



# Introducing Open Source Reference Management Software to a Rural South African Campus: Evaluating the Effectiveness of Workshops at the University of the Free State's Qwaqwa Campus

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## Abstract

Despite the increased availability of Free and Open Source Software (FOSS), the adoption of such information technology remains poor in developing countries. Free reference management software such as Zotero can significantly improve academic workflow and thus its adoption by academics in peripheral nations could be a cost-effective method of supporting and boosting research output. Guided by the Technology Acceptance Model, we assessed the effectiveness of a workshop as intervention to introduce Zotero (a novel FOSS in this particular community) to staff members and students at a rural university campus in South Africa. A series of questionnaires assessed how this intervention affected attitude towards, and use of, Zotero. While participants had positive attitudes towards the software at the start of the intervention, the workshop improved the perceived usefulness and ease of use of FOSS. For all participants, the main predictor of eventual regular use was its perceived ease of use. This study suggests that brief training workshops could significantly improve usage of novel open-source software, even with a lack of prior exposure to similar technologies. For students, it becomes important to emphasise the usefulness of the software, while academic staff may benefit from an emphasis on hands-on technical training.

**Keywords:** free and open source software, reference management software, South Africa, technology acceptance model, Zotero.

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## Résumé

En dépit de la disponibilité croissante des logiciels libres et open source (FOSS), l'adoption d'une telle technologie d'information demeure faible dans les pays en développement. Les logiciels libres de gestion de références tels que Zotero peuvent de façon significative améliorer le flux de travail et par conséquent leur adoption par les universitaires dans les nations périphériques pourrait être une approche rentable pour appuyer et booster les résultats de recherche. À l'aide du modèle d'acceptation technologique, nous avons évalué l'efficacité d'un atelier comme intervention pour introduire Zotero (un logiciel libre et open source novateur dans cette communauté particulière) aux membres du personnel et aux étudiants dans le campus d'une université rurale d'Afrique du Sud. Une série de questionnaires a permis d'évaluer comment cette intervention a affecté les attitudes envers et l'utilisation de Zotero. Alors que les participants avaient des attitudes positives envers le logiciel au début de l'intervention, l'atelier a amélioré l'utilité perçue et la facilité d'utilisation du logiciel libre et open source. Pour l'ensemble des participants, le principal indicateur de l'utilisation régulière finale était sa facilité d'utilisation perçue. La présente étude indique que les ateliers de formation de courte durée pourraient améliorer de façon significative l'utilisation des nouveaux logiciels open source, même sans exposition préalable à des technologies similaires. Pour les étudiants, il devient important de mettre l'accent sur l'utilité du logiciel, tandis que le personnel universitaire pourrait bénéficier de formation technique pratique.

**Mots clés :** logiciels libres et open source, logiciel de gestion de références, Afrique du Sud, modèle d'acceptation technologique, Zotero.

## Introduction

The surge in development of Free and Open Source Software (FOSS) has led to the availability of cheap, customisable alternatives to proprietary information technology. Numerous practitioners and researchers have proposed that FOSS could be an effective way for developing nations to compete with richer countries in terms of digital technologies, thereby starting to bridge the 'digital divide' between many African and Westernised countries (Singh 2004; Mutula 2005). Universities, in particular, need to remain at the forefront of the adoption and implementation of new technologies, or risk being left behind in the rapidly advancing digital age. In a recent survey on the global use and development of FOSS, Ghosh and Glott (2007) found that administrators and educators at universities in developing countries – including South Africa – perceived FOSS as more customisable and even easier to use than proprietary software. Although these respondents overwhelmingly agreed that FOSS needs to be adopted

within their institutions, free ware remains rarely used, a situation labelled 'proprietary lock-in' by Jeffrey James (2003). It remains unclear how to effectively transform potential users of useful FOSS into actual users of the novel technology.

In this study, we explored a specific intervention to introduce Zotero, an example of freely available reference management software, to academics and postgraduate students at the University of the Free State's rural Qwaqwa campus. We chose to introduce participants to reference management software, as it is not a discipline-specific technological tool, and is widely deemed to be an essential part of the modern academic's toolkit (Krooden 2004; Schilling 2005; Farkas 2012). Our intervention took the form of workshops presented to both staff and students, during which we assessed participants' perceptions of this particular FOSS, and their eventual usage patterns. We further contrasted different types of users in the light of a current debate (Prensky 2001; Bennett *et al.* 2008; Neil 2009; Brown and Czerniewicz 2010; Jones *et al.* 2012) on whether or not there is a meaningful distinction between students and their educators in terms of technology use: modern students are often described as highly proficient 'digital natives', in contrast to an older generation, purported to be less digitally fluent. In separate workshops, we introduced Zotero to both postgraduate students and lecturing staff members to assess whether or not the adoption of this software will vary between students and staff.

The Technology Acceptance Model (TAM: Davis 1986) guided our assessment of which factors most strongly influenced participants' understanding and use of reference management software. This model investigates the relationship between users' attitudes and utilisation of information systems, hypothesising that a user's overall attitude toward technology is a major determinant of the user's actual use of the technology (Davis 1986). Attitude toward technology is determined by two variables: (1) the perceived ease of use, and (2) the perceived usefulness of new technology. Perceived ease of use is defined as 'the degree to which a person believes that using a particular system would be free of effort' and perceived usefulness is defined as 'the degree to which a person believes that using a particular system would enhance his or her job performance' (Davis 1989:320). Tests of TAM show that it is a highly credible model for examining technology acceptance (King and He 2006), and it has been argued that the model is particularly useful in understanding technology acceptance in developing nations (Park *et al.* 2009).

Extensive research using TAM has indicated that both perceived ease of use and perceived usefulness are important predictors of novice users' acceptance of novel information technology (Lee *et al.* 2003; King and He

2006). This model is popular in developed nations, but its use in developing countries suggests that the link between usage and attitude (encompassing perceived ease of use and perceived usefulness) may not be similar across diverse cultures (Straub *et al.* 1997; Park *et al.* 2009). For example, Straub and colleagues (1997) elucidated how users' emailing behaviour could be predicted by TAM in two Westernised cultures (Switzerland and the USA), while TAM failed to predict user behaviour in Japan. They ascribed this distinction to cultural differences in relation to employer–employee relationships. In this empirical study, we therefore assess whether or not TAM (measuring user attitude towards an unfamiliar technology) can predict the eventual use of reference management software, as an example of novel technology, within the rural South African context.

The following research questions were posited to guide our study:

- Research Question 1 – Are there distinctions between staff and students in their attitudes towards/perceptions of Zotero?
- Research Question 2 – How does a single intervention/workshop impact participants' attitude towards a particular novel software system?
- Research Question 3 – How does post-workshop attitude and intent to use translate into long-term usage patterns of the novel technology?

## **Methodology**

### ***Intervention: Introductory Workshops***

For this study, we held separate workshops introducing lecturing staff members and postgraduate students at the rural Qwaqwa campus (a satellite campus of the University of the Free State) to Zotero. Staff members were recruited through emails advertising the introductory workshop to all academic (lecturing) staff members on campus. This led to a convenience sample comprising thirty staff members, of which thirteen were female and seventeen male. Staff members represented the faculties of Natural and Agricultural Sciences (N = 11 participants), Humanities (N = 11), Economics and Business Science (N = 4), and Education (N = 4). Student participants were members of the BSc Honours programme in the Life Sciences, and the workshop was presented as practical training in the course 'Scientific Research Methods'. Fifteen postgraduate students took part in this workshop (N= 8 female, 7 male students).

We introduced participants to the reference management software Zotero ([www.zotero.org](http://www.zotero.org)), a package with a powerful online and offline component.

Zotero enables the user to create and edit a personal digital library and integrates well with MSWord, adding citations and reference lists in a variety of citation styles (Farkas 2012; Zhang 2012). At the time of the study, Zotero was also compatible with 64-bit Windows, while Mendeley (an alternative, free reference manager) was not. We focused on the Firefox add-on for Zotero, while also introducing participants to the stand-alone program.

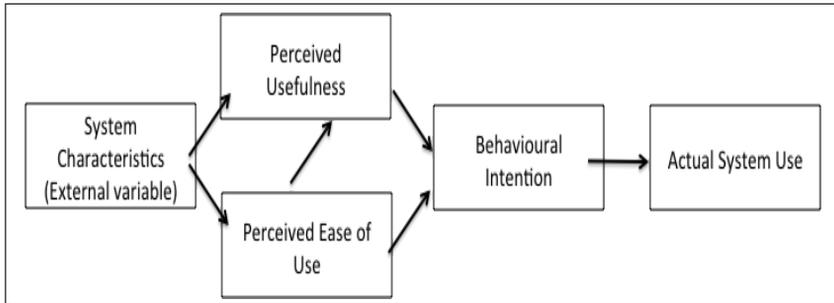
Workshops all followed the same format, assuming no prior knowledge of reference management software. Participants first received a brief introduction to the concept and purpose of reference management software, including an introductory video on Zotero.<sup>1</sup> For the next three to five hours (depending on Internet speed), participants were guided through the process of registering for and installing the Firefox Zotero add-on, creating a personalised digital library, and inserting citations and bibliographies into MS Word. Participants were made aware of Zotero forums and other sources of online help, but there was no further structured engagement between the first author and participants, beyond ad hoc informal contact.

### ***Data Collection***

All participants were asked to complete a pre- and post-workshop questionnaire to measure attitudes towards, and intent to use this particular FOSS. Participants were asked to complete the pre-workshop questionnaire after watching the introductory video, while the post-workshop questionnaire was completed directly after training ended. Due to errors and gaps in stated answers, we only assessed twenty-one complete sets of questionnaires from staff members, and fifteen from student participants. Three to six months after each workshop, attendees were requested, via email, to complete an anonymous online questionnaire to gauge their current attitudes and actual Zotero usage. This follow-up questionnaire yielded good response rates: nearly half of the original staff participants (N=14), and 60 per cent (N=9) of the student participants completed the form.

### ***Measures***

All questionnaires were designed with the Technology Acceptance Model (TAM: Figure 1) in mind and were based on Davis's (1989) questionnaire. Potential users were asked questions grouped into two categories: first, questions that relate to the perceived usefulness (PU) of the technology or 'system', and second, those questions relating to the perceived ease of use (PEOU) of said technology.



**Figure 1:** The Technology Acceptance Model (TAM), as refined by Davis and Venkatesh (1996), describing the relationship between users' perceptions of novel information technology (the 'system' in this flowchart), intent to use, and eventual use of the technology. In Davis's original thesis proposing TAM, perceived ease of use emerged as the dominant factor mediating actual/eventual usage of a system (Davis 1986).

Questions were posed on a 5-point Likert scale, with three questions measuring PU, and two quantifying PEOU. Items on the questionnaire were grouped together according to PEOU and PU, which has emerged as the optimal arrangement for TAM surveys (Davis and Venkatesh 1996). In exploring PU, we posed assertions similar to the following, 'Using reference management software in my job would/does enable me to accomplish tasks more quickly', while statements such as, 'It would be easy for me to become skilful at using reference management software' were used to gauge participants' PEOU. One open-ended question asked why participants did or did not use reference management software before this workshop. Post-workshop questionnaires asked the same questions, and also assessed motivation/behavioural intention (Davis 1986) to use Zotero, with a single statement, 'I plan to use reference management software in my future research'.

An electronic survey administered three to six months after workshop completion (the 'follow-up questionnaire') aimed to gauge how the intervention and participants' attitude towards technology translated into actual usage of FOSS. Again, statements were grouped according to the nature of the probe: two questions assessed PU and two measured PEOU. We measured participants' original motivation to use Zotero ('I felt highly motivated to use Zotero after attending the intro to Zotero workshop') and assessed the regularity of current Zotero usage. A further statement queried the barriers to using Zotero.

## ***Data Analysis***

Data from all questionnaires were analysed using the freeware package, RStudio Version 0.98.1017 (© 2009-2012 RStudio, Inc.). Descriptive statistics are reported as mean + standard deviation. PU and PEOU were both represented as component values, calculated as each user's average response value in the two to three questions describing that particular attitude. The direct impact of the workshop on user attitudes and motivation was investigated through linear mixed-effect models (the *lmer* function in the LME4 package) comparing user attitudes (PE and PEOU) as a function of user type (staff versus student) and training (contrasting before and after workshop data). This model allowed us to control for individual identity (i.e., repeated measures) as a random factor present in the pre- and post-workshop questionnaires. Using data collected in the follow-up questionnaires, we conducted Pearson's correlations to examine how attitudes and motivation translated into actual FOSS usage, three to six months after the intervention.

## ***Results***

### ***Workshop – Immediate Impact***

Our aim with Research Questions 1 and 2 was to assess differences between staff and students in terms of their attitude towards Zotero, and the impact that the workshop intervention would have on participants' attitude towards Zotero. Both staff and students were novices to this particular technology. The majority of participants reported that they were not familiar with reference management software in general (only two staff members and one student indicated that they were somewhat familiar with such technology). In the open-ended question (answered by twenty-six participants), most (N=20) described that they had never used this technology because they were simply unaware of its existence. A further six participants stated that they knew about the tools, but did not know how to use reference management software.

For all participants, the intervention appeared to significantly improve their attitude towards Zotero, and led to high intent ( $4.80 + 0.47$ ) to use the software. PU (Figure 2a) increased significantly after the workshop:  $SE = 0.1673$ ,  $F_{1,70} = 28.017$ ,  $P < 0.001$ ), as did PEOU (Figure 2b):  $SE = 0.153$ ,  $F_{1,70} = 8.172$ ,  $P = 0.004$ . However, there were differences in attitude between staff and student participants. Before and after the workshop students perceived Zotero to be less useful than did staff members ( $SE = 0.175$ ,  $F_{1,70} = 3.823$ ,  $P = 0.02$ ), while staff members perceived it to be more difficult to use ( $SE = 0.163$ ,  $F_{1,70} = 5.340$ ,  $P = 0.05$ ). This did not lead to any differences between staff and students in their behavioural intent to use Zotero ( $W = 156$ ,  $P = 0.779$ ).

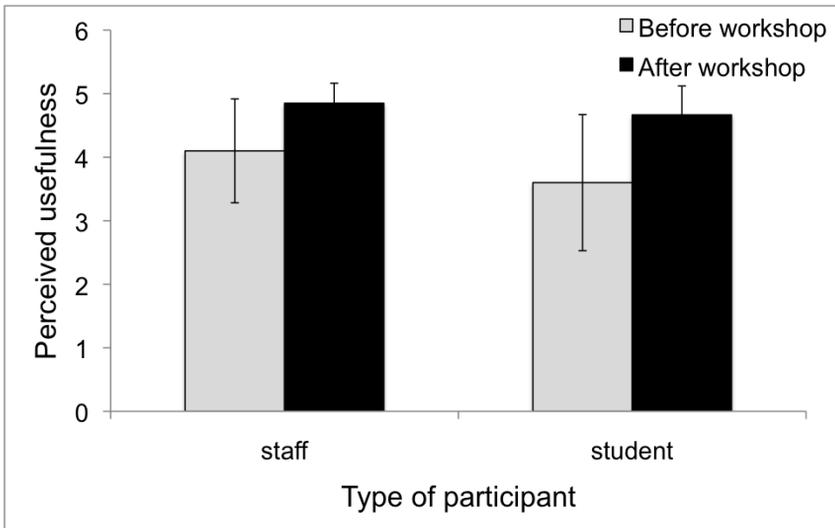


Figure 2a : Changes in perceived usefulness

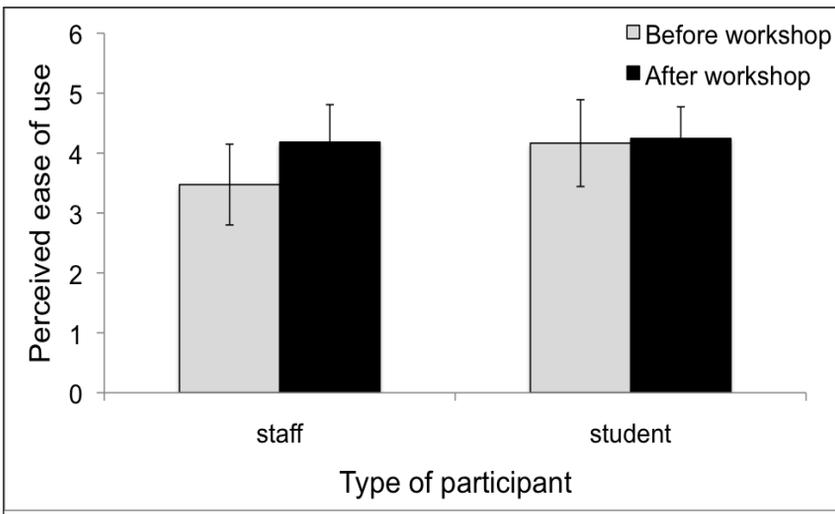


Figure 2 (a)&(b): Shows the Free and Open Source Software package, Zotero, over the course of an introductory workshop.

### Workshop – Long-term Impact

Our goal for Research Question 3 was to assess how behavioural intent influenced participants' actual use of the technology. In the follow-up questionnaires, we found that 35.7 per cent of staff respondents and 66.7

per cent of student respondents were still using Zotero months after the workshop. These usage rates did not differ significantly between types of participant ( $X_{21} = 1.05$ ,  $P = 0.307$ ), and only PEOU significantly predicted how regularly respondents used the software ( $t_{21} = 2.813$ ,  $P = 0.010$ ). Reported behavioural intent ( $t_{21} = 1.563$ ,  $P = 0.133$ ) and PU ( $t_{21} = 0.857$ ,  $P = 0.401$ ) did not vary with usage patterns. Various reasons were indicated for the non-use of Zotero. Of those respondents who did not use Zotero ( $N=9$ ), three reported that they had found another program that they preferred using, two indicated that they did not have any publications in progress and three noted that they had forgotten how to use the program. One individual reported that technical difficulties led him/her to stop using Zotero.

## Discussion and Implications

These findings suggest that even a brief intervention such as a workshop can effectively improve the adoption and usage of novel open source software such as Zotero at universities in South Africa. We confirm other researchers' findings (Duong 2010; Ghosh and Glott 2007), that participants had a highly positive attitude towards the technology, describing the software as both useful and easy to use even at the start of the workshop. For all participants the training offered during the three-hour workshop improved their perceptions of FOSS. Importantly, these two distinct perceptions/attitudes differed between the lecturing staff and postgraduate students participating in this study, as staff members perceived the software as relatively more useful, but students perceived it to be easier to use. We therefore suggest that, in future interventions introducing FOSS to postgraduate students, presenters should emphasise the ways in which the software may be useful to the participants' work and studies. By contrast, introductory workshops with staff members need to focus on reducing their trepidation of ease of use, involving interactive 'hands-on' learning. Our study does not imply that staff members were fearful of the software, or digitally naïve: similar to lecturers at other South African campuses (Naude *et al.* 2010; Centre for Teaching and Learning 2013) our participants exhibited high levels of digital literacy, but profess a lack of technological skills that can specifically enhance their research and teaching careers. Simple interventions led by experienced users can, clearly, start to reverse this trend. The relatively intensive usage patterns of students versus staff participants cannot be ascribed directly to a generational divide in technology adoption (Prensky 2001), as students also differed from staff members in terms of external drivers: staff members were not constantly tasked with the writing of reports and papers, while students had to practise regular academic writing in all of their coursework.

The Technology Acceptance Model was useful in predicting actual usage patterns, rather than simply the intention to use the novel technology (Ursavaş 2013). The workshop improved the software's perceived ease of use, which also acted as significant predictor of actual usage three to six months after the intervention, similar to Davis's (1986) findings. These results demonstrate the potential effectiveness of a single intervention to instigate the use of novel, useful software on a rural African campus. In contrast to a recent study on the challenges surrounding FOSS in South African libraries (Hoy and Koopman 2008), we have found that technological novices can be swayed and convinced to use technology, if its perceived usefulness and ease of use are high enough. Currently, free reference management software is still used to a much more limited extent by researchers in African countries than their counterparts in developed nations (Mendeley Ltd 2012). However, with Internet-based digital literacy becoming common amongst South African academics and students (Naude *et al.* 2010; Walton and Donner 2012), the time may be right for a deliberate, wider scale introduction of free software that can help sift through the abundance of information now available to researchers. Programs such as Mendeley and Zotero could be an excellent starting point for the wider introduction of FOSS at South African higher education institutions.

## **Conclusion**

Our study highlights the positive attitude amongst lecturing staff and postgraduate students towards Zotero, and suggests practical pathways for the introduction of similar software on South African university campuses. We recommend an emphasis on software usefulness when training students, and practical training to ease the perception of usage difficulty for both staff and students. Following on a broader request for face-to-face technology training at the University of the Free State (Centre for Teaching and Learning 2013) we recommend sessions similar in duration to the workshops conducted at the Qwaqwa campus, since this time investment allows users to get direct experience with the technology, and thus reduces the trepidation regarding actual usage. Brief follow-up sessions may also be fruitful, in particular if goals are set during the first workshop. Further, our application of TAM has demonstrated that, at least for this sample, the model could successfully predict user behaviour. This suggests that future studies on adoption of novel technology in South Africa's tertiary institutes may be able to use TAM as a useful analysis and predictive tool.

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## Note

1. Available at [http://www.zotero.org/static/videos/zotero\\_1\\_5\\_cast.flv](http://www.zotero.org/static/videos/zotero_1_5_cast.flv).

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