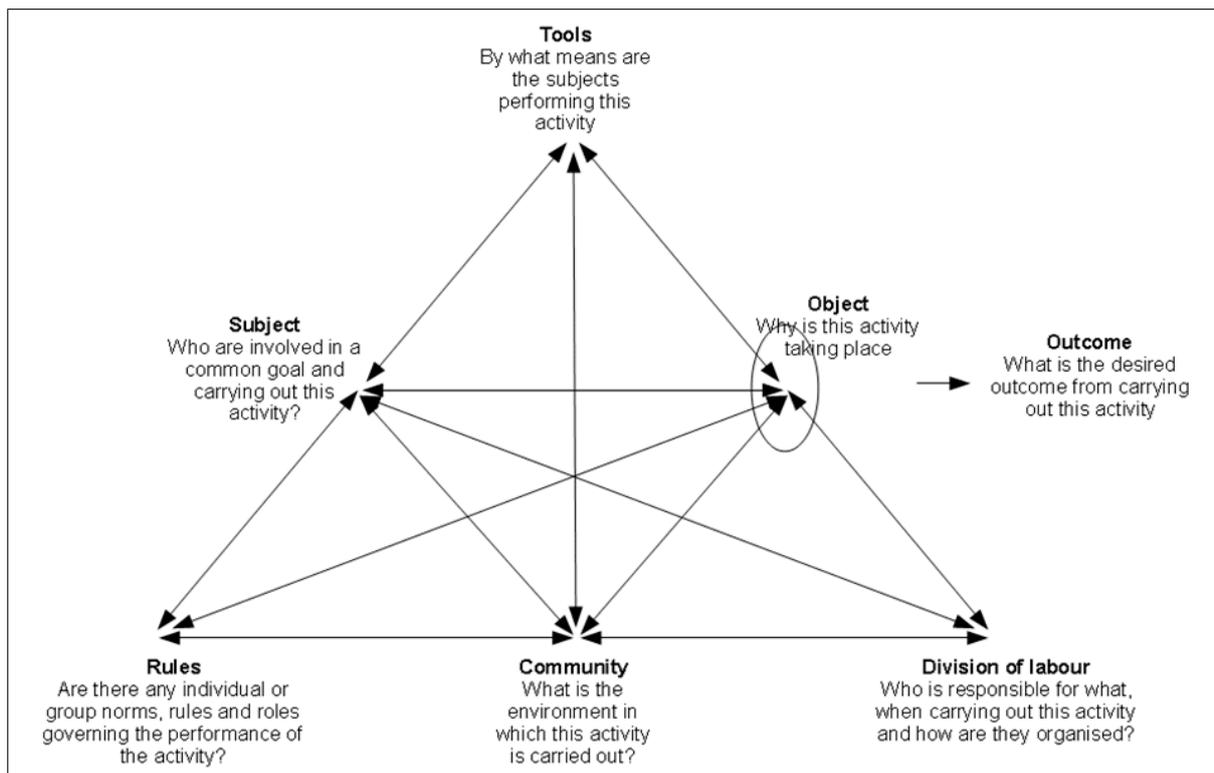


Figure 1: Activity system [23] [24]

action, where tools (e.g., language, signs, technology) play an important role in shaping the transformation of both object and subject while producing the outcome [28]. Mediation can also be described as “enabling and defining” [29, p. 268] the development of the relationship between the components of the activity system (i.e., subject and object).

AT has spawned two distinct schools of thought namely Socio-Structural Theory of Activity (SSTA) and Cultural-Historical Activity Theory (CHAT) [30]. CHAT focuses on the study of “meaning” and is more suited to analysing an activity in retrospect by specifically considering “tensions ... caused—or exacerbated—within the activity...” [30, p. 457]. It is argued that CHAT is a suitable theory for the purposes of the current study as is explained below.

Within the CHAT school of research, the original rudimentary Subject - Mediating Artifact - Object model, as developed by Vygotsky [25] and Leontjev and Hall [31], was subsequently extended by Engeström [23], among others. Rules were included that mediate a relationship between the subject and the community in which it functions and the division of labour (or roles and divisions of power and status) that mediates the relationship between the community and the object [23] [29]. The purpose is to provide a “meaningful collective context” [29, p. 268] for the previously individual-focused activity (Figure 1).

The resulting model is referred to as an activity system [26][23] and multiple activity systems need to be constructed in order to analyse relationships between multiple activities [28]. Five principles govern how CHAT is applied [26], namely:

1. an object-oriented activity system is used as the primary method of analysis,
2. an activity system always represents a multitude of perspectives,
3. activity systems can only be understood in the context of their history,
4. contradictions play a central role as the sources of change and development in an activity system, and
5. any activity system can experience “expansive transformation” (i.e., can undergo extensive and fundamental change in a fairly predictable manner).

Engeström defines contradictions as “historically accumulating structural tensions within and between activity systems” [26, p. 137], and these are considered to be the “driving force of change” in CHAT [26, p. 135].

5 ACTIVITY THEORY AND E-LEARNING ADOPTION STUDIES

CHAT studies have examined organisational learning in on-the-job settings [26] and been used to evaluate information technology in Higher Education [32] [33] [34]. A number of studies employ AT to study adoption in e-Learning/web-based contexts [29] [35] [36]. The overwhelming majority of those studies are generic [29] and educational environments [37] [36]. On the other hand, Netteland, Wasson and Mørch [35] performed an e-Learning study that utilised AT principles in a corporate setting, but the researchers did not use AT during data gathering and their study was performed

during a specific organisational change, not day-to-day operations of e-Learning.

Murphy and Rodriguez-Manzanares [38] give a useful overview and motivation for using contradictions in e-Learning research. According to them, researchers describe contradictions as conflicts, systemic tensions often accumulated over time or disruptions. In general, contradictions are seen as important since they lead to innovation and transformation in an activity system [26]. However, not all contradictions lead to transformation. Some contradictions are invisible as part of the normal functioning of a system—i.e., taken for granted—and others un-discussible—i.e., politically incorrect or embarrassing (Capper and Williams (2004), cited in [38]).

The studies identified by Murphy and Rodriguez-Manzanares [38] use contradictions to understand how they result in educational innovation, but also why contradictions are not always resolved. Examples range from the influence of technology in the classroom on changes in pedagogical practice to cultural misunderstandings in the contexts of distance e-Learning (Basharina (2007), cited in [38]).

6 RESEARCH DESIGN

The aim of this study is to gain an understanding of e-Learning adoption in the mining industry from e-Learning manager and practitioner perspectives. Since different perceptions are considered, the philosophical approach to this study is interpretivist. Case study research is used, “to obtain a rich, detailed insight into the ‘life’ of that case and its complex relationships and processes” [39, p. 141]. CHAT research frequently takes the form of qualitative case studies [40] that make use of interviews [30] [41] or are at least based on observation [26]. Berglund, Daniels and Pears [40] cite several of these qualitative studies found in educational environments. CHAT is therefore not new in qualitative research.

6.1 Data gathering

Participants for the study were selected from two South African mining companies under the pseudonyms Mines-R-Us and Dig-Deep. Both participating companies have in excess of 5,000 employees and were in various stages of implementing their LMSs. The study focuses only on the perceptions of e-Learning managers and practitioners. Interviewing was the main data gathering method, but a short questionnaire was also employed during the initial enrolment stage to determine the suitability of the respondents and to identify more participants.

Interviews were arranged with the identified participants, and were organised in a group setting where possible. The guiding questions used in these interviews were prompted by the literature study and organized according to the elements of Engeström’s [26] activity system. Table 1 provides a subset of interview questions categorized according to AT elements.

Table 1: A subset of interview questions

Rules
What are the policies governing learning (in general)? Is a policy document available? Can you think of any written or informal rules that govern the use of the LMS—e.g., does learning take a backseat to production, is too much training frowned upon ...?
Roles
Please describe your role within the learning function. Please describe the organisation of your learning function. Do you think this is a good structure?

The interviewees were: 1) Mines-R-Us: manager of learning technologies, three content developers plus three facilitators and 2) Dig-Deep: manager of learning technologies and a training facilitator.

Table 2: An example of data categorisation

Statement	Bandwidth. The speed. The speed of courses and technical problems. It has always been a pain to us.
Participant	Learning manager, Mines-R-Us
Contradiction	Tools vs. Object
Reality (fact or perception)	Fact
Time (history, present or future)	Historical and present

6.2 Data analysis

The purpose of the data analysis was to find common themes among the interview responses that related to the adoption or non-adoption of e-Learning in the mining industry. The process of analysis comprised of taking each statement made by a participant during an interview and classifying it according to the AT element or contradiction most applicable (Table 2). The resulting statements were grouped using a database to rate the statements in each category so that the most influential perspectives, as they applied to e-Learning adoption, could be determined.

The outcome of the data analysis process is discussed in the following section.

7 FINDINGS

In this section, the findings are presented in three sections. Firstly, the two case studies are described as activity systems in Table 3 and 4. Secondly, themes are identified from the identified contradictions. Finally, an analysis of participants’ views on future strategies for e-Learning is given.

7.1 Mines-R-Us and Dig-Deep as activity systems

Table 3 and 4 describes the two companies as activity systems from the perspective of the e-Learning team.

7.2 Contradictions

Tensions/contradictions were identified between the elements of the activity system (e.g., between community and tools) as well as tensions within an element of the activity system. Hasu and Engeström [42] see contradictions as manifesting in disturbances and breakdown in work processes. Breakdown is described as “a disruption in the normal functioning of things forcing the individual to adopt a more reflective or deliberative stance toward ongoing activity” [42, p. 65]. Based on this description, the following decision framework was used in this process:

- When participants clearly expected a different outcome from the status quo.
- Where there appeared to be a conflict between the intent and the results of an action.
- When the outcome was undesirable or had a negative impact.
- When two components of an activity system appeared to be in conflict or leading to conflicting outcomes.

A few themes emerged and are described below:

7.2.1 Learners' perceived resistance to e-Learning

Varying degrees of resistance from learners to e-Learning were noted by participants at both companies. The fact that there was resistance to the methods/tools used to deliver e-Learning was unexpected by most stakeholders.

Participants agreed that there was significant evidence of this resistance including poor involvement of the learners, low completion rates in non-compulsory e-Learning offerings and poor patronage of the learning venues that are made available. There was a noticeable decrease in initial enthusiasm under certain circumstances. One of the content developers interviewed was even ashamed to admit that she could not recall one e-Learning project that had been particularly successful. Resistance was mainly evident in non-compulsory learning with poor enrolment and completion rates reported by both Mines-R-Us and Dig-Deep. Some participants had strong opinions about the efficacy of compulsory training, but everyone agreed that compulsory training was necessary in a formal work environment.

Possible reasons for resistance from the perspectives of the participants were varied. At both Mines-R-Us and Dig-Deep, the most offered reason for low participation was lack of time. Participants observed a belief amongst learners that e-Learning would take up precious time. The learning manager at Dig-Deep considers this to be a misconception:

What they do not realize is that it will take more time to sit in a classroom than to determine your own e-Learning time schedule.

At Mines-R-Us they also attributed poor e-Learning utilization to the lack of motivation for self-development and conservatism in areas such as organisational development training. Also, a preference for classroom training was noted: some learners feel that classroom training offers the advantage of dedicated time for training and training facilitation.

People do not want to take responsibility for training, I think that is the culture. They want to go somewhere where they can eat lunch there or sleep there, do their own thing and come back and say: ‘I’ve been trained’.
(Mines-R-Us Learning Manager)

Other reasons offered by Mines-R-Us are unfamiliarity with e-Learning, the perception that e-Learning was difficult to use and that they do not require training. According to the learning manager from Dig-Deep, resistance to e-Learning was mostly experienced by the older generation of office workers. Miners and other artisans have no choice but to complete their functional training via e-Learning.

The perceived contradiction is therefore between the new object of activity, e-learning, and the historically constructed rules of a learner community used to traditional training.

7.2.2 Meeting learners' expectations

The contradiction just mentioned results in a perceived non-alignment between the objectives of the e-Learning team and the objectives and/or behaviour of the community (i.e., learners). Participants of Mines-R-Us and Dig-Deep speculated that their learners often have additional objectives in terms of training, namely to be rewarded in some other ways (e.g., time off, a trip, a good meal). Mines-R-Us also attributed poor e-Learning use to lack of motivation for self-development and conservatism in areas such as organisational development training.

A member of Dig-Deep observed that adoption rates were not necessarily increased by promising learners higher productivity in their job environment after completing e-Learning courses, since substantial self-motivation and self-discipline would still be involved in the activity itself. According to the learning manager from Dig Deep, success in e-Learning was when a learner learns something new that was applicable to his/her work environment.

Table 3: Mapping AT to Mines-R-U's and Dig-Deep (part 1)

Element	Mines-R-U's	Dig-Deep
Subject	Leadership, facilitators and content developers	Leadership, facilitator
Object	Using e-Learning to facilitate learning	Using e-Learning to facilitate learning
Tools	Blended learning 300 to 400 LMS courses Both off-the-shelf and in-house content are used Text, images, simulations, audio (in various languages) LMS functionality restricted by integration with ERP	Blended learning About 1000 LMS courses Both off-the-shelf and in-house content are used Text, images, simulations, audio, animations (in various languages) LMS functionality restricted by parent company Touch screens for illiterate users Effective integration of LMS with ERP
Community	10,000 learners consisting of employees, contractors and temporary staff of whom 80% functionally illiterate Culture of “unwilling to take responsibility for own learning” Learners prefer classroom-based training with facilitators	20,000 learners consisting of employees and contractors Minimum qualification grade 12 Learners have “somewhat” accepted e-Learning
Rules	Mostly functional training driven by legislation (Mine Health and Safety Act 29, 1996) Computer training labs with facilitators Functional training: learners need to complete the e-Learning in one or two days in training labs. Systems (e.g., ERP or Microsoft) and business process training: self-paced blended learning but learners can book slots in training labs for e-Learning part Learners and facilitators sign declarations to confirm learner competence Incentives: part of Performance Management and prerequisites for certain tasks, no access to ERP without training Formal assessment done using the LMS Scheduling, reporting and course management done through ERP and training through LMS	Up to 90% of functional training driven by legislation (Act 29, 1996) Computer training labs with facilitators Classroom training for illiterate learners and soft skills Blended learning for functional training: theory through e-Learning in labs, practical learning through demonstrations and hands-on learning. Theory must be revised each year Full e-Learning for ERP and other systems or business process training E-Learning done on own but workshops available if needed E-Learning can be done in labs Administrators might cancel enrolments if learners have been inactive in a course Incentives: part of Performance Management and prerequisites for certain tasks, users electronically prevented from operating machinery if training not up to date, no access to ERP without training Formal assessment done using the LMS Scheduling, reporting and course management done through ERP and training through LMS

Table 4: Mapping AT to Mines-R-Us and Dig-Deep (part 2)

Element	Mines-R-Us	Dig-Deep
Division of labour	<p>Management: manager + 5 e-Learning consultants + 2 content developers</p> <p>e-Learning administration: through ERP system</p> <p>Facilitators: ensure integrity of learner assessments, providing training guidance, motivate learners, technical assistance (not instructor's role)</p> <p>Learners: expected to take responsibility for own learning, once they are registered, expected to complete the training before the next Performance Management evaluation</p> <p>Support: support of learners (technically and content-related) provided by facilitators</p> <p>Interaction between learners not considered important</p>	<p>Management: manager + 2 e-Learning facilitators + 3 content developers</p> <p>e-Learning administration: through ERP system</p> <p>Facilitators: ensure integrity of learner assessments, providing training guidance, motivate learners, technical assistance (not instructor's role), maintain continuous contact with learners</p> <p>Learners: once they are registered can opt to complete training via class-based or e-learning</p> <p>Support: technical person who is very knowledgeable about the LMS. Learners can also contact the outsourced IT support function directly regarding LMS</p>
Outcome	<p>Cost savings: there is a drive to increase e-Learning courses and reduce classroom based training due to less time needed (2 days classroom training = 1 day e-Learning), more efficient use of resources (1 facilitator can facilitate 40 different courses at the same time in 1 lab), no catering and accommodation expenses, electronic assessments</p> <p>Improvement in generating legislative reports</p> <p>Flexible learning (own pace, own time, need-driven)</p> <p>To educate workers on compliance with mining and safety regulations. Ensure that operators know how to use equipment, i.e., improved safety</p> <p>Office productivity training</p> <p>Increased profits</p>	<p>Cost savings: there is a drive to increase e-Learning courses and reduce classroom based training</p> <p>Improvement in generating legislative reports</p> <p>Flexible learning (own pace, own time, need-driven)</p> <p>To educate workers on compliance with mining and safety regulations. Ensure that operators know how to use equipment, i.e., improved safety</p> <p>Office productivity training</p> <p>Training in regards to the Information Management Policies—increased productivity</p> <p>Increased profits</p>

Dig-Deep describes a scenario where the object of their current real-world e-Learning activity, namely to maintain safety and productivity levels, may be preventing the realization of a more advanced outcome (i.e., building competencies, personal development), simply because the latter may be perceived as too idealistic for the company's operating environment, constrained resources and external pressures. The facilitator's goal was to not simply to train people, but to create an environment where people not only need to, but also want to be trained.

7.2.3 Lack of learner support

At Dig-Deep, facilitators noted that the support that they provided to learners was virtually ignored for web-based content, although facilitators believed that support was needed, based on the interactions in classroom-based sessions:

The classroom and the e-Learning content is the same but you do not get any queries with e-Learning. (Dig Deep facilitator)

The facilitators and content developers of Mines-R-Us believe that facilitation and user support should play a more prominent part in training at the company but that not enough facilitators are employed to perform this function.

Although less pronounced, the companies mentioned low enthusiasm for e-Learning due to what they perceive as non-ideal change management and lack of resources. The facilitators and content developers at Mines-R-Us proposed that the e-Learning sponsors were not visible enough and that non-managerial e-Learning champions would be welcome.

These observations can be seen as a tension between the community, which includes the body of learners and stakeholders, and the different roles that are involved in the activity (i.e., division of labour). Resolution of these tensions would lead to a significant positive change in terms of the activity itself.

7.2.4 Role of management

Tension may be caused between the object and the division of labour components of an activity system, in this case higher levels of management, when the latter appears to discourage achievement of the goals and objectives of the activity.

E-Learning managers generally indicated that training and e-Learning were supported by top management, especially in terms of compliance-driven training. Despite this, e-Learning seemed not to be a priority or part of strategic planning.

They dump more e-Learning on us, because they see it actually works. But the moment you ask for more resources they refuse. (Mines-R-Us Learning Manager)

The low priority of e-Learning was also evidenced by e-Learning managers not being able to attend international conferences, the perceived low importance associated with e-Learning among stakeholders, attempts on the part of managers to shorten training

periods beyond practical limits, difficulty in having new content signed off for deployment and disproportionate efforts needed to obtain or renew e-Learning software licenses.

The learning manager at Dig-Deep reported that obtaining a single additional e-Learning resource had proved difficult and several managers remarked that justifying the time needed to develop good quality content was challenging:

So when you ... make it easy for the learner, business will say: 'You have taken too much time developing content'. But if you rush it and the learners will say: 'I don't see value. I've learned but I still need to go to a classroom.' ... It's very difficult.

Participants from Mines-R-Us further noted a perceived lack of shared vision and participants from Dig-Deep explained that they do not have a specific strategy for e-Learning in the company:

They must know that when they switch off servers they also switch off the training ... with other words it is going to affect production.

At Mines-R-Us, it was proposed that the top management role could embrace and encourage the use of technology more to realise its substantial benefits, something that the participant found to be lacking throughout South Africa. Likewise, participants from Dig-Deep commented that some higher-level managers did not seem to understand even the basics of the e-Learning system. The participants of Mines-R-Us and Dig-Deep believed marketing as a tool was underutilised, typically because of a lack of financial resources.

7.2.5 Technology constraints

A major category of contradiction in this study was found to be between the tools and object components of the activity. The assumption is that the outcome can be reached using the tools (in this including IT systems). This manifests when tools appear to constrain the ability of the subject to achieve the objectives and goals of the activity's actions. The smooth functioning of IT depends on a multitude of factors, e.g., bandwidth, proper integration of systems and robust and up-to-date software to name but a few. This reality of systems fallibility is often disregarded when envisaging successful e-Learning adoption.

Participants from both companies complained about bandwidth in South Africa, attributing many difficulties in e-Learning to a lack of national Internet bandwidth. Since the two companies have operations throughout the country, network access was central to providing e-Learning throughout the company, especially to remote sites. Both companies opted for remote content servers to relieve some of the bandwidth demand, but in the case of Mines-R-Us this had not solved all their difficulties. Mines-R-Us stated that the use of multimedia content for e-Learning was currently constrained by bandwidth, which was mainly

why video was not widely used in their content. Dig-Deep had difficulty obtaining and using content from its parent company due to local bandwidth constraints.

Both Mines-R-Us and Dig-Deep had problems with the integration of the LMS and ERP system. The learning manager from Dig-Deep reported that the integration had improved but Mines-R-Us shared their frustration: although the LMS has a learner administration function, they had to use the ERP Human Resources module. Learning and assessment takes place on the LMS whereas training data management and reporting are done through the ERP. The learning manager of Mines-R-Us ascribed 10% of errors in reporting to the cumbersome process of managing training data.

7.2.6 Content constraints

Part of the category of contradictions between tools and the object of the activity system was the effect that poorly designed content had on learning. The participants from Mines-R-Us explained that some of the custom content that had been purchased in the past was of poor quality, which had led to a decision to custom-develop most of their current content.

E-Learning managers of the companies complained about the high cost of external custom content development, resulting in overwhelming agreement that the development of content internally was considered to be the most cost-effective solution.

Participants at both companies had poor experiences with content in a presentation-style format containing a great deal of static text to read. It was common among participants to associate such content with poor adoption and participants consequently aim to develop content in a more interactive way. In general, participants were proud of the quality content they develop within the given constraints.

An example of where formal rules of the company influenced the tools mediating the activity was where the introduction of corporate branding at Mines-R-Us limited the creativity of content developers:

Before ... we had free range, we could do whatever we wanted with e-Learning, and we had beautiful designs which were not approved by guys at 'corporate affairs'.

7.3 Wish list

Participants were asked to suggest operational or strategic changes to the e-Learning function. As can be expected, ideas were presented at all levels of the activity system, but correlated closely to the problem areas identified in 7.2. The lack of resources were noted,

I would have more developers.

(Dig-Deep Learning Manager)

as well as the limited user support:

There should be a more important role for the facilitation and user support.

(Mines-R-Us Developer)

A more strategic suggestion addresses the changing of the learning culture:

From day one a new employee must know what e-Learning is and what it does. I would give more attention to implementation, evaluation and change management.

(Mines-R-Us Developer)

Lastly, from the learning managers' side, there was the wish for top management involvement:

I would have like to have all the stakeholders in one room to convince them of the importance of what we are doing.

(Dig-Deep Learning Manager)

So, if you can have a place for e-Learning in CEOs minds then, I will think, that will be the biggest success.

(Mines-R-Us Learning Manager)

8 DISCUSSION

The main purpose of this study was to describe the adoption of e-Learning in mining training environments and to isolate perceived factors that influence the adoption. Using the elements of activity theory plus contradictions and tensions within the activity system, the rich descriptions of the e-Learning teams' perceptions and experiences were analyzed.

From this analysis perceived contradictions were identified between the elements community, rules, division of labour and outcome. By focusing on these contradictions, it becomes clear that tension was created by the difference between perceived expected outcomes of implementing e-Learning by learners, e-Learning practitioners and higher levels of management respectively. Figure 2 shows the tensions created by the perceived difference in expected outcomes and the results.

The primary outcome of e-Learning was clear, namely to focus on training for safety and legislative compliance. E-Learning practitioners complained that this focus stands in the way of e-Learning that centers on more general people development, especially targeted at the workers in the organisation. This confirms findings from Australian mining companies by Newton et al. [7]. E-Learning teams share the goal of cost savings through administrative efficiency, improved reporting and fewer human resource requirements, with management. But they feel that management's lack of knowledge about what e-Learning entails leads to unrealistic expectations with inadequate resources. Also, the failure of aligning e-Learning strategically with corporate goals, results in no e-Learning strategy and no integration with other business units.

Learners readily accept e-Learning when the training was compulsory. However, with non-compulsory training, the difference in the learning environment between e-Learning and traditional learning, seems to result in resistance. Practitioners report that learners,

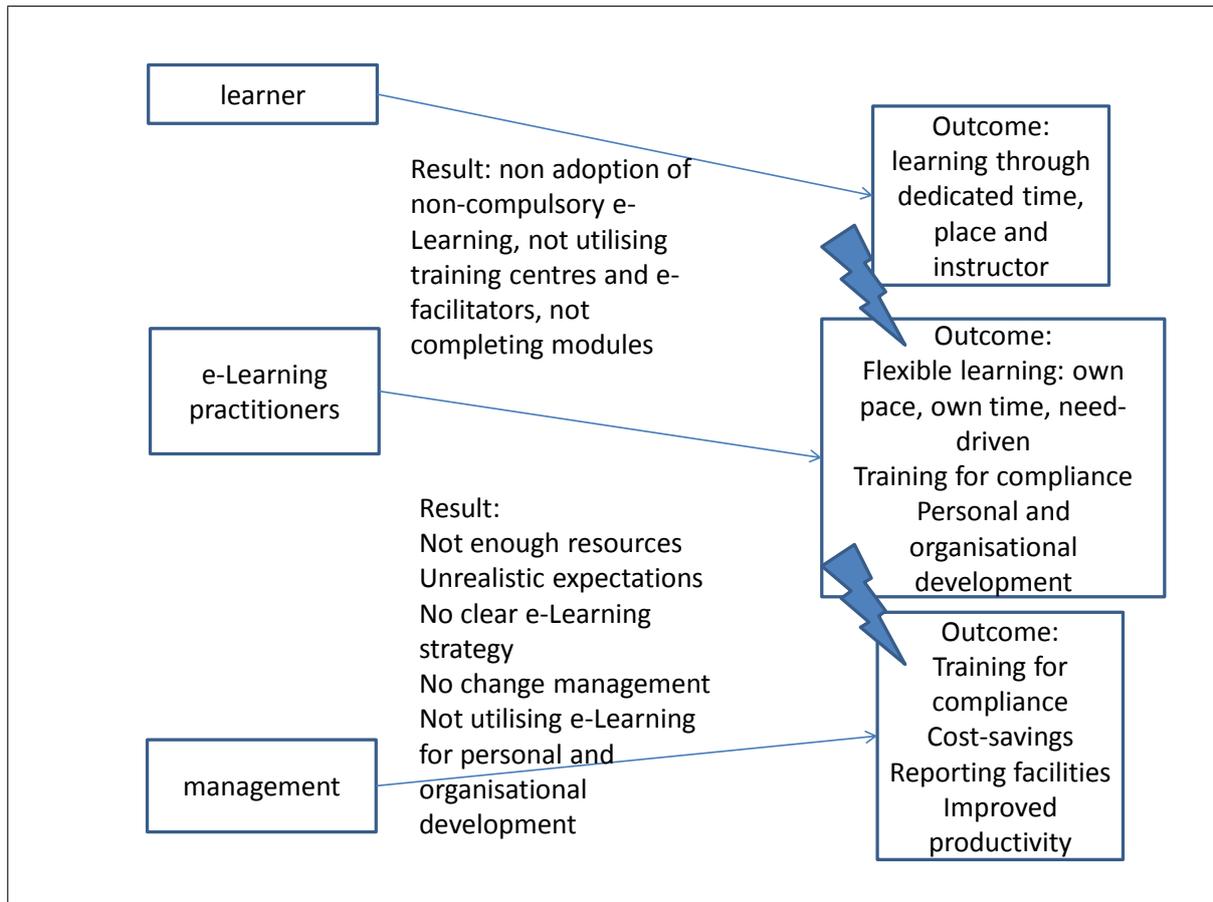


Figure 2: Contradictions between community and outcome

especially office workers, prefer classroom training with a dedicated time schedule, instructor and venue. However, even when sessions were scheduled for e-Learning to take place in learning centres, these centres were not used often. Also, no queries were directed to e-Learning facilitators and courses were often not completed.

Engeström [26] considers tensions in activity systems to be opportunities for expansive transformation or drivers for change. What are strategies or activities that might be considered to resolve these tensions? A few suggestions can be offered, based on the findings of the study and existing literature: stakeholders should have a clear understanding of each other's expected outcomes of e-Learning implementation. This would enable the management of expectations towards corporate goals. This is why it is imperative to align e-Learning with the business strategy. Newton et al. [7] provide a way of creating awareness amongst top management by involving them in pilot e-Learning programs and to evaluate this against organizational goals. This would give management an idea of the value of e-Learning but also of the effort it takes to create and deliver quality content. It will also make managements involvement in e-learning more visible.

When e-Learning practitioners and management understand learners' expectations, they can implement measures to meet or change expectations. For example, practitioners found that utility judgment, that is how much training is needed before there is an impact on

work performance, appears to correlate with positive attitudes on the part of learners. This can be promoted by making learning outcomes more specific to work environments. Additionally, structured and just in time individualized training can be provided [43]. The change from the traditional classroom culture to e-Learning can be managed by providing structured times to do e-Learning. Better interaction among learners and facilitator-learner interaction might also improve acceptance. From the study it was clear that very little attention was given to e-Learning content development for communication among learners. Facilitators even felt that learner-to-learner interaction would be distracting. This was in stark contrast to findings from literature, which show that interaction among learners plays an important role in satisfaction, performance and attitude towards e-Learning [44]. Although interaction between learners and facilitators was considered to be very important, the number of facilitators assigned to e-Learning in the companies did not seem sufficient to effectively perform this function.

High quality content remains imperative for successful adoption. However, some of the factors influencing the quality of content relates to scarce resources or corporate branding, broadening the responsibility of it beyond the content developers only. Netteland et al. [35] emphasize the importance of information sharing during e-Learning implementation in large organisations. Whether this takes place through work-

shops or marketing efforts from the e-Learning team, it needs to be ongoing and focused on specific audiences and contexts. It is only through information sharing that stakeholders will become aware of each other's assumptions and views of e-Learning.

The change laboratory as proposed by Virkkunen and Newnham [45] seems to be an ideal platform to test and refine the suggestions provided above. This entails a formative intervention bringing together practitioners and high level managers involved in the activity. These stakeholders work together with few interventionists for five to twelve sessions to analyse and specify the challenges of developing the activity and creating a new model for it. The structure of the session, choice of participants and space are carefully designed according to the activity system as described by activity theory. By resolving the tensions in this way, expansive learning is enabled.

9 CONCLUSION

From a practitioners' perspective, the authors of this paper are particularly interested in the views of other e-Learning teams and believe that this is a valid point of view to report on. When preparing to include learners' views for the sake of validation, it was found that the heterogeneous nature and the vast numbers of trainees justify a separate study. Consequently, it was decided to limit the research to the perspectives of e-Learning managers and other practitioners only. Admitting this weakness, this study is offered as a first step towards understanding this complex activity. The views presented here is therefore not the complete picture and perceptions and attitudes of learners as well as that of high level managers still need to be directly investigated.

Seven members of Mines-R-Us were interviewed in contrast to the two participants from DigDeep. The motive was purely practical and related to the availability of practitioners for interviews. Although Table 3 and 4 appear to contrast the two mines, this study is not a comparative study but an attempt to get an overview of adoption of e-Learning in the mining industry. Table 3 and 4 should therefore be seen as the context for the discussion on perceived contradictions.

This study expands the existing knowledge by illustrating the power of using AT to describe corporate e-Learning contexts in a coherent fashion. The findings of this study can be compared with the findings of research conducted to understand the frequently unique challenges that industrial training environments face. This study can also find practical implementation where factors that are known to encourage adoption in one area, but are under-represented in the studied environments, could be corrected to assist practitioners.

From the preceding discussion it is clear that with proper communication of expectations between the different stakeholders (e-Learning practitioners, high level management and learners), an organisational and training culture can be established where increases in autonomy, competency and relatedness regarding

e-Learning can be facilitated. Quality content development remains imperative and collaboration amongst learners should be enabled by the design. Also, top management in the mining industry should embrace and encourage e-Learning to realise its substantial benefits.

Some participants mentioned their wish to include compulsory e-Learning focusing on people development. They see broad computer literacy training as one way of elevating and emancipating employees. However, the strong focus on training for safety and legislative compliance and lack of time prevent this from happening. It is highly unlikely that the crippled mining industry will invest more money and resources in the people development aspect of e-Learning but rather try to automate compulsory training as far as possible. The question arises whether this focus on the operational and safety compliance value of e-Learning might hinder the use of e-Learning to emancipate and educate disenchanted and highly mobilisable workers and in this way misses the opportunity to contribute towards the rebuilding of the industry.

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