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Analysis of the Impact of NVivo and EndNote on Academic Research Productivity

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***Abstract*—**The aim of this paper is to analyze the impact of literature review software on researchers. The aim of this study was achieved by analyzing models in terms of perceived usefulness, perceived ease of use, and acceptance level. Collected data were analyzed using WarpPLS 4.0 software. This study used two theoretical frameworks, namely, Technology Acceptance Model and the Training Needs Assessment Model. The study was experimental and was conducted at a public university in South Africa. The results of the study showed that acceptance level has a high impact on research productivity followed by perceived usefulness and perceived ease of use.

***Keywords*—**Technology acceptance model, training needs assessment model, literature review software, research productivity.

I. Introduction

LITERATURE review software is used by academic researchers to increase research productivity. It can be used to analyze qualitative data, import and code textual data, edit text, retrieve, review and recode coded data, search for combinations of words in text or patterns in coding, import data from or export data to other platforms [1]. Software tools currently in use for analysis of literature include Atlas.ti, N4 Classic, N5, NVivo and WinMax [2]. However, only NVivo (to date) has a set of tools that is ideal for literature analysis, and is more flexible than other available software packages. According to [3], NVivo is a leading package in the market, and is the most popular one and well recognized among researchers.

Bibliographic management tools are used by researchers and scientists to store, organize, and manage their references for research papers, theses, dissertations, journal articles, and other publications [4]. This software helps researchers to find and retrieve references quickly in the format required for a particular publication. Bibliographic management tools in the market at present include EndNote, RefWorks, BibTex, and Zotero. However, very few tools can stand out as truly useful, time saving and work enhancing therefore increasing research productivity. According to [5], EndNote can increase research productivity. It was first released in 1988 and it can be purchased individually or site-licensed by institutions. It is widely used by researchers, faculty, and students in order to collect, store, organize and manage references, images and PDFs, as well as to insert references into manuscripts and to place figures and tables anywhere in a Word or any other word processing document [4]. According to [6], EndNote is an online search tool that can help search online bibliographic databases and retrieve references directly into EndNote. It is specialized in terms of sorting, managing, and searching bibliographic references in the reference library.

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II. Problem Statement

The problems associated with manual methods of literature review include an over-emphasis on code-and-retrieve, postponed analysis, and distancing of data into the filing cabinet [7]. According to [8], qualitative data analysis is a complex process and demands clear thinking on the part of the analyst. However, there are a number of deficiencies that may obstruct the research analyst during the process, leading to inconsistencies. According to [9], several problems occur when referencing manually such as citations being removed but references remaining in the references list; citations being added but references not being added to the reference list; citations and references being incorrectly formatted; changing from one referencing system to another such as Harvard to Vancouver requires all citations and references to be individually reformatted. Reference [10] indicated that the citation and the errors rates in nursing journals is 22.9%, in the neonatal-material nursing journals is 24.4% [10] and finally in the paediatric nursing journals the error rate is 41.6% [11]. Journal reference error rates and the quotation error rates ranged from 8% in the New England Journal of Medicine to 10% in the Lancet [12], 44% in Medical Care [13], 52% in Surgery, Gynecology, and Obsterics [14]. Reference [15] reported that the error rate in references in five leading medical journals ranged from 4.1% to 40.3%.

III. Research Question

What factors of NVivo and EndNote software affect research productivity?

IV. Aim and Objectives

The aim of this paper is to analyze the impact of literature review and reference management software on perceived usefulness, perceived ease of use, and acceptance level for academic research productivity.

This aim is achieved through the following objectives:

- To analyze the impact of literature review and reference management software on the perceived usefulness of academic research productivity;

- To analyze the impact of literature review and reference management software on the perceived ease of use of academic research productivity;
- To analyze the impact of literature review and reference management software on the acceptance level of academic research productivity;
- To design a model on the factors (perceived usefulness, perceived ease of use, acceptance level) affecting academic research productivity.

V. Theoretical Framework

This research is grounded within the theoretical frameworks provided by [16] in terms of the Technology Acceptance Model and by [17] in terms of the Training Assessment Model. The Training Needs Assessment Model is anchored around five questions: why, who, how, what, and when? The technology acceptance model has three steps: perceived usefulness, perceived ease of use, and, acceptance level.

VI. Literature Review

The aim of this section is to present existing literature on the impact of literature review and reference management software on academic research productivity. Such software, namely, NVivo and EndNote for the purposes of this study, are used to increase research productivity.

A. NVivo for Literature Review

1. Analyzing Literature Review Using NVivo

A study was conducted by [2] using a questionnaire based survey method and the results indicated that software tools such as NVivo and ATLAS, WinMax, etc. can be used to analyze the literature review and thereby increase productivity. The study found that of the software studied "only NVivo has a particular set of tools that is ideal for analyzing literature" for the researchers.

2. *NVivo for Qualitative Data Analysis*

Reference [1] conducted a study using a questionnaire based survey and found that NVivo is usually used for data collection in the field but is increasingly being used for reviewing literature to increase productivity. Her research results also found that searching text versions of articles using NVivo is useful to search the entire collection of literature for new key themes, and to compare notes and ideas collected from literature across a subset of researchers, and reference a single repository of literature. Reference [18] conducted a study using a survey based questionnaire method and found that moving from paper-based to electronic software-based research allowed more freedom to play with ideas because researchers could compare documents, find results in a shorter time and save and print material.

3. Facilitating Literature Review Using NVivo

Reference [19] found in their questionnaire based study that NVivo is a powerful tool for literature review to increase research productivity and can be used to facilitate different aspects of the grounded theory process starting from the design and early sampling procedures. A study conducted by [20] using a questionnaire based survey found that NVivo software facilitates and allows text searches, and for "ideas to be linked, data coded and searched, and models to be drawn while always being able to instantly access the original data behind the concepts."

B. EndNote for Reference Management

1. Saving Time Using EndNote

A study conducted by [21] found that there are many existing software tools in the market and that one of the most popular software tools is EndNote. EndNote is useful, time saving, and work enhancing for researchers; it has an excellent combination of features, is easy to use and permits cooperation with Microsoft Word ('cite while you write'). Reference [22] states that EndNote is very useful for researchers to format and organize their references for publications in medicine, or other fields.

2. Facilitating Using EndNote

According to [23], EndNote is the best package to manage the bibliography since it provides the most flexible facilities, is easiest to use, permits information sharing with peers and can assist in gaining publication in a refereed journal. According to [24] cited in [23], most bibliographic software packages provide hundreds of build-in pre-configured citation format styles for books, dissertations, and individual journals or allow researchers to customize according to the target publication to increase productivity and improve accuracy.

3. Referencing Using EndNote

According to [25] cited in [23], the reference management tool EndNote can help researchers to increase research productivity by: "(i) maintaining a database of references; (ii) automating the collection and organization of citations from databases; (iii) inserting and formatting citations and bibliographies; (iv) inserting and formatting citations and bibliographies into word processing; (v) automatically formatting and reformatting references into particular styles for publication (e.g. American Psychological Association and particular journals); and (vi) outputting the information to separate files for interchange or printing."

4. Reason to Use EndNote

According to [5], the main reason for using EndNote is its improved functions and features: "for instance a new library window, a better search function, automatic updates and completion of term lists and an improved identification of duplicate references."

VII. Research Design

The underlying research design is based on the use of validated questionnaires. Collected data was analyzed using WarpPLS 4.0 software. The next section discusses these questionnaires and their measurements.

A. Sample and Procedure

This study was experimental and conducted within one university in KwaZulu-Natal, South Africa. The sample consisted of 20 academic staff comprising 10 NVivo and 10 EndNote participants. Each participant's participation was purely voluntary and they were assured of anonymity. The questionnaire, which is described in more detail in the following section, was administered to participants in the first week to second week of October 2014, prior to and after training in the relevant software (NVivo and EndNote) package.

B. Questionnaire

The questionnaire was developed to capture information relevant to the study and consisted of three parts. Part One sought information on perceived usefulness, Part Two consisted of questions regarding perceived ease of use, and Part Three consisted of questions regarding acceptance level. Each participant was allocated one computer during the training (EndNote X6 and NVivo 10). Participating academics were given a text manual so they could practice on the computer. The questionnaire was developed from the existing literature and the training was validated using the Training Needs Assessment Model [17]. The questionnaire for the experiment was validated with the Technology Acceptance Model [16]. The academics level of training was assessed using a questionnaire.

VIII. Results

A. Proposed Model

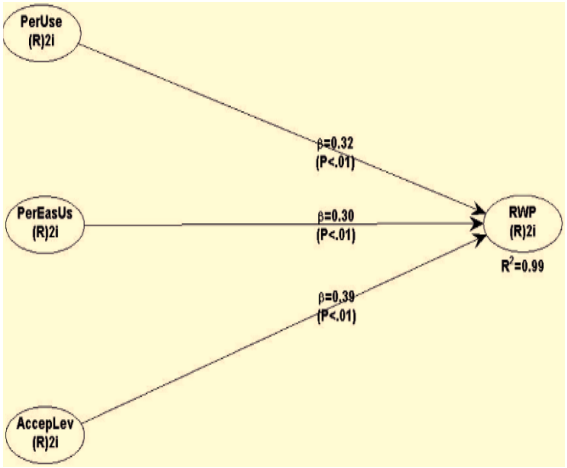

Fig. 1 Model of the factors affecting academic research productivity

Fig. 1 shows that acceptance level has a significant value of $\beta = 0.39$ and $p < .01$, perceived usefulness has a significant value of $\beta = 0.32$ and $p < .01$ which is less than the acceptance level. Similarly, perceived ease of use has a significant value of $\beta = 0.30$ and $p < .01$. Of the three variables, acceptance level has the highest significance in terms of respondents' research productivity.

TABLE I
Model Fit and Quality Indices

Fit index	Model	Recommendation
Average path coefficient (APC)	0.339	Good if P=0.002
Average R-squared (ARS)	0.992	Good if P<0.001
Average adjusted R-square (AARS)	0.988	Good if P<0.001
Average block VIF (AVIF)	21.073	Acceptable if <=5, ideally <=3.3
Average full collinearity VIF (AFVIF)	93.803	Acceptable if <=5, ideally <=3.3
Tenenhaus GoF (GoF)	0.753	Small >=0.1, medium >=0.25, large >=0.36
Sympson's paradox ratio (SPR)	1.000	Acceptable if >=0.7, ideally=1
R-squared contribution ratio (RSCR)	1.000	Acceptable if >=0.9, ideally=1
Statistical suppression ratio (SSR)	1.000	Acceptable if >=0.7
Nonlinear bivariate causality direction ratio (NLBCDR)	1.000	Acceptable if>=0.7

TABLE II
Mean and Standard Deviation of Variables (I: Perceived Usefulness, II: Perceived Ease of Use, III: Acceptance Level, IV: Research Productivity)

Factors	Mean	Standard Deviation	Variable	Mean	Standard Deviation
I	21.60	4.73	IV	21.20	4.24
II	20.10	4.38	IV	21.20	4.24
III	21.60	3.75	IV	21.20	4.24

B. Correlation among Latent Variables with Square Roots of AVEs

According to [26], the Average Variance Extracted (AVE) is a measure of the variance of a set of items. Table III shows the AVE values and the correlations among factors, with the square root of AVE in brackets on the diagonal.

TABLE III
Correlations among Latent Variables with Square Roots of AVES

	Perceived usefulness	Perceived ease of use	Acceptance level	Research productivity
Perceived usefulness	(0.750)	0.903	0.886	0.951
Perceived ease of use	0.903	(0.802)	0.974	0.984
Acceptance level	0.886	0.974	(0.716)	0.978
Research productivity	0.951	0.984	0.978	(0.754)

C. P-Values Correlations Using Variables

Table IV shows the p-value correlations of each variable (perceived usefulness, perceived ease of use, and acceptance level).

TABLE IV
P Values Correlations Using Three Variables

	Perceived usefulness	Perceived ease of use	Acceptance level	Research productivity
Perceived usefulness	**1.000**	<0.001	<0.001	<0.001
Perceived ease of use	<0.001	**1.000**	<0.001	<0.001
Acceptance level	<0.001	<0.001	**1.000**	<0.001
Research productivity	<0.001	<0.001	<0.001	**1.000**

D.Case Comparison and Evaluation of Three Variables

Table V represents the comparison of variables and their effect on respondents' academic research productivity.

TABLE V
COMPARISON OF THREE VARIABLES

Variable	Significance	Research Productivity
Perceived usefulness	$\beta = 0.32$	$R^2 = 0.99$
Perceived ease of use	$\beta = 0.30$	$R^2 = 0.99$
Acceptance level	$\beta = 0.39$	$R^2 = 0.99$

E. Graphs Showing the Effect of Variables

Graphs are presented for each latent variable affecting respondents. Fig. 2 shows that the relationship is positively supported and is linear. The relationship intensifies at approximately -1.22 standard deviation to the right of the mean of the standardized data. Further, the unstandardized scales (Fig. 3) show the linear relationship begins to increase when the mean for the respondents is 21.20 and the standard deviation is 4.24. These results show that perceived usefulness significantly affects and productivity.

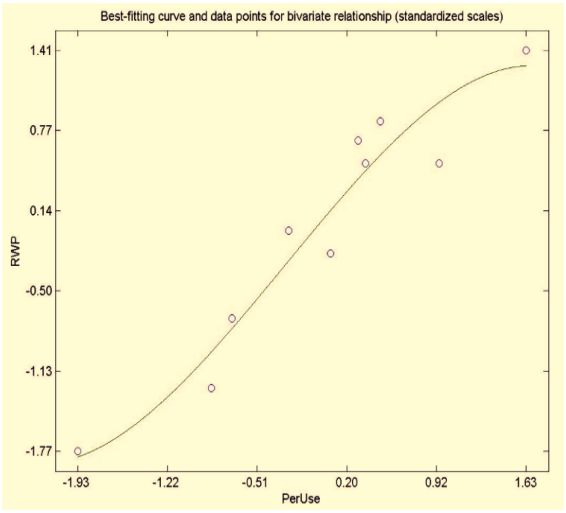

Fig. 2 Perceived usefulness on the factors affecting academic research productivity

Fig. 4 shows that the relationship is positively supported and is linear. The relationship intensifies at approximately -1.22 standard deviation to the right of the mean of the standardized data. Further, the unstandardized scales (Fig. 5) show the linear relationship begins to increase when the mean for the respondents is 21.20 and the standard deviation is 4.24. These results show that perceived ease of use significantly affects research productivity.

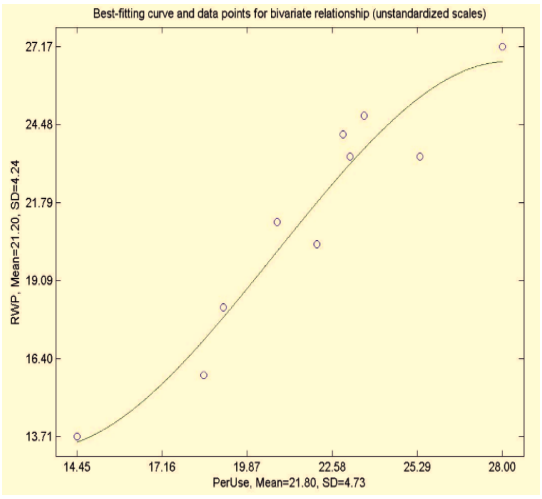

Fig. 3 Perceived usefulness (with mean and standard deviation) of the factors affecting academic research productivity

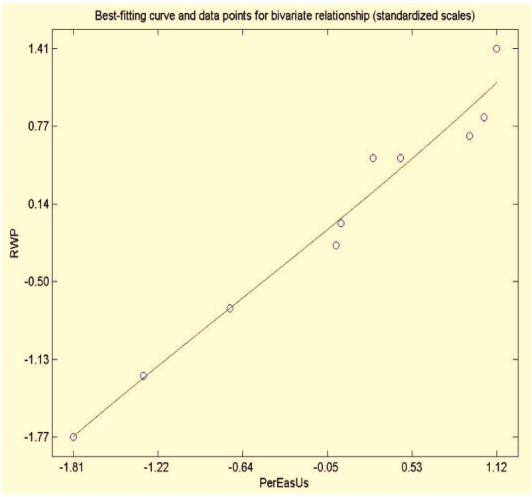

Fig. 4 Perceived ease of use on the factors affecting academic research productivity

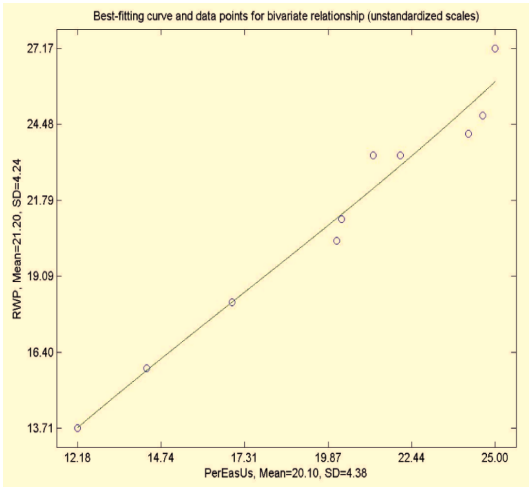

Fig. 5 Perceived usefulness (with mean and standard deviation) on the factors affecting academic research productivity

Fig. 6 shows that the relationship is positively supported and is linear. The relationship intensifies at approximately -0.91 standard deviation to the right of the mean of the standardized data. Further, the unstandardized scales (Fig. 7) shows the linear relationship begins to increase when the mean for respondents is 21.20 and the standard deviation is 4.24. These results show that acceptance level significantly affects and research productivity.

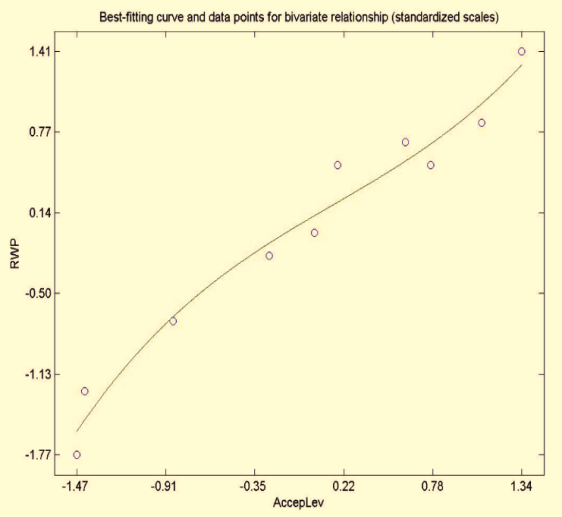

Fig. 6 Acceptance level on the factors affecting academic research productivity

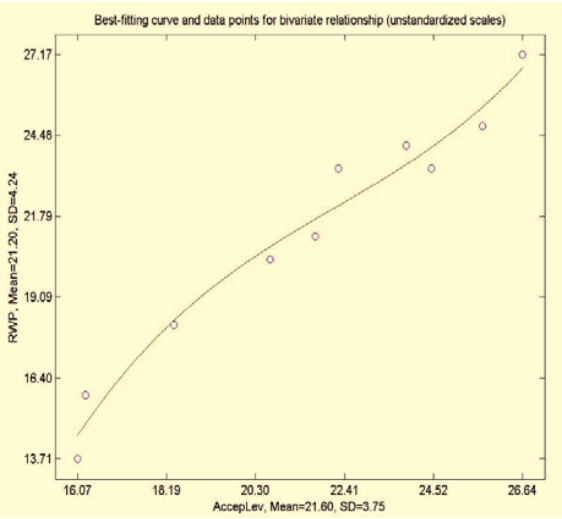

Fig. 7 Acceptance level (with mean and standard deviation) on the factors affecting academic research productivity

F. Summary of the Study Results

Respondents in this study showed that acceptance level, $\beta = 0.39$ and $p < .01$; perceived usefulness, $\beta = 0.32$ and $p < .01$; and perceived ease of use, $\beta = 0.30$ and $p < .01$ affect their research productivity.

IX. Discussion

The originality of this study can be attributed to following three points: Firstly, this study designed for literature review to increase research productivity purposes. Secondly, this study used EndNote and NVivo as a tool for increasing research productivity. Thirdly, this study restricted itself to a specific aspect of research productivity. Another important aspect of this research is that it is grounded within a solid theoretical framework: Technology Adoption Model [16] and the Training Assessment Model [17]. This study confirmed that both EndNote and NVivo are useful, effective, and efficient for literature review in terms of research productivity as per [21].

X. Conclusion

This paper presents researchers' perceptions on the usefulness, ease of use, and acceptance level of literature review and reference management software and its impact on research productivity. This paper shows that perceived usefulness, perceived ease of use, and acceptance level for both software packages had significant impact on research productivity. Furthermore, this paper shows that software training has significant impact on research productivity. The results of this study indicate that NVivo for literature review and qualitative data analysis and EndNote for reference management software have impact on the academic research productivity.

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