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Skilling Up: Evaluation of a design-based research methodology

Abstract

This paper reports on the external evaluation of a two-year project aimed at improving educational opportunities for Aboriginal Education Workers (AEWs) through technology-based pedagogy. A design-based approach was selected by the research team to increase the relevance of the research for both praxis and practice, with emphasis on improvement of practice through evidence-based education throughout the project. To complement this research approach a design-based approach was also adopted for the external evaluation that was undertaken in parallel to the research study. Design-based methodology has advantages and issues for an independent evaluator due to the inter-relationship of the research team in iteratively using findings of phases of the evaluation to inform and enhance the project. Internal evaluative data collected by the research team need to be balanced with that collected independently by the external evaluator to ensure authentic evaluation of the nature and effects of the interventions on participants. The paper reports on the outcomes of the external evaluation process and reflects on its capacity to serve dual objectives for evaluator and research team.

Key Words: Aboriginal education, Indigenous education, design-based, evaluation, education, technology-based pedagogy

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Introduction

The role of an independent external evaluator in a higher education research team is complex in that it needs to serve dual purposes of providing objective evidence of the quality and effectiveness of the research project and also adding value by informing the research process through evidence and advice throughout the duration of the project. These dual but contrasting roles can create ethical dilemmas for the evaluator in balancing the vested interests of research team, research participants, funding body and the need for objective data independent of these interested parties (Jenlink and Jenlink 2016; Calzoni 2016). Agendas, scope and purpose of evaluations are also impacted by the multiple audiences, the control and ownership of the project and collected data; and the multiple uses that the evaluation evidence may serve (AUTHOR).

A requirement of higher education grants funding has been to include the employment of an independent external evaluator to conduct both formative and summative evaluation of funded projects (Doyle and McDonald 2016). An external evaluator typically is selected by the project team on notification of the success of their funding application. The evaluation of funded research projects has dual objectives in that it is a requirement of the funding body for the purpose of making judgments on the value and effectiveness of the project, but also has the objective of adding value to the project itself through formative feedback to the research team. Difficulties that may arise due to differences in audience, scope, purpose, project control and power that such dual purposes of evaluation of research are discussed by AUTHOR.

This paper reports on the external evaluation of one Office of Learning and Teaching (OLT) (OLT 2013) project *Skilling Up: Improving educational opportunities for Aboriginal Education Workers (AEWs) through technology-based pedagogy* (Jackson-Barrett, Price, Herrington, Parker and Gower 2015). The 'Skilling Up' project (Jackson-Barrett, et. al. 2015) commenced in 2014 and was funded for two years by the OLT. The project was developed with the aim of improving the career and educational opportunities of Aboriginal Education Workers (AEWs) through the use of digital technologies in three regions of Western Australia. Aboriginal Education Workers have been employed in Australian schools since the 1950s, in Western Australian schools since the 1970s, and have undertaken a range of significant roles (Gower, et. al. 2011). The long term aim of the research project was for technology-based pedagogy to provide a sustainable way for AEWs to influence improvement in outcomes for Aboriginal students in their schools (Kral and Schwab 2012; Jorgensen 2013).

The methodology of the research project took the approach of design-based research informed by Indigenous research theory (Singh and Major 2017; Yunkaporta and McGinty 2009). There was a focus on empowering participants and in ensuring that Indigenous people had ownership and control over the research and their participation in it. A complementary design-based evaluation was designed as an integral component to inform the research process and to assist the research team in meeting the project aims through formative evaluation. In addition, it was also required to provide a summative evaluation to meet reporting accountability and compliance requirements. The evaluation therefore considered data developed and collected by the team themselves through professional development (PD) interventions at metropolitan, regional and remote sites in Western Australia, and documentary evidence of meetings and development of literature, in addition to data collected independently by the external evaluator. Whilst it is the latter

external evaluation data and process which form the focus of this paper, a general outline of the data collected by the research team is provided for context. The details of outcomes of the actual project are being published separately by the research team.

Project and Evaluation Design

Design-based methodology is one approach to research and evaluation that can assist in managing the multiple purposes and audiences of both a research project and its evaluation. An approach that focuses on research theory, design of instructional interventions or tools, and educational practice (Bowler and Large 2008; Herrington, McKenney, Reeves and Oliver 2007), it allows complex problems to be investigated and evaluated in real and authentic contexts in collaboration with participant educational practitioners and the research team. Wang and Hannafin (2005) defined design-based research as "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (pp. 6–7). It is a pragmatic approach in that it incorporates the requirements of all parties, including the evaluator, and is contextualised within a real-world problem or intervention (North 2017). In addition, it is interactive, iterative and flexible, allowing collaboration through an iterative cycle of theory, design, enactment, evaluation and redesign that meets the needs of all participants (DBRC 2003). In this case the participants were AEWs who undertake a complex role involving liaison between families and communities, in addition to daily support of students and classroom teachers. Kanowski, Form and Hart (2009) emphasised the particular importance of using evaluation feedback to iteratively adapt training

interventions when working with Aboriginal participants and communities to ensure their needs are met.

The design-based approach was selected to increase the relevance of the research for both praxis and practice, with emphasis on improvement of practice based on evidence (Barab and Squire 2004). To this end the design research specifically included formative evaluation, the results of which could then be included in an iterative approach to the development and design of interventions and the research process as part of a cumulative cyclic process (Wang and Hannafin 2005). This approach assists in improvement of the research process in addition to the summative evaluation of the quality and effectiveness of the research. There are some overlap and synergies in this approach with traditional empirical cycles of hypothesis testing (Gravemeijer and Cobb 2006). However, in design research the research team uses the results of each iteration of testing to revise learning goals or activities, to develop specific interventions or otherwise adapt the learning process to improve both the underlying instructional theory and its outcomes (Bowler and Large 2008; Anderson and Shattuck 2012). This approach has been adopted by many researchers in the area of educational technology (Reeves 2006) due to opportunities it presents to improve the design of curriculum instruction, interventions, or professional development (PD) facilitation (McKenney, Nieveen and van den Akker 2006) similar to this study. It has also been identified as an appropriate approach for teachers, in this case AEWs, in isolated schools with minimal access to professional development and support (Barab and Squire 2004; Cobb, Confrey, diSessa, Lehrer and Schauble 2003).

The evaluation followed the design-based evaluation approach outlined by Reeves and Hedberg (2003) specifically developed for technology-orientated design-based research projects. The six functions of evaluation in this approach include:

- Review;
- needs assessment;
- formative evaluation;
- effectiveness evaluation;
- impact evaluation; and
- maintenance evaluation. (Reeves and Hedberg 2003)

It should be noted that only the first four of these evaluation components have been completed and are reported on in this paper. The final two functions, impact and maintenance evaluation, are still to be conducted post the project conclusion. This is a limitation of the accountability requirement for the evaluation to be provided at the immediate conclusion of the research project.

Within this approach the design researchers themselves can take on dual roles as research designer and as evaluator. However, there is a risk of conflict of interest between these dual objectives which could lead to a lack of objective measurement when all evaluation is conducted by the research team. In this study, whilst the researchers had these dual roles, there was also an independent external evaluator who was not part of the research team. This allowed another objective perspective to both the formative and summative components of the evaluation, and also allowed the participants to interact and respond in ways that could differ from their interaction and response to the team delivering the interventions within the design-based research project. Such independence assists with validity. However, if data were collected only by the external evaluator there is a risk that the data collection points may be limited, leading to a lack of authenticity.

Data collection for this external evaluation included a critical review of documentary evidence created by the team, including the professional development

framework model, pedagogical strategies, development of curriculum and authentic tasks collected during the planning, development and intervention phases respectively. In addition, the evaluator engaged with the research team in regular meetings throughout the study to investigate the nature and effects of the interventions. Whilst the research questions and criteria underlying the success of the project were the same for both the project and the external evaluation, additional data were collected independently by the external evaluator in the final phase of the evaluation. This included conduct of a focus group with the research team to reflect on issues that arose throughout the implementation and the outcomes achieved; and a structured on-line questionnaire administered by the evaluator in an interactive focus group of AEW participants to triangulate data collected by the research team. This approach was undertaken to maximise the benefits of both forms of evaluation, minimise the identified risks, and allow for the iterative formative evaluation to feed back into the design-based research approach. Focus on reflections of the researchers and independent collection of views of participant AEWs on their perspectives of the intervention and its usefulness for their role in the future enabled the consideration of alternative views of the usefulness of the project intervention and its potential impact for AEWs.

The structure of the remainder of this paper follows the above Reeves and Hedberg (2003) model discussing methods and results iteratively within each of the evaluative components consistent with design-based research and evaluation.

Review phase of evaluation

Following agreement to undertake the evaluation, the independent evaluator initially met with the two Indigenous team members, being the project leader and another researcher. A face-to-face meeting was then held to meet the full project team, and the

evaluator subsequently met with team members on five further occasions across the two-year period of the funded research. Access was provided to all documents, including working documents, to enable a full documentary analysis.

The evaluation found the review of literature undertaken by the research team to be inclusive of academic literature, government reports at Commonwealth and State level, Department of Education information, policy and reports. The academic literature included studies focussed on the use of digital media and technology to mediate learning with Indigenous people and also in remote communities, studies of Aboriginal and Torres Strait Islander education, the roles of Aboriginal Education Workers and action research conducted, and also narratives from within Australian schools.

A reference group of Indigenous academics, teachers in consultancy roles and key stakeholders had been established to guide the project. This group was utilised at the beginning of the project and provided a valuable contribution to the needs analysis and in the development of the project model and direction. However, there was limited use of the group throughout the later phases, and the group was not consulted to provide input regarding the outcomes of the project.

Needs Analysis

Based on the literature review (Price, et. al. 2018) the problem and objectives for the project were established by the research team and a model developed for the planned intervention in light of the objectives and the target group based around three themes; enabling, pathways and understanding (Jackson-Barrett, et. al. 2015). The linkage of the model developed to the literature was clearly articulated throughout the project. The application of the model to produce design principles and implementation of solutions in practice and resources was developed and implemented as the project progressed.

Initial recommendations from the evaluator on points to be covered in the first professional development sessions and the uptake of this first iteration of external evaluative input included:

- Assessment to be made of each participant's prior ICT experience and capability, as if limited, AEWs may require additional training in prerequisite skills to enable participants to fully participate. In response, a question was included in the initial AEW survey on prior use of mobile devices and need for training. Personalised assistance was provided by the team to each participant AEW during the PD sessions.
- Clear understanding of whether and how the AEWs can control the rate, sequence and other aspects of the intervention/instruction, and whether there was scope for AEWs to initiate unique or unexpected uses, either individually or in groups.
- Outline of the monitoring of use and record management that would occur so that participants could produce sources of evaluative data. This was to include a checklist of use made of the iPad and a weekly diary/journal entry. However, this recommendation was not implemented and journal data were not collected which limited the authentic data collected by the evaluator to one professional development session with participants.

Formative Evaluation

As part of the formative evaluation process the evaluator discussed with the project team possible measures of individual participant progress, use of the iPads and how it assisted with their AEW role (AUTHOR). Classroom teachers have been able to access professional development in the use of technology in the classroom since the late 1990s (Blyth 2002), but this had not previously been available to AEWs. The project

team had developed draft interview questions to be used. The intent was to use non-scheduled standardised interviews (Denzin 1989) using qualitative questioning techniques for individuals and groups, with questions focussed on participants' perceptions of the following areas:

- use of ICTs in their school/classroom, including mobile devices;
- their PD needs that would enable the use of mobile devices in their classrooms;
- pedagogical strategies that would assist them to use mobile devices in authentic Indigenous learning environments; and
- ways in which their AEW roles could be enhanced through understanding and use of mobile devices in educational contexts (Jackson-Barrett, et. al. 2015).

The project team collected data informally based around these guiding questions during the PD sessions and utilised the feedback during the formative evaluation phase in line with the design-based research approach. Whilst there was a common curriculum developed to use with the participants, there were some differences in the conduct of the intervention at each location as different research team members were assigned to manage each cluster. This is consistent with the design-based approach and Indigenous methodology, however, it did mean there was no basis for comparison of the consistency of approach or standard of PD delivery across the participant groups and school sites. The emerging findings of the evaluation across the differing sites did indicate a number of common issues including confidence, self-esteem and communication (Jackson-Barrett, et. al. 2015). These issues were raised and incorporated into the planning for the modules and the PD sessions included in an iterative approach to the development and design of the interventions and the design-based research process as part of a cumulative cyclic

process. Whilst elements of the data arising were used in this way allowing a number of issues to be resolved by the team as they arose, data from all sites were not available until the conclusion of the project. In retrospect, it became clear that the implementation at the remote site had differences from those provided at the other metropolitan and regional sites. This was partially as a consequence of restrictions at that site applied by the principal; partially due to impacts of time constraints imposed by distance and mode of travel; and also as a consequence of the interaction effect of an independent but related project being conducted concurrently that appeared to amplify the impact of the interventions of the Skilling Up project. It was clear that the support of principals was critical in AEWs having the time and confidence to engage with technology and utilise it effectively in their role in schools.

Effectiveness evaluation

The effectiveness component of the evaluation was undertaken by the external evaluator at the conclusion of the final professional development session. It included focus groups with both the participants of the professional development intervention and separately with the research team members. The results of each are reported and discussed below.

Focus group with research team members

A focus group was held with four members of the research team following the final PD session. The focus group provided the opportunity for the research team to reflect on issues that arose throughout the implementation of the project providing evidence related to the research process; and also related to the quality and effectiveness

of the project and outcomes achieved. The session was recorded and transcribed. The main themes arising from the focus group are discussed below.

Theme 1: Selection of Schools

This theme relates to the research process. The sample of sites and participants was an initial concern for the research team as the responsible state department requested to select the schools to be involved in the project. Whilst this was negotiated to meet ethical requirements associated with research, the selection was not random in that schools "self-chose because they got to fill in the survey and gave an indication of whether they would be willing to participate" (excerpt from focus group). It was therefore a convenience sample but from an evaluation perspective it incorporated sufficient diversity: in schooling sector, including government, Catholic and private schools; geographical location, including metropolitan, regional and rural and remote schools.

Theme 2: Impact of Principal

This theme relates to both the overall research process and the quality and effectiveness of outcomes, demonstrating the dual nature of the design evaluation process and how the issues arising in the research process can impact on effectiveness of research outcomes. A key issue that impacted participants was the principal at each school site. Supportive principals were important in AEWs having the time and confidence to embrace the technology. However, they were also critical in the level of support given for the project and there were differences between schools in how principals allowed AEWs to use the provided iPads and school internet. At the remote site the principal controlled internet access and determined that the iPads could only be used for certain uses during the school day. These participants were therefore not able to utilise apps outside of school and had restrictions imposed by the principal regarding their use at school. For example, they were unable to access social media sites using the iPads. Whilst the restrictions

imposed by the principal and the remote location were independent factors they did interact to cause a barrier to this group of participants taking maximum advantage of what the technology could offer. It was acknowledged by the research team that iPads are a personal device and greatest benefits come when participants can personalise the device and use outside of school hours in addition to using as part of their role whilst at school.

Theme 3: Upgrade of Skills

This theme relates to the quality and effectiveness of outcomes. There was general agreement that participants had their skills upgraded in iPad technology; that their confidence in using this technology increased over the course of the project, and that participants saw the value of iPads in an educational context. Participants at each site were very enthusiastic, with a very low dropout rate, and most requested future sessions. The most significant challenges experienced from the perspective of the research team was in relation to internet technology – accessing Wi-Fi; Wi-Fi being slow; finding passwords; accessing iTunes; and downloading of apps. This caused some frustration and the team was of the view that more workshops would have allowed more time to be spent using educational apps rather than spent on internet access issues.

However, it was clear that an additional and valued outcome was that the facilitators learnt along with the participants. This is a significant outcome consistent with the design-based approach of the study. This was exemplified when participants became involved in problem solving with the facilitators when technological issues arose, for example, when there were difficulties in logging onto networks, in using passwords and Wi-Fi. Participants made suggestions to resolve the issues as they arose and through incorporation of their knowledge and experience were able to jointly solve the problems. This was empowering for the participants, and showed respect for each person's

knowledge and skills, which is consistent with both design-based research and also Indigenous research methods (Lowe 2017, Yunkaporta and McGinty 2009).

Theme 4: Discovery of Learning

This theme relates to the quality and effectiveness of outcomes. It was apparent that participants had a journey of discovery through learning. The PD workshops encouraged a community of practice (McLean, Dixon and Verenikina 2014; Wenger, McDermott, and Snyder 2002) and the AEWs learnt by playing and watching and interacting with other participants. Most participants had utilised some forms of personal technology, including smart phones. This provided a sound basis for them but there was significant time required for learning technical aspects that impacted on time for learning cognitive aspects that could be applied to education. Even so, outcomes for participants included incorporation of technology for literacy, numeracy and community development as part of their educational role.

The AEWs participating generally had little to no higher education, although four had completed a Certificate IV qualification. It is a possible longer term outcome that some participants may be empowered from the learning outcomes achieved to undertake further study to become qualified teachers.

Focus group with participants and questionnaire

To ensure authentic evaluation of implementation components, the external evaluator planned to accompany the research team to a sample of the communities to engage with participants to investigate the nature and effects of the interventions. However, the evaluator was not included in visits on-site at the regional locations so the authentic data collection for this phase conducted on-site was undertaken by the members of the research team responsible for each site location. The on-site evaluation by the

external evaluator was limited to attendance at one PD day conducted at the lead university for a sub-set of the participants. This evaluation was attended by AEWs from the metropolitan and regional sites only and therefore does not include data from the remote site. Difficulties with timing of sessions at the remote location meant that the evaluator was unable to accompany the team to that location to collect similar data.

Whilst there were significant limitations with regard to the evaluator's access to the participants, both effectiveness and preliminary impact evaluation data were collected in person by the evaluator at a session on the final PD day to allow personal face-to-face interaction. This was essential to enable some level of development of trust and reciprocity through two-ways learning (Lowe 2017). Alignment with Indigenous methodology required an evaluation approach that was ethical, authentic and respectful and allowed the voices of the participants to be heard (AUTHOR; Chilisa 2012; Denzin, Lincoln and Smith 2008; Fine, Tuck and Berkman 2008). Data were collected via a structured on-line questionnaire administered by the evaluator in an interactive focus group during this final PD session. The instrument measured how the 18 participants felt about the use of iPads, their involvement in the project, and also their future expectations.

The results of this data collection are listed for each of the questions below:

Had you used an iPad or any other mobile devices in your role as an AEW prior to being involved in the Skilling Up program?

- The majority of AEWs had never used (8), or did not regularly use (6) an iPad or other mobile device in their AEW role prior to the program.
- Most participants had used a laptop or computer to undertake the main functions of internet access, email access and production of word documents and classroom resources.

- Those who had used an iPad, mostly used it to take photographs, access emails or use educational apps.
- Other devices used included a Smart Board/Apple TV and iPhones

After doing these PD sessions with the Skilling Up team, do you use your iPad or any other mobile devices in your role as an AEW?

- All participants used the iPad and other devices in their role, but for most (10) not regularly.
- Computers and laptops continued to be used for emails, internet access and resource creation, but iPads were being used more for photos and email access, taking notes, recording literacy and numeracy test results.
- A greater range of uses of the iPad was indicated after the session than before.

To what extent did the PD sessions assist in your understanding of how to use the iPad?

- No participants advised that they did not find the PD sessions useful and most participants found them to be a little helpful (5), helpful (6) or very helpful (3).
- The most useful things learnt were:
  - How the technology can be used within the classroom and with the children;
  - How to create a website using Weebly; and EduCreations.
  - Learning which apps to use.

What have been some of the challenges or difficulties of using the mobile device provided through this program?

- Participants generally found that they experienced a little difficulty in using the device (9) although others experienced technology challenges quite regularly (6).

- The biggest challenges were:
  - Gaining access to the internet both at school and home;
  - Issues with internet speed;
  - Difficulty in using some of the apps; and
  - Finding enough time to experiment and play around with the device.
- Some issues were able to be resolved during the PD sessions (e.g. internet connection at school) however, others remain outstanding such as internet access at home and having time at school to use iPad.

What are the three most useful things you learnt with regard to how to make use of mobile devices in your AEW role?

- The majority of participants found the PD sessions helpful (10) in assisting their understanding of apps and other functions of the iPad.
- The feedback from participants indicated that the most useful things were:
  - In the group helping and sharing their knowledge of apps; and
  - Learning the capabilities of the devices.

Have you experienced any challenges or difficulties in being able to make use of the mobile device provided through this program in ways you planned or wanted to?

- Most participants (8) who answered this question experienced a little difficulty in being able to make use of the device in ways they planned.
  - This was due to being unable to find adequate time to use the device (6); and
  - Technology related reasons (accessing the internet at work and home).

- 4 participants found their issues to be resolved during the PD sessions.

What ethical issue has arisen for you and how have you managed this?

- Participants who answered this question found the PD sessions were helpful (2) or greatly helped (5) in their understanding of ethical issues. Three (3) found the sessions only a little helpful.
- The most common ethical issue to arise was related to the filming or photographing of children and the permissions required for this.

Describe one impact involvement in the PD sessions has had with regard to your beliefs and values about your role as an AEW?

- Participants who answered this question found the PD session a little helpful (4), helpful (4), or very helpful (2) in assisting them to reflect on their beliefs and values around their role as an AEW.
- Reflections included:
  - Realising the capabilities of the device within their role;
  - How much their role is valued by their school and important to the children; and
  - How more time would benefit their understanding and use of the iPad.

Discussion of participant questionnaire results

The majority of AEW's had never used, or did not regularly use an iPad or other mobile device in their AEW role prior to the program. Most participants seemed to have used a laptop or computer to undertake the main functions of internet access, email access and production of word documents and classroom resources. Those who had used iPad,

mostly used it to take photographs, access emails or use educational apps. Other devices used included a Smart Board/Apple TV and iPhones. However, following the PD sessions, all participants felt confident to use the iPad and other devices in their role with most participants, using the devices either a few times or regularly. This result was indicative that the PD sessions were providing participants with the time and confidence to understand iPad capabilities for their roles. Computers and laptops continued to be used for emails, internet access and resource creation, but iPads were being used more for photos and email access, taking notes, recording literacy and numeracy test results, with a greater range of uses of the iPad seen after the session than before.

No participants advised that they did not find the PD sessions useful and most participants found them to be at least a little helpful with the most useful things learnt being, how the technology can be used within the classroom and with the children they work with, and how to create a website using Weebly and learning which apps to use. Whilst participants generally found that they experienced little difficulty in using the device, several did indicate that they experienced technology challenges quite regularly. The biggest challenge faced was in gaining access to the internet both at school and home, followed by issues with internet speed, difficulty in using some of the apps, and finding enough time to experiment and play around with the device. Some of these issues were able to be resolved during the PD sessions (e.g. internet connection at school) however, others remained outstanding such as internet access at home and having time at school to use iPad.

The majority of participants found the PD sessions helpful in assisting their understanding of apps and other functions of the iPad. The feedback from participants indicated that being a participant in the group, meeting people in the same role, helping each other and sharing ideas around the use of the iPad, their knowledge of apps and the

capabilities of the devices, was one of the most useful aspects of the PD that enabled them to gain confidence in the use of these devices.

Group discussion was also helpful in developing understanding of ethical issues surrounding the use of devices. The most common ethical issue to arise for participants was with regard to the filming or photographing of children and the permissions required for this. From the perspective of the research team an ethical issue that arose early in the project centred on the ethical use of the internet and the security of passwords. The participants did not initially appreciate the need for confidentiality and this was a topic that the team had not foreseen a need to include, but it had to be addressed and incorporated into the PD. The need for passwords and the AITSL standards were therefore discussed to address this issue.

The most common difficulty was being unable to find adequate time to use the device. Technology related reasons such as accessing the internet at work and home added to this problem. There was only limited reflection by participants on individual beliefs and values around their role as an AEW. Such reflections included realising the capabilities of the device within their role; how much their role is valued by their school and important to the children, as well as how more time would benefit their understanding and use of the iPad, but the majority of participants did not progress to this level of engagement.

In relation to the presentation of the PD, the majority of participants found the presenters to be clear and engaging during the PD sessions. The presenters were regularly described as clear, helpful, friendly, understanding and encouraging. The presenters were also acknowledged as providing assistance in solving problems. In addition, the sessions were agreed to have been culturally appropriate and participants valued the fact that presenters came to their schools to conduct PD sessions.

Impact and Maintenance evaluation

The project focussed on using technologies for professional development in three areas: Enabling skills, Pathways in higher education and Understanding of AEW roles (Jackson-Barrett, et. al. 2015). These project aims relate to long term sustainable outcomes that are based on judgments of added value for AEWs as a consequence of participating in the PD sessions. Doyle and McDonald (2016) have identified the challenge in evaluating the enduring impacts of research in the complex higher education funding environment where academics are under pressure to demonstrate 'quick impacts' through reporting of measurable outputs of a research project. In the shorter term of this funded project the sustainable impact and maintenance of emerging outcomes were unable to be evaluated. The achievement of identified outputs of the project completed during the project implementation were able to be assessed. However, it should be noted that whilst these are positive indicators, they do not necessarily ensure that sustainable value and impact will follow longer term. Research conducted with classroom teachers' uptake of technology has shown that whilst they used devices for some administrative tasks and communication, making sustained use of technology in the classroom and its impact on curriculum and pedagogy was problematic for many teachers (Blyth 2002; Author 2006; Author 2015).

The evaluation data collected indicated that the project was successful in achieving each of the specific outputs listed including development of the professional learning program for AEWs and workshop resources; and creation of a website of exemplars, strategy descriptions and digital stories. Some of the participants were able to successfully develop authentic projects that incorporated local knowledge and stories reflecting links to Aboriginal culture. Yunkaporta and McGinty (2009) indicated that the "interface

method" that incorporates Aboriginal knowledge and learning styles is likely to have greater impact on outcomes for Aboriginal students' achievement of outcomes. However, whilst there is initial evidence of impact for this group of AEWs and the schools participating in the project, the broader impact that may be achieved is not yet apparent. Design-based research requires further iterations (Wang and Hannafin 2005) although Abdallah and Wegerif (2014) have argued for the viability of adopting DBR methodology even where such limitations with timelines exist that restrict the opportunity of a longitudinal study. This project has been limited by timescales required in the funded project that restricted the PD to only two sessions conducted with each group of participants and the one cohort of participants. There is certainly scope for the participating AEWs to further extend their own skills beyond the funded PD and the website provides a mechanism to share the developed curriculum and pedagogical strategies more broadly.

The requirements of the longer term design-based evaluation components are unable to be met in the timeframe of the project, creating a dilemma for the dual purposes of evaluation of the project (Author 2016) and meeting the requirements of design-based research. For a valid and reliable summative assessment of the impact outcomes of the project and their sustainability, ideally the impact and maintenance components of evaluation need to occur one or more years after the innovation has been fully operational. This requirement was acknowledged in the project proposal and was identified as part of the project design. This component of the evaluation will require follow up with the participants in 12-24 months to gauge their ongoing use of the technology and their progress in incorporating this in relation to their roles as AEWs. The instrument developed for use in the final PD session may be utilised for this purpose as this will allow the collected data to be compared to current-use patterns and issues being

experienced. The recent data collection forms a baseline for measurement of sustainability of outcomes that will be useful for the maintenance evaluation going forward. Further key measures will be the number of AEWs who are actively teaching rather than assisting in classrooms and the number of AEWs who have enrolled in further education to gain a teaching qualification.

The research team has allocated funding to maintain the project website and resources over a further five-year period (Jackson-Barrett, et. al. 2015). Impact measures can be also collected via hits on the site over this time. At the end of the five years the maintenance evaluation will need to be conducted to ascertain sustainability.

Limitations

Data collection for the external evaluation included critical review of the planning and development phases including the literature review, and the professional development framework model. As they were developed, the pedagogical strategies, curriculum and authentic tasks were also subject to critical review. The research team held regular monthly meetings, the minutes of which were made available to the external evaluator. The evaluator was invited to attend three of these team meetings via teleconference over the course of the project. Closer liaison with the external evaluator and inclusion in routine meetings would have enhanced the design approach of inclusion of evaluative feedback into the decision-making processes of the team throughout the project. The communication strategies worked well initially, but were limited through the implementation phases of the project with restricted opportunities for evaluative input by the external evaluator into the formative iterative cycle of the design research. Similarly, the formative use of the external evaluation was limited as evaluation of the project focussed more on effectiveness and impact phases that occurred towards the end of the

project. This limited the level of relationship that could be developed with the participants which is a critical component to enabling authentic Indigenous methodology to be implemented.

The sample of schools for this project was based on convenience through self-selection which ensured willingness and interest in the aims of the project and involvement. This selection method impacted positively on project outcomes as participants were motivated to participate and invest their time into learning and applying the technology in their classrooms. As a consequence of the selection method and size of the sample it cannot be assumed that the findings can be generalised to other locations or AEWs more broadly. However, the findings do provide evidence and insight into the key research questions that met the aims and rationale for the project.

Conclusions

The evaluation found that the focus and scope of the planned project, the methodological approach and conduct of the project were consistent with the reviewed literature, that the design-based research approach was appropriate to the focus and scope of the project, and that the approach was culturally appropriate and consistent with Indigenous research theory. The project team collected data based around the guiding questions during the PD sessions and utilised the feedback during the formative evaluation phase in line with the design-based research approach, but the consistency of approach and standard of PD delivery could not be validated across the participant groups and school sites.

The project was found to meet the stated aims and rationale and provided evidence and insight into the key research questions, and the key outcomes of the project were achieved. Participants had their skills upgraded in iPad technology; their confidence

in using this technology increased; and participants saw the value of iPads in an educational context and utilised them to implement relevant pedagogical strategies in their schools. Overall, both participants and presenters viewed the PD sessions as being beneficial in increasing participants' knowledge and confidence in how to use iPad technology and educational apps. Feedback from both sources suggests that the biggest hindrances to learning this technology was in gaining access to the internet, acquiring reasonably fast internet; accessing the app store and subsequently downloading apps. Many participants agreed that more PD sessions would provide more time to learn about the capabilities of individual apps; provide time from their role to experiment and play; and allow for collaboration with colleagues to share ideas and strategies. No participants felt that the sessions were not useful.

The PD workshops encouraged a community of practice (McLean, Dixon and Verenikina 2014; Wenger, McDermott, and Snyder 2002) where the AEWs were able to share strategies for incorporation of technology for literacy, numeracy and community development as part of their educational roles. Choy, Delahaye and Saggers (2015, p.22) have suggested that "the success of a cohort lies in the continuity in the group's learning journey to strengthen the stability of the community of learners as they grow to know each other and count on one another for support". The significance and benefits of face-to-face discussions with peers about professional roles are emphasised where individuals work in isolated circumstances or communities (Reading 2010) particularly in relation to quality digital pedagogies (Broadley 2012; Maher and Prescott 2017; Reading 2010). The importance of reciprocity and connectedness in building professional knowledge and capacity within supportive communities of practice (Reading 2010) was an important outcome for participants who did not have regular access to professional development opportunities with other AEWs.

In addition the project website (Jackson-Barrett, et. al. 2015) was a key deliverable for the project in itself, providing information about the project and also hosting the curriculum materials developed for the project. It provides tangible evidence of outcomes through the uploading of exemplar tasks completed by participant AEWs. This site goes some way to meeting the goal of sustainability. With the project materials being available as a resource to assist others, the reach of the developed resources and project outcomes has been significantly extended.

The evaluation process reflected the design-based approach requiring the evaluation to serve dual objectives for evaluator and research team. The primary aim of the evaluator was to measure the quality and effectiveness of the research process whereas the primary aim of the research team was to enhance the research process through continuous reflection on the emerging findings of the formative evaluation process. The meeting of both aims involved collection of evidence by both the research team and the external evaluator that was utilised for both purposes in an iterative approach. The challenges associated with assessing the sustainable impacts of an education intervention project, as required in the design-based research approach, were complicated due to the nature of short-term funding for higher education research projects. The term of funding is most frequently concluded with submission of the research report. For this reason, the final two phases of evaluation, impact and maintenance, did not receive the attention they deserved and was required by the design-based evaluation process. Short-term impacts cannot be assumed to be ongoing, so sustainability of this initiative cannot be confirmed unless further components of the evaluation are conducted in a follow-up study at a future time. However, whilst this limitation is acknowledged it is also noted that this is a shortfall of many if not all

evaluation methodologies of funded projects where the evaluation is conducted as part or immediately on conclusion of the project (Normand 2016; Doyle and McDonald 2016).

Overall, this approach to conducting research and evaluation provided both an ethical and rigorous means of meeting complex goals of a diverse group of stakeholders including funder, research team, evaluator and participant educational practitioners. The binaries of research and evaluation, of theory and practice, project implementation and accountability were each able to be addressed to some measure through this process. The alignment of the evaluation approach and the research paradigm of design-based research encouraged the use of formative evaluation that enhanced the project. This study has shown that design-based research, inclusive of design-based evaluation, is an approach that has merit for further investigation and use in higher education funded research aimed at generating knowledge and improvement of educational practice.

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