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Using digital storytelling to externalise personal knowledge of research processes: The case of a Knowledge Audio repository

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ABSTRACT

While articulation gap describes skill deficiencies displayed by university entrants emerging from underperforming schools, the high attrition and articulation gap at postgraduate levels demonstrate inadequacies of the entry-level intervention programmes implemented to address these challenges. Since inadequate socialization into postgraduate research and limited supervisor support contribute to the articulation gap and attrition rates at South African universities, digital storytelling (DST) potentially addresses these challenges. DST tends to foreground rigorous research, script writing, collective engagement and public expression of subdued voices to ensure effective participation in higher education. The research explores the potential of DST to externalize personal knowledge among postgraduate students at a South African university. It employs a Knowledge Audio Repository (KAR) for the generation and archiving of knowledge for future access and reuse. Findings suggest that DST is ideal for information generation, collaborative engagement and tracking of the developmental trajectory of postgraduates involved in cognitively-demanding research activities.

1. Introduction

One of the widely debated challenges in South African higher education (SAHE) is the articulation gap (Academy of Science of South Africa (ASSAf), 2010; Fisher & Scott, 2011; Hendricks & Volbrecht, 2003; Scott, 2007; South African Department of Education (DoE), 1997). The articulation gap describes South African high school students' lack of sound academic foundations for tertiary studies, which negatively affects their ability to respond positively to higher education programmes irrespective of their academic giftedness (Scott, 2007). These foundational skills include critical thinking skills, analytical skills, sound judgement and a deep grasp of academic content. It is often assumed that academically underprepared students' participation in academic development programmes, their graduation and enrolment in postgraduate studies bears testimony to their possession of solid research skills as well as the eradication of their academic "deficiencies." This deficiency model for explaining the articulation gap uncritically absolves higher educational institutions of the blame for student inability to participate in higher education effectively. The approach fails to recognise sufficiently the role of supervisor student academic relations in postgraduate students' effective engagement in higher education. The deficiency model is also shortsighted in its assumption that underprepared students' completion of studies and progression to postgraduate study are sufficient proof of their acquisition of solid research skills.

The recurrence of the articulation gap at postgraduate levels is self-evident in limited academic participation, extended times to graduate and high dropout rates in SAHE at this level of study. For instance, a growing body of work provides converging evidence for high attrition rates at postgraduate levels especially Masters and doctoral levels in South Africa (Academy of Science of South Africa (ASSAf), 2010; Essa, 2010; Lessing & Schulze, 2002; Mdyogolo, 2012). This suggests the continuance of the articulation gap even at postgraduate levels. A Consensus Report compiled by ASSAf (2010) highlights that although the attrition rate at doctoral level in South Africa is presumably high, there are no measures in place currently for determining it accurately let alone explain its prevalence. This is due to a lack of certainty and consensus on the direct causes of these attrition rates. However, there is increasing consensus on the role of the articulation gap in explaining attrition at postgraduate levels.

One of the effective ways of addressing the articulation gap and attrition challenges is the utilisation of new technologies such as digital storytelling (DST) to foster rich, meaningful learning experiences for postgraduates. Malita and Martin (2010) define DST as a modern expression of the ancient art of storytelling that combines narratives with digital content, including images, sound and video with a view to empower students marginalised by educational disadvantage to find their voice and to speak out. For students from previously disadvantaged backgrounds who lack confidence in public speaking, display low self-esteem and limited linguistic competence, DST, therefore, provides a

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self-empowering platform for the articulation of research knowledge and sharing of personal experiences of conducting research. Hung, Hwang, and Huang (2012) contend that DST promotes student motivation and concentration on the learning tasks and provides a way to guide them in the organisation of their knowledge. It enables the articulation of complex matters in more accessible ways (Van Gils, 2005), recruits and retains the attention of the audience (Malita & Martin, 2010) through the presentation of information in an interesting narrative (Rijnja & Van der Jagt, 2004). The dialogic and relational nature of DST enables the storyteller to connect to the audience through public articulation of personal narratives and adjustment of her story to fit the context and life worlds of the listeners. The aforementioned affordances of DST make it a viable intervention for increasing student meaningful participation in SAHE, breaching the articulation gap and addressing the challenges of attrition.

Mindful of the communicative and empowering value of DST for South African postgraduates affected by the articulation gap and attrition, this study explores the potential of DST to leverage the externalisation of tacit and procedural knowledge of research by previously disadvantaged postgraduate students to ensure their effective academic participation in university. As such, the paper draws on a Knowledge Audio Repository (KAR), a special-purpose Web-based knowledge-sharing environment, designed at the University of Cape Town to support collaborative research and information exchange among Masters in ICTs in Education students. The study also seeks to investigate the potential of DST to foster the collaborative sharing of their lived experiences and challenges of conducting research.

The significance of this research lies in the potential of DST to leverage the academic participation and engagement of subverted voices. In traditional supervisor–student consultations, the academic expertise, experience and authorial voice of the supervisor tends to overshadow the active involvement of novices (i.e. research students) in knowledge production processes as much as it may inspire them to become experts in their fields. Externalising personal knowledge through DST enhances postgraduate students' effective contribution of authentic knowledge, boosts their meaningful participation in collaborative learning activities and supports open negotiation of perspectives to create new knowledge. Knowledge production through DST is credited with integrating people and their (tacit) experiences (Bittel & Bettoni, 2012), supporting collective intelligence through group narratives (Borges & Vivacqua, 2010) and stimulating productive discussions (Cianciolo, Cianciolo, Prevou, & Morris, 2007) to build knew knowledge. Despite this acclaimed value of DST, how it contributes to the externalisation of personal knowledge by previously disadvantaged students remains a grey area in literature.

2. Literature review

This section reviews literature on the reasons for the articulation gap and high attrition rates in South African postgraduate studies, the potential of DST to close the articulation gap and its potential contribution to the externalisation of personal (tacit and procedural) knowledge on postgraduate research processes.

2.1. Articulation gap in South Africa

Two strands of thought namely, the "deficiency model" and the "systemic blockages model" mainly explain the articulation gap among South African postgraduates. The student deficiency model places emphasis on the academic shortcomings of students who enter postgraduate studies particularly their limited scholarly, digital and linguistic skills and competences. It emphasises, inter alia, the admission of previously disadvantaged students with limited experiences of library facilities and independent research work (Lessing & Schulze, 2002) and students' limited academic and computer literacy (Mdyogolo, 2012) as major contributory factors to their failure to graduate and dropping out of university. In contrast to this model, the systemic blockages model attributes the articulation gap to structural, environmental and organisational constraints in the South African postgraduate system that impede students from effectively participating in their studies. The model describes "the structural, legal, policy and organisational [barriers or] blockages in postgraduate education and training that might impede the escalation in the number of PhDs in South Africa" (Academy of Science of South Africa (ASSAf), 2010, p. 32). The ASSAf (2010, p. 67, 68) report summarises the systemic blockages that frustrate students' successful participation in doctoral studies as: (1) pipeline constraints: quality of students exiting an underperforming school system, and blockages in the graduate and postgraduate pipeline; (2) institutional constraints: limited supervisory capacity at South African universities; (3) financial constraints: inadequate funding for doctoral studies and (4) administrative constraints: rules and procedures in government departments that impact on doctoral education. Other institutional constraints underpin inappropriate supervision processes and an inappropriate research environment as the chief reasons for the articulation gap at postgraduate levels (Ssegawa & Rwelamila, 2009).

2.2. High attrition rates in South African postgraduate studies

Just like the articulation gap, there are multiple explanations presented for the high attrition rates among South African postgraduates ranging from personal motivations, institutional to structural barriers. At personal level, work commitments and inadequate funding are some of the main hindrances to the successful completion of degrees by postgraduates (Academy of Science of South Africa (ASSAf), 2010). Competing work commitments deprive postgraduates of the time investment and devotion to private study needed to accomplish their studies effectively. At institutional levels, the "hidden curriculum," which describes students' inadequate initiation into the academic conventions and "codes" of engagement of their discipline, is at the heart of the explanation for the failure of South African postgraduates to function successfully in university. Essa (2010) examined the factors that contributed to the non-completion of the postgraduate nursing studies by students at Stellenbosch University, South Africa. The study reports that a lack of initiation into academic values and limited exposure to defensible forms of teaching and learning accounted for the high attrition at postgraduate level at this institution. Mutula (2009) work on the supervisor–student relationship in Sub-Saharan Africa reveals complicated academic relations comprising: supervisors who are always too busy to meet students, delays in provision of feedback, poor supervision particularly lack of schedules for meetings or records of discussions and a lack of support for students from other disciplinary backgrounds (Mutula, 2011). Structural barriers relate to national legislation that complicate or block students' exit from particular programmes until they fulfil certain performance requirements. For instance, the South African Higher Education Qualification Framework's requirement that students may not graduate with a lower qualification upon completion of course work if they fail to complete their thesis (Bitzer, 2009).

2.3. Digital storytelling's contribution to closing the articulation gap

Digital story telling (DST) "combine[s] narratives with digital content, including images, sound and video" with a view to "invoke an emotional effect and or to communicate a message to its audience" (Malita & Martin, 2010). It varies in complexity from the use of images with narratives to the integration of advanced multimedia (sound, animations, video, pictures, and rich text) with the intention of combining analytical interpretation, social learning and inter-cultural engagement. For Robin (2008) DST is a technology application that takes advantage of user-contributed content to enable computer users (e.g. students) to become creative storytellers through selecting a topic, conducting some research, writing a script and developing an interesting story. The user-generated story is combined with multimedia (computer-

based graphics, recorded audio, computer-generated text, video clips, and music) so that it can be played on a computer and uploaded on a web site (Robin, 2008) to provide a widely accessible original personal narrative.

Since DST encapsulates the practical application of investigative skills to conduct research, development of a rich interesting narrative and dialogic communication with the audience, it ideally fits the framework of conducting social science research, which emphasises rigorous investigation, interpretive and analytical writing. As such, the foregrounding of user generation of content, user agency through their choice of the story and writing genre based on the user' experience in DST convince scholars that DST fosters multiple academic literacies (Banaszewski, 2005) and fosters empowerment through emancipation of ordinary voices (Ross, 2011). The integration of empowerment of muted voices, acquisition of research and digital literacy skills qualifies DST as a productive strategy for bridging the articulation gap. It also creates meaningful learning experiences by rendering postgraduates a sense of ownership of their academic stories and potentially closes the revolving door of postgraduate dropouts.

Tolisano (2009) highlights the transactive nature of DST particularly the appropriate tuning of components of the story by the storyteller to the age level and knowledge of the intended audience. Recursively, listeners also use the story to explore new worlds and scenarios, develop critical thinking skills to connect them to their world and their own experiences. It can be inferred that DST has potential to promote dialogic exchanges between the storyteller (postgraduate student) and listeners (peers, educators and broader academic community) that heighten opportunities for student socialisation into research processes and disciplinary practices. Through [digital] storytelling, a teller conveys a message, truths, information, knowledge or wisdom to an audience using musical, artistic or creative props he chooses to enhance the audience's enjoyment, retention and understanding of the message conveyed (Dudley, 1997, p.13 cited in Hronová, 2011). Mindful of the limited socialisation of South African postgraduates into academic and research practices critical to their effective participation in higher education, the sharing of research experiences, challenges and complex problems using DST potentially broadens the chances of closing the articulation gap for previously disadvantaged postgraduates.

Malita and Martin (2010) argue that learning and [digital] storytelling are intractably intertwined because storytelling enhances student reflection on their knowledge, affords the examination of their taken-for-granted assumptions, enables self-regulation and fosters monitoring of their cognitive development trajectory. Sole and Wilson (2002) summarises the potency of [digital] storytelling for learning organisations as: the revelation of one's commitments and competence to others, efficient exchange of the embedded and embodied highly contextual knowledge and facilitation of the emotional connections and the unlearning of the organisation.

2.4. Digital storytelling and externalisation of tacit knowledge

Tacit knowledge is one of the most contested terms in knowledge management literature (Nonaka, Toyama, & Konno, 2000; Polanyi, 1966; Sternberg et al., 2000; Taylor, 2007). The complexity of tacit knowledge lies in addressing the difficult questions about its location, that is, whether it lies in individuals' psychology or in the social realm. Other contestations relate to its form, that is, whether it is entirely implicit, partly explicit and implicit or wholly explicit. Another cause of disagreement is whether tacit knowledge is acquired, whether it is learnt entirely through imitation, practice, observation or a combination of these techniques. While a full response to these issues is beyond the scope of this paper, it suffice to highlight that tacit knowledge is that personal knowledge which the possessor may find difficult to articulate or explain but whose skills and techniques the possessor may demonstrate naturally. Usually this technical know-how comprising skills, techniques and routines have become so embedded in the individual that she performs them so naturally and unconsciously.

Rosenberg (1982, p. 143) defines tacit knowledge as "the knowledge of techniques, methods and designs that work in certain ways and with certain consequences even when one cannot explain exactly why." Sternberg et al. (2000) define tacit knowledge as practical intelligence that is acquired implicitly through everyday experience. Taylor (2007) provides conditions that should be fulfilled for knowledge to qualify as practical intelligence. These are: (1) that there is no general support from the external environment (other peers, books and other media) in its acquisition; (2) tends to be procedural to the extent that it focuses on "knowing how" rather than "knowing what" and (3) has a direct practical outcome. In summary, tacit knowledge is acquired through experience, imitation, observation or trial and error rather than direct instruction. It focuses mainly on that procedural knowledge that cannot be articulated easily and underscores knowledge about what to do in specific situations (Taylor, 2007). In research processes, rigorous analysis, logical interpretation of ideas and systematic argumentation are some issues that can be acquired through experience but are difficult to articulate.

For Nonaka et al. (2000) tacit knowledge is made explicit through the process of externalisation that is, from tacit knowledge to explicit knowledge. The most acknowledged ways of sharing and transferring tacit knowledge are through practical knowledge (learning by doing), personal interaction with experts who possess the relevant experience or knowledge, and interaction via social networks (Alwis, Hartmann, & Gemünden, 2004; Senker, 1993). The fact that people who possess tacit knowledge cannot explain the decision rules that underlie their performance and that tacit knowledge is context specific, that it is acquired in the context of application (Ambrosini & Bowman, 2001) make DST an ideal candidate for fostering the articulation this embedded knowledge through personal narratives and scripts. Storytelling emerges from the interaction and coordinated efforts of the storyteller and audience including the creative imagination of listeners (National Storytelling Network, n.d.) thus making DST suited for the sharing and transferring of tacit knowledge embedded in listeners and tellers.

Tecnam (2013) examined the effects of using DST on Korean English language learners' attitudes and perception towards learning in English. The study reports that DST positively impacted student learning of English by fostering a deeper understanding of the lesson and promoting active voluntary participation of students in class. However, since the externalisation of tacit knowledge by the performer may require "the [audience's] observance of a set of rules which are not known as such to the person following them" (Polanyi, 1958, p. 49), DST necessitates the active involvement of the audience through their direct observation and personal judgments on the technical procedures of the performance. For Taylor (2007) individual tacit knowledge that is implicit can be transferred through demonstration, apprenticing and actual practice or doing.

Since DST has potential to empower the student voices through personalising a narrative, broadening student research skills through investigating topics assigned by the educator and enhancing student ability to communicate with a wider community (Robin, 2008), its conduct dovetails with the externalisation of tacit knowledge. This externalisation unfolds through the sharing of research stories, hunches and personal judgments that are embedded deeply in individuals, their existence of which they may take for granted. For Taylor (2007) tacit knowledge of an implicit nature can be transferred through storytelling, metaphor, analogy and by mentoring to allow the transmission of such automatic knowledge. As such, DST capitalises on students' creative talents through fostering a culture of research and telling personal stories using library and the Internet resources to research and develop deep analytical and synthesis skills (Robin, 2008). As such, collective or implicit knowledge (another variant of tacit knowledge) can be transferred mainly by

socialisation — observation, informal behaviour modelling and by direct explanation of the rule in a particular context. One can decipher that methods of externalising tacit knowledge vary depending on the nature of the tacit knowledge, that is, whether it is implicit tacit, explicit tacit, social explicit or social implicit knowledge.

3. Theoretical framework

3.1. Community of practice (CoP)

Mindful of the potential of online research communities to create a safe haven for the exchange of tacit knowledge, community of practice (CoP) theory provides an ideal theoretical and analytical framework for understanding student collaborative exchange of tacit and procedural knowledge of research processes in such communities. Wenger (2004) defines CoP as "groups of people who share a passion for something that they know how to do and who interact regularly in order to learn how to do it better." Research novices' (postgraduates) mutual engagement in joint activities, collective problem solving, sharing of experiences about complex research processes including hunches on possible research alternatives all constitute engagements in a CoP. Therefore, CoPs embody social structures that focus on knowledge and enable knowledge management to be placed in the hands of practitioners (Wenger, 2004). For Wenger (1998) CoP engenders learning, which transforms researchers' ability to engage with the social world, their identity, practices and their communities (p.226). Wenger (1998) summarises three main dimensions of CoPs: (1) mutual engagement, which deals with connecting participants in a variety of ways and defining membership; (2) participation in a joint enterprise, a negotiated way of working together to achieve something and (3) a shared repertoire of "routines, words, tools, and ways of doing things — which become part of its practice" (p. 83).

Examining mutual engagement, Wenger (1998) elaborates that, "practice […] exists because people are engaged in actions whose meanings they negotiate with one another" (p. 73). Joint enterprise foregrounds the possession of a shared goal or objective and a practice that identifies with that CoP (Wenger, 1998). In digital storytelling, all three fundamental dimensions of CoP are readily captured. Through individual and collaboratively generated stories, informal negotiation of meanings unfold as the storyteller (student) responses to peers' queries, which serve as information resources for new forms of understanding and transformative learning (joint enterprise). Stories about research processes can connect and bring together individual students' diverse experiences and subjectivities in the interpretation of problems, issues and constructs (mutual engagement). Shared repertoires are located in reasoning styles and ideas that identify with a community. Academic networking, critical questioning, self-generated social objects and joint problem solving collectively constitute shared repertoires that potentially inform deep, meaningful learning of complex research processes.

4. Research questions

1. How can DST be harnessed to externalise personal (tacit and procedural) knowledge of research processes by previously disadvantaged students?
2. In what ways does DST foster the expression of lived experiences and challenges of conducting research by these students?

5. Methodology

This research adopted participatory ethnography as its research approach. In this approach, the digital storytellers (postgraduates/novice researchers) participated in the production of the ethnographic data thus providing a second frame of construction (Hlubinka, 2003). Although both authors participated in digital storytelling processes, they assumed different roles (see the section on research design). Their direct involvement coheres with protocols of participatory ethnography where the creators of digital stories join [researchers] in the research effort (Hlubinka, 2003) to assert their voices, enact their agency and overcome potential misinterpretations of their perspectives by researchers (Geertz, 1993). As such, the authors involved the novice researchers (/postgraduates) and the expert (the educator/course convener) in the production of artifacts based on their individual research experiences and perspectives to provide a more balanced account of their stories. Participatory ethnography should result in the production of text that gives the researcher-as-author the power to present the subject's story (Denzin & Lincoln, 2005). This unfolds through interpretation and self-reflexivity, while synchronously ensuring that participants' representations of their own reality are not diluted or distorted.

To grasp participants' (novice researchers, convener and the independent researcher) different experiences, realities and tacit knowledge sharing processes, Krauss (2005) recommends that researchers immerse themselves in the activities and the world of the subjects being studied. As such, both authors participated in the storytelling research community to access the mental frames of the participating subjects, their narratives that embodied tacit knowledge, their subjective constructions of their world of research and its concomitant challenges.

5.1. Research strategy

Mindful of the twin challenges of the articulation gap of postgraduate students (particularly the previously disadvantaged) and the high attrition gap in South African higher education, digital storytelling was introduced into the research phase of postgraduates' studies. A knowledge generation environment called the Knowledge Audio Repository (KAR) provided the basis for the realisation of DST. The KAR is a Web-based collaborative learning environment developed in the Centre for Educational Technology at the University of Cape Town to academically support postgraduate students in conducting research. It hosts textual narratives, audio, video and graphics generated by participants (educators, students) to support an engaging academic community. The rationale for using KAR as the platform for fostering DST was to: (1) facilitate the sharing of tacit and procedural knowledge among students; (2) empower students through open conversations about their research challenges and research support they needed; (3) develop critical questioning practices that contributed to student meaningful engagement and participation in higher education and (4) develop students' technology, research and knowledge construction skills through empirical research, script writing and storytelling. Students used KAR for 6 months.

KAR was designed to capture the tacit and procedural knowledge (mental representations of subjective research experiences, intuitive judgments, subjective worldviews and hunches) of participants. The sequence of DST in KAR is summarised as follows: (i) create an online social learning environment (SLE) containing tools similar to DST; (ii) canvas participants (students) offline and record the research challenges and issues they are facing, (iii) transcribe and clean-up the audio and audio recording obtained in step (ii) above; (iv) seek offline some comments and responses from expert researchers in response to the research challenges/issues obtained in step (ii); (v) transcribe and clean-up the video/audio recording obtained in step (iv) upload onto the online tool the artifacts created in steps (iii) to step (v); (vii) encourage the initiator of the research challenge/issue and other participants to view the request for help, respond online and make further comments on the response from the expert researcher and independent researcher; (viii) encourage the experts to comment on the comments made in (vii) by participants and their peers in the study; (ix) repeat steps (ii) to (viii) until the conversations in steps (vii) and (viii) are self-sustaining and progressing naturally without the mediation of the researcher; (x) interview all participants: the students, expert researcher and independent researcher to obtain information about the

knowledge facility and (xi) analyse the online conversations and interview transcriptions, interpret and conclude the report.

5.2. Ethical considerations

The researchers sought ethical clearance from the Centre for Educational Technology and the School of Education, the department in which the majority of research participants were enrolled. Participants were informed of their voluntary participation in interviews and DST processes via KAR and of their right to withdraw from the study without any prejudice or harm. They were also assured of their anonymity and the reporting of their views in aggregate form to protect their identities. Pseudonyms were used in situations where it was necessary to identify participants in relation to their utterances.

5.3. The Knowledge Audio Repository (KAR) learning environment

The KAR is a social constructivist learning environment which renders: (1) an academic consultation space for students with research-related questions, queries, comments and contributions; (2) a collaborative knowledge sharing environment where they document their personal narratives, experiences and challenges of conducting empirical research and (3) a knowledge base in which artefacts posted accumulate and are consolidated into shareable resources that can be accessed by members of this online community. KAR, therefore, serves as an authentic online environment for novice researchers to "meet" with knowledgeable peers and experts, reflect and discuss their research challenges and brainstorm solutions to their common research challenges.

As shown in Fig. 1, the Web-based learning environment comprises the SMS gateway, the KAR and the mobile learning environment. The SMS gateway allows students to make their postings/messages via SMS while the mobile learning environment employs the web-based interface for question-based consultation. Its user interface comprises discursive spaces for initiating posts, responding to peers' posts, writing personal narratives and discussing research topics of interest to participants. It comprises a suite of tools and applications for navigating, initiating new topics/conversations and posting audio component of interactions. KAR collaborative environment and the main topics discussed in this platform (see Fig. 2) (See Fig. 3).

5.4. Participants in KAR learning environment and data generation process

The postgraduates comprised 5 purposively sampled Masters in ICT in Education and two doctoral students who contributed their research stories to the KAR in diverse formats (textual narratives and audio recordings). These students were at various stages of their thesis writing — from data collection to report writing. They were ideal for this investigation as they had diverse experiences, insights, challenges and dilemmas during their conduct of research. The different academic levels of students (Masters and doctoral levels) were crucial in providing and unravelling a diverse mix of research problems, experiences and dilemmas experienced in postgraduate research.

All the participants were previously disadvantaged — they emerged from under-resourced high schools, which had limited access to ICTs, had few successful academic role models and educational materials to guarantee student academic success. Since the articulation gap and high attrition problem at postgraduate levels are often attributed to students with limited academic socialisation into disciplinary practices and those with impoverished backgrounds, this understanding informed our choice of postgraduate students. Table 1 below summarised the gender distribution, level and focus of study of the participants.

While there was a gender imbalance in the sample of participants, the sample seemed to be reflective of the participants enrolled on these courses, which tended to be male dominated (see Table 1). As such, the researchers had no control over the gender distribution of participants. More so, the majority of the research participants were enrolled or previously enrolled for a Masters in ICTs in Education at this university. Most of their topics were linked to the adoption and effective utilisation of ICTs or the complexities of ICT adoption in resource-constrained environments. All participants interacted with the KAR, which mediated their DST for six months (July to December).

Fig. 1. The Knowledge Audio Repository and related interfaces.

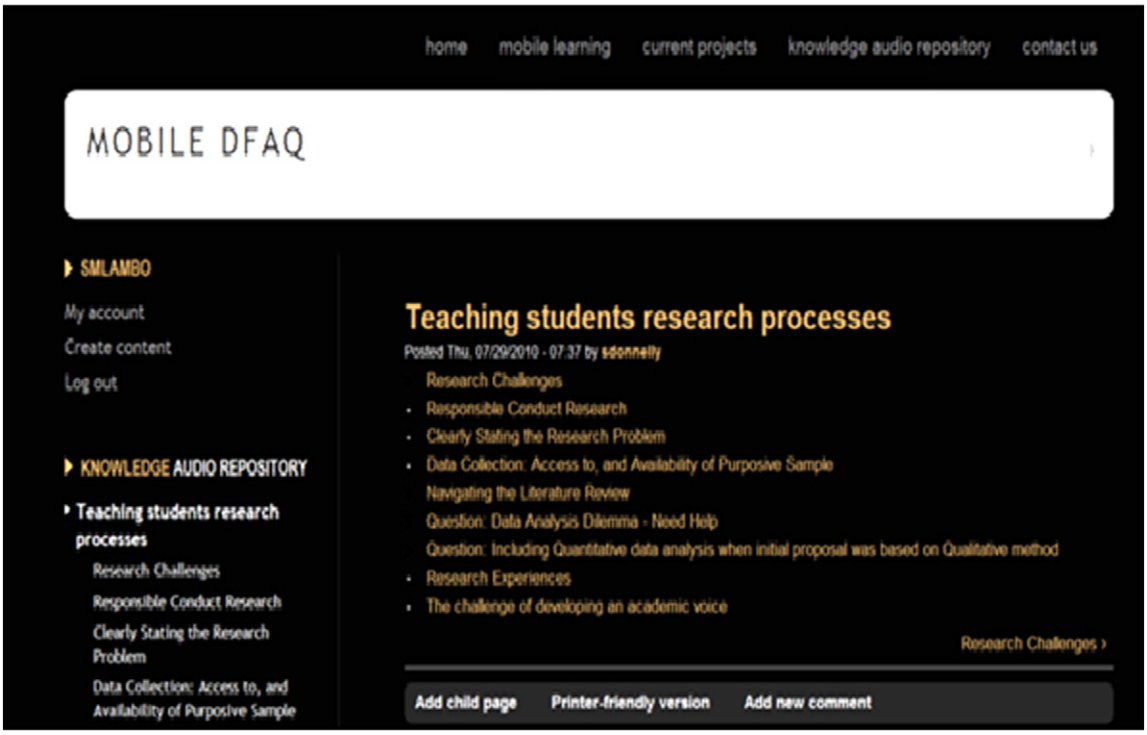

Fig. 2. The topics interface of KAR.

5.4.1. Participants' roles on KAR

The educator supervised all but one of the research projects student were researching. He also designed the KAR environment with a view to promote interactivity among low self-esteemed postgraduates, support externalisation of tacit knowledge and "glean" the challenges that students encountered during their studies. He trained students in the effective use of the KAR for posting texts (research questions, experiences, insights, hunches, techniques, ideas and beliefs), videos, audio clips and other educational resources. He also trained students in storytelling, script writing, and editing video and audio clips using Audacity software

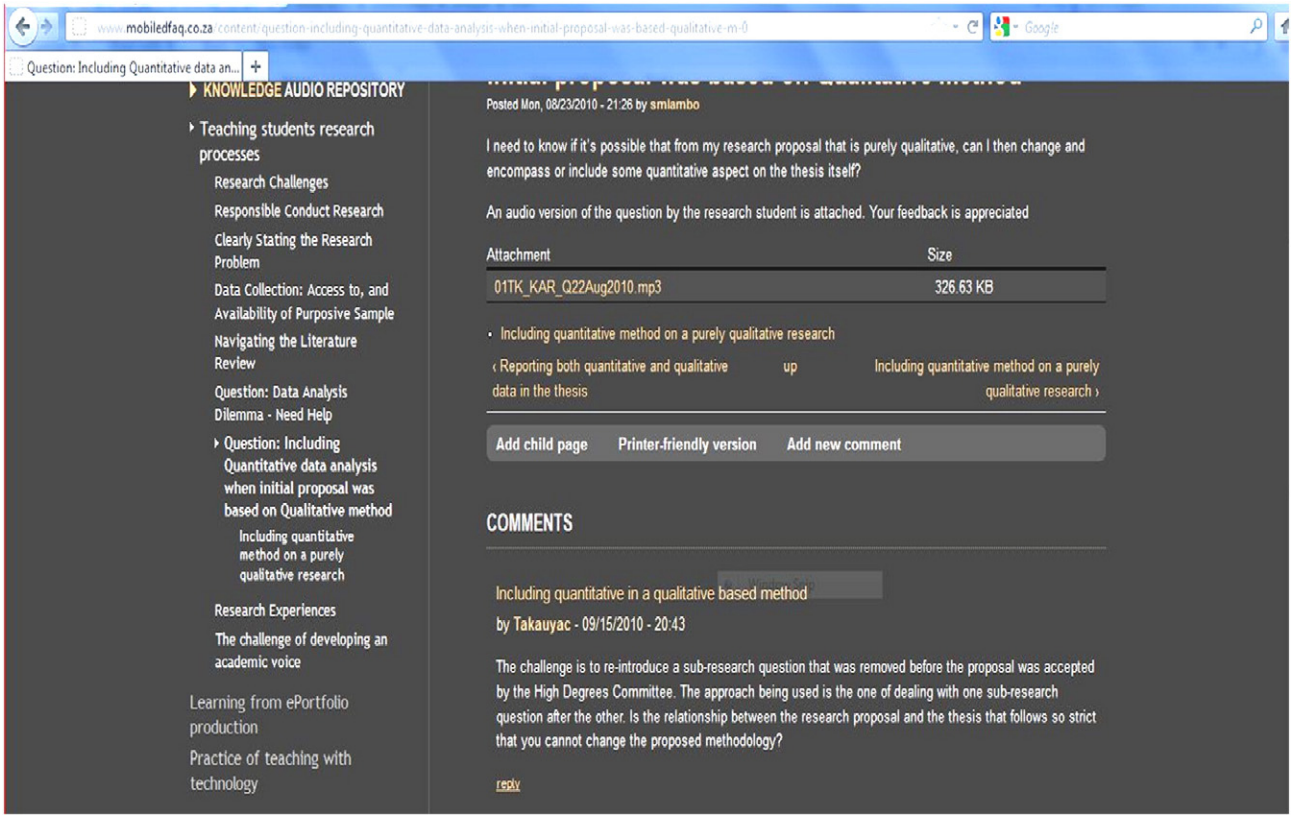

Fig. 3. A textual and audio narrative of one student's challenge with research methodology and peer's comments.

Table 1
Subject's gender profile and investigation focus.

Pseudonym	Gender	Level and focus of investigation
Sibu	Female	Masters by research student exploring the practice of teaching and learning in Zimbabwean formal schools in rural areas.
Paki	Male	Masters by research student investigating the use of mobile learning applications to encourage active classroom participation in large undergraduate classes
Mic	Male	Masters by course work doing a mini dissertation on reuse of digital teaching and learning materials by a social outreach student group
Eshi	Male	Masters by course work student conducting a mini dissertation on the role of ICTs in promoting the teaching and learning activities of winners of Distinguished Teacher's Award
Tibo	Male	Masters by course work student conducting a mini dissertation on teachers' methods of assessment of science learning
Sue	Female	PhD student researching on the molecular and ecological assessment of the Southern African dung beetles Scarabaeinae.
Herm	Male	PhD student developing a model to establish information and knowledge flow within virtual communities of practice

and how to ask critical questions. The educator also addressed the tough questions, which students could not address by themselves.

To avoid interfering with research participants, independent researcher (the main author) maintained some social presence in the KAR environment but did not participate directly. His main duty was to track and assess the flow and direction of student conversations, storylines and artefacts that accumulated in KAR. Social presence is considered critical to the understanding of the developments in an online learning community. The co-author was a postgraduate student (see next section) as well as a novice researcher who also tracked student participation on the KAR.

Students were directly involved in almost the entire process of digital storytelling except for the design of the KAR environment. As such, they directly participated in soliciting the stories, developing research scripts, editing stories, posting artifacts (asking and responding to questions, posting video and audio clips) and critical commenting on peers' stories. They also contributed to the discussion threads on KAR. Thus, KAR provided a web-based rendezvous for students (novice researchers) and educators (experts) to "meet" and share their hunches, insights, views, ideas, beliefs, problems and solutions, experiences, other research objects and concepts.

In the training to use KAR (See next section) students were advised of the communicative and research benefits of DST particularly for low self-esteem students. This motivated students to participate to voice out their subdued voices. However, the researchers provided no direct incentives for participation apart from the educators' informative responses to student queries and questions on KAR that attracted their sustained participation.

5.4.2. Training in KAR-mediated DST

The educator (also designer of KAR) invited all the students to a seminar to train them in the effective use of the KAR environment. Students were initiated and socialised into the KAR interface, and related interfaces like the SMS gateway and mobile learning spaces. He provided training to students on how to post messages, join a conversation and contribute to discussion threads. He also trained them on how to pose questions on challenges they were facing, their research experiences, exchange ideas, views and gain insights through online interaction.

The educator also trained the participants in DST practices and activities like the conduct of research, development of personal scripts on learning experiences, challenges and research beliefs, generation of video and audio clips using Audacity, importing of videos and audios from Audacity and uploading in KAR, conversing with the audience after watching the videos to give informative feedback.

5.5. Data collection method

Data collection method involved the mining of online artifacts/narratives of research participants and in-depth semi-structured interviews with them.

5.5.1. Mining of online artifacts/narratives

To ascertain the externalisation of tacit and procedural research knowledge by previously disadvantaged postgraduate students, the researchers examined students' digital artifacts (personal narratives, research questions, queries and responses, beliefs and insights) on KAR. Students posted their personal experiences of conducting postgraduate research, research-based challenges that hindered their smooth progress in research and research cues and insights they acquired through their research experiences. After six months, the novice researcher (i.e. co-author) sought the consent of research participants to download and mine all the aforementioned artifacts and printed them for in-depth content analysis. The artifacts were analysed using CoP constructs (see Table 2). To enhance the dependability of the results, the mined data was corroborated with interview data from participants.

5.5.2. Recorded personal narratives

Some students also audio recorded their personal narratives of research experiences and posted these on the KAR. The researchers downloaded the narratives, transcribed them in Microsoft word and analysed thematically. The use of original narratives in DST is critical to readers' understanding of the authors' interpretations of story tellers/participants' data. The dependability of research is derived from personal accounts (Hammersley & Atkinson, 1983) since the appropriateness of researchers' inferences can be judged from extracts of original data.

5.5.3. Interviews

To improve the dependability and credibility of evidence, researchers corroborated recorded online interactions (mined narratives) with semi-structured interviews to solicit information in normal conversations as well as to situate the evidence provided in the research environment. Semi-structured interviews conducted with participants explored postgraduate students' lived experiences of conducting research and associated challenges they encountered in that process. The interviews uncovered the contribution of DST to the externalisation of personal knowledge (tacit and procedural) of research by these students. They solicited information on participants' research experiences,

Table 2
Main themes and categories emerging from raw data.

Main theme	Mutual category
Mutual engagement	Engaged diversity
	Doing things together
	Relationships
Joint enterprise	Negotiated enterprise
	Mutual accountability
	Interpretations
Shared repertoire	Personal stories
	Artifacts
	Tools
	Discourses
	Concepts

their research challenges and the academic support they received from peers and the expert to address them. They also covered participants' experiences of KAR tools and their engagement in an online research community to share research knowledge.

Mishler (1986) critiques the traditional decontextualised stimulus–response model of interviewing, which entrenches skewed control of the interview process by the interviewer and deprives the interviewee of joint construction and ownership of the outcome of the research. Semi-structured interviews allowed for natural conversations as the interviewees told their research stories and experiences in ways that did not necessarily conform to the interview guide questions. Interviews were conducted in the quiet laboratory foyers with minimum interference from by passers. The average duration of the interviews was 45 minutes. The interviews were audio-recorded, transcribed, and imported into NVivo7 to sort and develop categories.

5.6. Analysis of evidence from KAR and interviews

The researchers first submitted interview transcriptions and mined artefacts to participants for authentication and proofing before they analysed separately. All the data were captured in Microsoft Word and then imported into NVivo7 software, from which themes and categories were developed subsequently. Themes that emerged from the topics articulated in data (i.e. interviews, mined artifacts and recorded personal narratives) were taken, coded, compared with other pieces of data (that is, concepts drawn from CoP model) for consistency. These data were examined to establish whether they were similar or different, and additional categories were developed based on this constant comparison method (Glaser & Strauss, 1967).

Patterns identified in the data (e.g. interviews, artifacts and recorded narratives) were compiled and reanalysed across different data (i.e., concepts from CoP model) until the data had been saturated and could be grouped into major themes (Veletsianos, 2013). Since the study was preoccupied with exploring how DST could be harnessed to externalise personal knowledge of research processes, how it fosters the expression of lived experiences and challenges of conducting research, only those themes that fitted these research objectives were considered for further analysis. More so, since the aforementioned objectives are social constructivist and collaborative learning activities, CoP theory, with its preoccupation with sharing and joint activities, best suited this analytical investigation.

The various themes and categories that emerged from data were colour coded and comments that interpreted all the data chunks were made accordingly to enrich the analysis. The process of constant comparison of research data and CoP concepts yielded the following themes and categories (see Table 2).

To ensure the dependability of this analysis process, the two researchers also compared and matched their different understandings to breach any conceived inconsistencies in the development of their categories. Subsequently, they shared their results of their data analysis with a colleague who had prior experience in DST to further refine their categories and remove extraneous material.

6. Presentation of findings

The current study sought to establish the potential of DST to externalise tacit and procedural knowledge of postgraduate students from previously disadvantaged backgrounds. To establish this, it explored the different ways students employed KAR to make explicit their tacit knowledge and articulate their procedural knowledge. Findings suggest that students externalised tacit and procedural knowledge through mutual engagement on their research processes, involvement in joint research activities and practices (joint enterprise) and collective participation in shared repertoires of research. These findings are elaborated in the first half of the presentation of findings. Table 2 summarises CoP elements mapped against themes and categories emerging from raw data.

The study also explored the ways in which DST fosters the public expression of participants' lived experiences and their challenges of conducting research. Evidence suggests that DST enhanced student articulation of their research collaborations with peers and senior academics, fostered their adoption of mutual accountability in joint research, and enhanced their public participation in discursive dialogues (engaged diversity). DST made the following student difficulties more explicit: their challenges in articulating complex research ideas in unambiguous ways, ambiguous responses from peers during consultations, reluctance of some students to share information and occasional inaccessibility of seasoned academics during consultations. These issues will be articulated in the second segment of this presentation of findings.

6.1. Mutual engagement

Evidence from student textual messages on KAR, transcriptions of audio-recorded messages and in-depth semi-structured interviews demonstrated that students externalised tacit and procedural knowledge through mutual engagement. Mutual engagement manifested in three main research practices: engaged diversity, joint activities and building of relationships. These practices are presented in Table 3.

6.1.1. Engaged diversity

Students formed informal peer-based groups that deliberated research issues and fostered social learning through the collaborative exchange of diverse ideas. They shared their subjective research experiences, self-discovered hunches during problem solving and lessons learned informally during dissertation writing. As one student recounts: "…in our [postgraduate] meetings when you listen to someone or you hear something that rings a bell. …, it intrigues you… So I can say during those meetings I always pick something. There are times you think maybe you mastered something, and somewhere during the course of these meetings, you pick something that intrigues your mind" (Interview Ref: EV57/STD). These collaborative discourses allowed the exchange of hunches, clues, intuition and taken-for-granted ideas that illuminated understanding of the academic tasks at hand. These resources enabled the circumvention of the pitfalls that normally accompany novice research such as faulty research designs.

Narratives of diverse personal experiences and informed personal judgments during research dilemmas allowed students to learn intuitively from peers (see the first student interview extract under engaged diversity in Table 3). Mutual accountability in the deliberation of common research issues, problems and dilemmas played out in new comers' reception of the advice of supervisors and peers. The statement "Through the exchange of personal perspectives with supervisors, colleagues and others, and through interpreting the situation on the ground, the initial methodology should be fluid, we should be able to devise new methods that will produce expected results" (Interview Ref: EV319/STD) demonstrates that interpretations and personal perspectives are at the heart of the sharing of tacit knowledge. DST allowed the articulation and transfer of tacit knowledge for the benefit of peers in the same learning community.

The statement that: "I think you have suggested a good strategy of aligning ones' research questions to the literature…Thanks for your assistance!" (KAR student posting) suggests student complementation of their peers for the informative feedback. Student receptivity of expert and peers' advice laid a formidable foundation for collective responsibility and mutual accountability in scholarly research.

6.1.2. Joint activities

The KAR constituted an information repository where participants' collective postings accumulated and knowledgeable researchers provided research insights and shared their perspectives on research

Table 3
Mutual engagement — categories emerging from raw data.

Main theme	Category	Extracts from interviews and student postings on KAR
Mutual engagement	Engaged diversity	"…in our [postgraduate] meetings when you listen to someone or you hear something that rings a bell. …, it intrigues you… There are times you think you mastered something, and somewhere during the course of these meetings, you pick something that intrigues your mind." (student interview extract) "I have noted that through internet interaction, more students and academics responded than in face-to-face talk. So it was helpful since we work at different times." (Ref: EV291/STD)
	Joint activities	—"If I have certain results which I cannot explain, a more experienced lab user may help. Sometimes during general discussions on our study on animals, people may mention facts that help me understand my observations better." (student interview extract) "The peer group meeting we had created a learning process that allowed me to go through how peers write their dissertation or how they write their papers… At the end of that session it helped me to really like um get something. It's like putting everything into its own location." (Ref: EV54/STD)
	Relationships	"…I share research ideas with an office mate on what research designs I would use and why? Why would one have to use an eye tracker for data collection?" (student interview extract) "You could have tried sending an online questionnaire or dropping the semi-structured in-depth questionnaire in their pigeon holes." (KAR student posting)

processes. These knowledge sharing practices, insights based on personal research experiences and advisory services generated an informal scaffolding framework for the development of research knowledge by novices. As one student alluded: "Like how do you ask for help when you can't explain your problem? Anyway, the good thing about my new discovery is the book that was suggested by a peer after I told him about my struggles of finding stability in my research" (Interview EV311/STD).

Joint activities played out student sharing of primary text resources like books that illuminated understanding of complex processes like problem identification. Through the KAR-mediated storytelling a seasoned expert (the supervisor) provided useful strategies of solving research problems and accessing informal assistance from knowledgeable colleagues. It also provided supplementary information for novices struggling to make sense of their research work: — "…it will be a good supplementary platform to share knowledge across time and boundary" (KAR posting).

KAR-mediated storytelling also provided a platform for the solving of practical problems of conducting credible research. Student endorsements on peers' postings: "…you have suggested a very good strategy of aligning ones' research questions to the literature…" (KAR posting) bear testimony to the value of collaborative generation of procedural knowledge in KAR spaces. Discovering a strategy of aligning different components of a research study indicates student acquisition of new experience for solving research problems.

KAR-based DST, therefore, provided a supplementary platform for lightweight conversations and narratives that afforded postgraduate student externalisation of procedural knowledge. These included problem formulation, intuitive processes of appropriate research designs, common practices of developing literature review and informal strategies for merging disjointed chapters (see second extract in joint activities in Table 2).

6.1.3. Relationship building

Social relationships occasionally served as the social adhesive that bonded conversants to particular research concerns and fostered persistent interactions. Dyadic conversations constituted test beds for launching unproven claims and platforms for brainstorming nascent ideas. One such academic exchange of tacit knowledge between research affinities is articulated here: "…I share ideas with an office mate on what research designs I would use and why? Why would one have to use an eye tracker for data collection?" Spatial proximity, mutually beneficial relationships and common research interests laid a common ground for informal dialogic exchanges and sympathetic critique between peers in ambient habitats.

6.2. Joint enterprise

Joint enterprise manifested in three ways: negotiated enterprise, mutual accountability and student interpretations of concepts during informal conversations (see Table 4).

6.2.1. Negotiated enterprise

Negotiated enterprise manifested in student access to peer academic support to resolve their research dilemmas: "If for example, I have certain results which I cannot explain, a more experienced lab user may be able to help. Sometimes, during general discussions on our study animals, people may mention facts that will help me understand my observations better." However, the distinctness of individual projects meant that a shared understanding of concepts and research processes in KAR was reported only on those issues for which a heuristic understanding of generic research processes was expected irrespective of discipline such as problem identification and scope, motivation and justification research studies and development of sampling techniques.

Table 4
Joint enterprise — categories from raw data.

Main theme	Category	Extracts from interviews and student postings on KAR
Joint enterprise	Negotiated enterprise	"I was quite indistinct as to what I was going to do but then my supervisor came forth with ideas and funding and then I went on that path. So it was a collaborative experience coming up with the question and the methodology" (student interview extract) "Of course one can never get enough of other people's thoughts and opinions, people will always have different points of view etc. so research communities should encompass as many researchers as possible." (Ref: EV71/STD)
	Mutual accountability	On the use of both qualitative and quantitative methods: "Linkages on these two methods are possible and you can combine them well in a 'multi-method design.' I refer you to… [citation mentioned]." (KAR student posting)
	Interpretations	"My opinion on selecting theories is: first read and read as much literature as possible but be focused on the research question that you are trying to tackle." "In particular, I noted that most empirical research reports which incorporate both quantitative and qualitative divide the chapter on analysis of the data into two major sections; one for quantitative data and the other for qualitative data." (Ref: EV337/STD)

6.2.2. Mutual accountability

Mutual accountability played out in student commitment to their peers' work and desire to assist them when they were confronted with learning difficulties. The affirmative acknowledgement of peers' assistance is self-evident in statements such as: "I think you have suggested a very good strategy of aligning ones' research questions to the literature…Thanks for your assistance!" (Ref: EV326/STD). Other expression of procedural knowledge lies in the statement: "On the use of both qualitative and quantitative methods, linkages on these two methods are possible and you can combine them well in a 'multimethod design.' I refer you to… [citation provided]" (EV333/STD).

6.2.3. Interpretations

Common interpretations were prevalent in the application of generic terms and concepts in research like theory and methodological concepts like sampling techniques and triangulation of data. Students expressed the importance of wider readership during the development of their theoretical frameworks and their reflections on the use of mixed methods. Through interpretations of concepts in KAR, students externalised their informal ways of knowing and personal knowledge in "safe" social spaces.

6.3. Shared repertoire

Shared repertoires manifested in student personal artefacts, tools and concepts that they drew on during collaborative dialogue and the fostering of research learning communities. Given the formative nature of student discourses, these repertoires played out in varying intensity both in personal accounts during interviews and in the KAR.

6.3.1. Personal stories

Personal stories were informal, coherent narratives often presented as personal observations, recounts of personal encounters with complex dilemmas in research contexts, general tales and perspectives on research issues. Student capacity to build on existing research in their investigations was critical to sharing personal stories that advanced knowledge exchange between experts and novices. The statements: "…sample [participants'] access and availability should not be taken for granted; their availability doesn't mean their accessibility." This is because their unavailability could derail and change the project timeline. "If I happen to use the same methodology in the future, I will do it differently" (Ref: EV314/STD) bear testimony to this. Interpretations of complex situations were, therefore, deeply embedded in student stories. Student narratives also related the different ways supervisors scaffolded their engagement in research.

6.3.2. Artifacts

Shared repertoires also manifested in research artefacts and concepts, which constituted building blocks for the development of theory. These diverse artefacts ranged from books, articles, historical accounts and biographies — legitimate literature for conducting credible research. The conduct of dependable research often necessitated drawing on such artefacts in building research perspectives. As one student professed: "…without researchers who have done research before me in that area I wouldn't be able to [do] this." Similarly, the statement: "You don't have to start from scratch, if somebody has already done it, why should you start afresh?" bear testimony to this dependence on historically developed artefacts.

6.3.3. Concepts

One excerpt acknowledged the role of socio-cultural artefacts such as theories and concepts in formulating new knowledge. This highlights the value of theories as abstraction tools and instruments for communicating ideas. The KAR, therefore, conceptually highlighted those constructs, tools, techniques and processes that gave effect to quality research.

6.4. Expression of lived experiences

6.4.1. Engaged diversity

DST was also instrumental in supporting student expression of their lived experiences of conducting postgraduate research. Students reported on the diversity of opinions that emerged from dialogic discussions with peers. Dialogic interactions with peers in labs created a productive platform for their exchange of insights and perspectives that augmented their knowledge base. As one student observed: "… most likely on that person's table there will be a tray of dung beetles and then they'll start talking about them, where they were found, why they are there, you know. So it's very good compared to being by yourself and isolated" (EV36/STD).

6.4.2. Mutual accountability

DST also demonstrated the mutual accountability between supervisors and students with regard to student accomplishment of their dissertations. For instance, students expressed the direct involvement of their supervisors in their research through persistent communication, sharing of views and provision of opportunities for student effective engagement with their extended research community. As one student reported: "I am always in close communication with my supervisors. I have to know their thoughts, the direction their research is going. It has also helped me to keep in touch with other members of my research group and our work is linked one way or another" (EV26/STD). This mutual accountability also ensured that supervisors exposed their mentees to new areas and concepts to enrich their research experiences: "My supervisor suggested that in my discussion of a piece I was writing I include biogeography. For me this was a very new area and required extensive search for material on South African Forests, their formation etc. During a sorting session of the research group I talked about it and within a short time I was directed to the most relevant texts, articles and my work became much simpler" (EV37/STD). As such, DST revealed the different ways in which educators productively supported student engagement in research, with implications for improving their effective academic participation in university.

6.4.3. Personal stories

DST also allowed the articulation of individual student's research journeys exposing their strengths and weaknesses in the conduct of credible research. Prior knowledge presented a useful resource for students to draw on in their research processes: "My IT knowledge has allowed me to work with lots of data as well as navigate the internet for good sources of material. My social media knowledge allows me to share my work and connect with others, most notably global experts in my area of interest" (EV220/STD). As such, DST externalised student experiences of research particularly the essence of their prior knowledge in the effective accomplishment of their research studies.

The telling of personal stories also illuminated understanding of how students drew on work of leading scholars in their fields in the conduct of research: "…, as I said some specimens or species are particularly difficult, and for that we have to refer to other papers or other people's research, you know. We are working on dung beetles but we look at other people who have looked at other insects, for example in the Neuroptera or other families to see what they have used and we try that as well" (Ref: EV38/STD). DST, therefore, afforded the public expression of students' collaborative research activities and their keenness to draw on previous studies in their research work. Most importantly, DST enabled students to publicly showcase their academic achievements especially their successful accomplishment of particular research processes: "… doing a good literature review has helped me to focus on what I want to do and out of that, I have managed to come up with a conceptual framework/model for my research" (Ref: EV297/STD).

6.4.4. Discourses

Students also used dialogic discourses to articulate their lived experiences of conducting research. In an interview, a student affirmed

the value of discursive exchanges: "Definitely because I see it [KAR discussions] as like a two way traffic. Because if I'm learning from you definitely you're learning from me. So it's like if you're presenting today and I learn from you and if I present tomorrow you learn something from me. So I think, to me it's a two way traffic" (Ref: EV149/STD). Impliedly, DST provided a means through which students externalised knowledge through transactive exchanges of information during their research. The psychosocial benefits of learning collectively and sharing common problems were implicit in student narratives: "We share our experiences and challenges and learn from one another. Also senior researchers are able to mentor and coach new researchers" (Ref: EV227/STD).

6.5. Articulation of research challenges

6.5.1. Negative discourses

One common phenomenon among students was the public dialogue about the common challenges they faced in conducting their research. Clarity of purpose and categorical expression of complex research ideas were some of the challenges of conducting research. As one student bemoaned: "Another challenge is knowing how to pull "punch lines" that succinctly describes your research. Putting it in the most clearest unambiguous and acceptable words. This is one experience I still have to master. I tend to wind about not nailing it" (Ref: EV298/STD). As such, DST provided a platform for expressing students' limited understanding of succinct, concise articulation of research ideas.

6.5.2. Tentative suggestions

Another negative discourse was student ambivalence about providing concrete advice to peers. This tentativeness tended to compromise the academic worthiness of peers' advice as this statement depicts: "The answer to this student's question is: it depends. The supervisor is the only person who can know what it depends on, and so the supervisor should be answering this question" (EV321/SUP). For those students who conceived their peers as the first line of support, such comments were unhelpful.

6.5.3. Reluctance to share

Peers' reluctance to share advice and information was another barrier to productive participation in postgraduate research. As one student claimed: "People have to share but then students are reluctant to share, they would rather share on social issues than on academic issues. Yeah the tendency is to withhold information (EV72/STD)." The reluctance to share information was also reportedly prevalent among senior researchers: As one novice researcher highlighted: "Experienced researchers do not just volunteer to share, instead there has to be some trigger, for example, a new researcher asking or struggling with something and bringing it to the fore, then they can share the knowledge" (EV204/STD). Our inference is that DST thus exposed the multiple challenges of conducting research in resource poor environments where access to information from experienced scholars and peers was neither certain or guaranteed.

7. Discussion

It is critical to highlight that digital storytelling involved in-depth personal interviewing, recorded personal narratives and contributions to the KAR environment. Personal interviewing provided insights into student research tools like self-reflexivity and informal assessment of their intellectual growth. Personal narratives and the KAR contributions comprised personal stories, research questions, peers' answers, research-based insights on complex problems, intuitive judgments based on personal reflections and common research practices.

Digital story telling promoted the externalisation of tacit knowledge in research processes in four main ways:

(1) It fostered the development of subjective narratives on research processes based on student experiences and personal observations; (2) allowed collective meaning making through task-focused engagements and productive use of historical artefacts, tools and concepts by peers and educators; (3) nurtured informal knowledge clusters for critical reflections, observational learning and sharing diverse knowledge and (4) activated informal strategies for collective problem solving among experts and novices. These issues are elaborated in the following paragraphs.

Firstly, digital storytelling encouraged participants to develop personal narratives around their experiences of intuitive problem solving, individual perspectives on the meaning of complex theories, insights and cues they discerned from mixed data collection methods and interpretation of results. Wenger (1998) reiterates that opportunities for engagement arise through mutual and shared activities, through challenges and responsibilities that call upon learners' knowledgeability and encourage them to explore new territories. The findings on personal stories' potential to externalise knowledge buttresses its capacity to develop learning communities. As literature suggests, [online learning] communities [employ storytelling to] provide a mechanism for individuals to better communicate and keep each other current in the developments of a shared discipline by providing multiple, direct methods of disseminating information and ideas (Barwick, 2008; Garcia & Dorohovich, 2005). The social negotiation of meaning embodied in storytelling communities "provide[s] broad access to peers, expert help, best practices, lessons learned, and innovative ideas because it is not constrained by the conventions of traditional hierarchical structures" (Garcia & Dorohovich, 2005, p. 5). As such, DST potentially bridges the knowledge gaps among heterogeneous novices in multiple research streams through sharing hunches during problem solving, exchanging intuitive-based lessons, perspectives on complex research matters and joint negotiation of meaning.

Secondly, DST also fostered collective meaning making through task-focused engagements among participants based on contemporary (books, articles) and historical artefacts, tools and concepts. Since, student tacit knowledge emerged from students' cogitative processes and from their engagement with literature, collaborative processes of meaning making were therefore constitutive of students' subjective judgments and intuitive perspectives assimilated through interactions with literature. These engagement processes further buttress the view that learning unfolds through the process of interactions, negotiations and co-construction of meaning (Hull & Saxon, 2009).

Thirdly, informal knowledge clusters for critical reflections, observational learning and sharing diverse knowledge was an additional benefit of KAR-based storytelling. These clusters fostered critical questioning about individual research challenges and talk-back processes that clarified complex, ambiguous responses thus externalising tacit knowledge. Informal clusters of CoPs are hailed for their capacity to develop the social infrastructure to further knowledge translation and sustain collaborative efforts across jurisdictions and disciplines (Bentley, Browman, & Poole, 2010, p. 2).

Fourthly, the KAR presented informal strategies of collective problem solving among experts and novices. The KAR postings and student interviews suggest that narratives, insights, perspectives, questions and heuristic suggestions were all based on shared collective experiences and desire to transcend research frontiers by consulting with a wider community. A "sense of community" ensured that learners could interact, seek information and form relationships with anyone from within their research community (Brook & Oliver, 2003).

Informal knowledge sharing was critical to the development and growth of a collaborative research community in several ways: (1) through research-based affinities and relationships via KAR; (2) creating complementary spaces for academic consultations and resolution of "wicked" problems between supervisors and novices and (3) providing a basis for personal interpretations of concepts/constructs and development of mutual accountability in problem solving. These issues are elaborated in the following sections.

Firstly, informal knowledge sharing illuminated understanding of the multiple research-based affinities and relationships among

participants. Office mates, colleagues and peers circumvented academic seclusion that often accompanies postgraduate research as these become audiences and "critical readers" for the validation of academic opinions. As illustrated by KAR extracts, communicating research challenges and soliciting responses via this platform mitigated student isolation and forged digital artifact development (Brook & Oliver, 2003).

Secondly, informal knowledge sharing created complementary spaces to mainstream spaces (seminars, lectures) for academic consultations and negotiating meaning between supervisors and novices on problem definition, data triangulation methods, mixed research methods and sampling methods. Therefore, knowledge sharing in KAR provided a research context for distributed cognition. Bronack et al. (2008) provides three attributes of distributed cognition, namely: (i) learning communities containing people with varying backgrounds and levels of expertise, (ii) technology which supports communication and productivity within the community and (iii) engagement in authentic activity (p. 64).

8. Implications for practice

While peer group meeting were critical to student exchange of research knowledge, additional strategies for externalising their literacy practices (i.e. writing genres, ways of synthesising literature, ways of distilling and interpreting subtle meanings from literature) were necessary. Perhaps, DST needs broadening to cover literacy practices like thesis writing styles and synthesis of literature during literature review development.

Engaged diversity was promoted by the "convergence" of students' diverse minds around the different research phases and processes. The KAR's embedding of DST coupled with the supervisor's academic support provided unique opportunities for the development of nascent debates between the experienced researcher and novices. However, the opening up of the research discussions on KAR to other research students at other universities worldwide and the inclusion of leading scholars in research processes could enrich the transactive and intellectual quality of the debates unfolding on the KAR.

The joint activities embodied in joint experiments, sharing of observations and research knowledge allowed for informal learning and broadening of the interpretive capacity of students. DST mediated by KAR not only created supplementary spaces for convenient productive engagement on research issues, but rather expanded the traditional boundaries of academic interaction. Given the need for intensified expert support in research processes and the value of granting novice researchers a sense of ownership of their individual research, the involvement of opinion leaders in particular research fields through video conferencing would further enrich the knowledge exchanges while minimising the educator's dominance of these processes.

Although the KAR provided a virtual platform for public expression of research stories, the interfacing academic consultations and individual knowledge generation potentially undermined the optimal externalisation of knowledge by students. For instance, while direct engagement and provision of supplementary material by the educator (i.e. supervisor) in KAR enhanced mutual accountability in supervisor–mentee relations, the educator needed to balance such direct "instruction" with student self-generation of knowledge to sustain a mutually beneficial, productive learning community. Since educator provision of supplementary academic material tends to reinforce a culture of academic dependence, scaffolding strategies such as "props and fading" were necessary to increase learners' responsibility for their learning, heighten individual and collective participation in generation of artifacts and reduce academic inactivity.

The occasional challenges of affirmative discussions, tentative suggestions, lack of clarity and conciseness during discussions necessitated the involvement of external expert on research issues. Research experts could be recruited as guest on KAR to contribute to authentic scholarly knowledge in various formats (texts, voice and video), stretch student imaginations and challenge their misconceptions. The challenge of shallow learning embodied in these weak narratives calls into question the integration of authentic learning tasks and assessment activities into DST. Where DST is tightly coupled with meaningful learning tasks effective research experiences and deep learning can be expected.

While the distinctness of individual projects often undermined possibilities for sharing disciplinary content, generic issues about research were however, shareable. Since a basic understanding of specific disciplinary issues is a prerequisite for more meaningful sharing of the mechanics of research in that discipline, inter disciplinary and transdisciplinary discourses on research processes are necessary. As such, KAR-mediated DST needs to be seamless integrated and supported by interdisciplinary and cross disciplinary research activities like collaborative writing of papers, articles, interpretation and reporting of results. Cross and trans-disciplinary scientific research that demands the expertise and experience from experts and novice researchers from multiple disciplines is critical to externalising research knowledge and mitigate the reluctance to share information prevalent among some students.

9. Research limitations

Our study findings should be considered in light of the small number of research participants, particularly postgraduate students from historically disadvantaged backgrounds. Reference to other target groups such as postgraduate from privileged backgrounds might yield different results. As such, notwithstanding the rigorous nature of this investigation and triangulation of data to increase the credibility of results, the extent of generalisability of the findings to postgraduate studies in the developing world might be limited due to our sample size. The diversity of our participants in terms of their research streams and topics they were investigating, however, affirms the relevance of our study to understanding the academic participation of disadvantaged students enrolled at elite universities in South Africa.

Given that KAR is a relatively new phenomenon in postgraduate studies at the institution studies, it was not clear whether student research practices, research narratives, patterns of use and research challenges they reported were consequences of novelty of the platform or rather the social agency and educational backgrounds of students. Extended studies (e.g. longitudinal studies) involving more postgraduate students will be necessary to ascertain whether existing research practices can be sustained, whether new research narratives and patterns of use could merge or others could recede with sustained adoption of the KAR by students.

Since the relaxed authority of the educator allowed students' free expression of their stories but did not necessarily optimise student participation, more research needs to be carried out to establish the effect of more educator/tutor moderation of KAR discussions on student articulation of their research processes. Whether increased educator moderation of KAR discussions enhances the student externalisation of knowledge about research processes necessitates further inquiry.

10. Conclusion

This research explored the capacity of KAR-based DST to externalise postgraduate students' personal (tacit and procedural) knowledge on research processes. It also examined the potential of informal knowledge sharing to foster the growth of collaborative research communities. Drawing on CoP as an analytical framework for exploring the abovementioned issues, digital storytelling was conceived as instrumental in fostering information-rich personal narratives on research processes based on individual experiences. DST also engendered collective meaning making through task-focused engagements among participants involving collective generation of artifacts, tools and concepts. Most importantly, DST nurtured informal knowledge clusters for critical reflection, observational learning and sharing of diverse knowledge. KAR also fostered a platform for expressing personal experiences,

sharing strategies of problem solving and deepening expert–novice consultations. DST rendered a complimentary space (to mainstream spaces) for joint participation in academically focused tasks and informal knowledge sharing.

DST, however, was not without its limitations. The provision of academic materials by the educator was not adequately complemented by sustained student–peer engagement and individual self-generation of materials. This imbalance inadvertently reinforced an implicit academic dependence on educators. Other challenges included student reluctance to share information, affirmative yet uncritical discussions, lack of clarity and precision in articulating research ideas as well as unhelpful, tentative suggestions. Other impediments to externalisation of personal knowledge exhibited in DST included the uniqueness and discipline-specific nature of individual researches that undermined the cross fertilisation of research processes from diverse disciplines. The study has thus proposed productive scaffolding processes, the involvement of external research experts as guests on KAR, integrating meaningful learning tasks into DST and collaborative scientific research projects within, across and beyond disciplines.

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