Assessing the impact of e-learning on decision-making to reduce health risks: Perceptions from UCT's pesticide risk management cohort

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Abstract

There is a need to build the capacity of professionals in low- to middle- income countries (LMICs) in order to reduce pesticide risks on human and environmental health. To address these risks, the University of Cape Town (UCT) introduced the *Post Graduate Diploma in Pesticide Risk Management (DPRM)*. This programme utilises a mixed teaching mode including an e-learning component which includes virtual seminars/discussion forums. The DPRMs' discussion forum aimed to strengthen skills in managing and reducing pesticide risks. Due to the shortage of skilled professionals in LMICs, e-learning can facilitate the on-going training and skills development in pesticide management to address pesticide related challenges. The study focus was on evaluating the impact of the DPRMs' e-learning Discussion Forum bi-monthly sessions on the decision-making processes of professionals in LMICs working in pesticide risk management. The sample for this study was obtained from a population of working professionals, who either completed or were currently enrolled for the DPRM programme (N=37). Twenty-two participants completed the online questionnaire anonymously. These participants were employed by governments, non-governmental organizations (NGOs), research institutes and private companies in Africa and Fiji.

This mini-dissertation is divided into four parts. The protocol (Part A) provides the study justification and describes the methodology for collecting the data and the analysis thereof. The literature review (Part B) describes e-learning and how it relates to capacity building of pesticide risk management (PRM) professionals in LMICs countries. It looks at the challenges of implementing and maintaining

ii

successful capacity building and the role e-learning plays. The manuscript of a journal ready article (Part C) presents the research findings on the perceived effectiveness of the e-learning based DPRM discussion forum and whether it aided PRM professionals in making better decisions. There are four appendices (Part D) which include the questionnaire, consent form, ethical approval and instructions for writing the manuscript. The study found that participants reported improved application of information gained through e-learning in a practical and effective manner, thereby improving their skills for real world scenarios. Overall benefits acknowledged by participants included establishing a knowledge resource, improved communication with colleagues and stakeholders, as well as improved ability for knowledge application in their work and pesticide use in context. An important finding was that just over half of respondents (55%) felt that they were able to contribute to policy change in their countries as a result of the discussion forum. Unfortunately, no statistical significance could be established between variables due to the limited sample size. It is recommended that a follow-up study with a larger sample be conducted, to establish whether the discussion forum has a long-term and sustainable impact in decision- making processes and policy implementation.

ACKNOWLEDGEMENTS

CONTENTS

PART A: PROTOCOL

Abstract

Distance learning plays a major role in the education and continuous training of students and alumni in LMICs. South Africa and Africa faces challenges such as poverty and ever increasing unemployment rate. E-learning is an instrument used to address challenges through continuous education of health. Due to the shortage of skilled professionals in LMICs, e-learning can facilitate the on-going training and skills development in pesticide management to address pesticide related challenges. The purpose of this study is to evaluate the learning experiences of students and alumni who are and were enrolled in the *Post Graduate Diploma for Pesticide Risk Management (DPRM)* programme at the University of Cape Town. This study specifically focuses on the DPRM online discussion forum which simulates a virtual seminar. These forums take place every fortnight and are presented by local and international experts, and students. The effectiveness and usability of the forum is determined by students' abilities to apply the knowledge gained from the discussion forums in their respective working environments. Five topics from the forum will serve as indicators which will be used as a basis for measurement. These are as follows: improving the efficiency of existing vector control systems, container management issues, enforcement of an international system for chemical categorization and labelling of pesticides, the role of inspectors in pesticide risk management, and pollinators and pesticides: what is all the fuss about? Feedback from students through the analysis of questionnaires will be used to identify benefits and challenges. This information will be used to enhance the programme and promote the "students" ability to translate information from the forum discussion to practical implementation. Moreover, the information acquired will equip students with current knowledge. This will lead them to make decisions, which results in better health outcomes for their respective programmes.

1. Introduction

More than 1000 institutions in approximately 50 countries have electronic learning (e-learning) as an option for tuition to build capacity of health professionals and students (Sharma & Kitchens, 2004; de Beurs et al., 2013). E-learning refers to computer-enhanced learning which involves the dissemination of knowledge, training or courses, through the use of technology such as laptops and computers (Guibert and Bullen, 2007). The reason why e-learning is being used is due to new technologies which become available, different forms of multimedia becoming increasingly accessible, cost effectiveness and the flexible learning time it allows. Due to these aforementioned reasons, e-learning programmes are being incorporated into university programmes traditionally focusing on face-to-face teaching. E-learning has also made it possible for working professionals to gain an education and improve their skills by gaining access to quality resources through collaboration and professional guidance from course conveners (Shing & Hing, 2012). Despite the international use of the previously mentioned programs, not many assessments have been done to monitor and evaluate the impact of distance learning programmes in Africa as a means of improving the health of the public through capacity building of professionals. This research focuses on evaluating the effectiveness of a component in e-learning at the University of Cape Town (UCT) in South Africa for students who are already professionals working in their fields.

This study will focus on the *Post Graduate Diploma in Pesticide Risk Management (DPRM)* at UCT and will specifically evaluate the online virtual bi-monthly seminar referred to as the Pesticide Discussion Forum (hereafter "the Forum") (Rother, 2011). The Forum purpose is to provide knowledge to empower distance learning students to make informed decisions regarding pesticide risk management. The Forum will be evaluated on whether Forum participants are able to apply information and concepts learnt from discussions to their current work context.

1.1 Program assessments

There are shortages in workforce, imbalances of appropriate skills and an uneven distribution of health professionals in both rich and poor countries (WHO, 2010). Attempts are being made to address the ever changing landscape of health needs, and overcome professional skill-based barriers and harnessing e-learning platforms. This has been compounded by the rigidity of policy reform, especially in LMICs (Merson & Schulman, 2010). However, in recent times a renewed willingness towards policy reform has gained attention, partly driven by a determination to the global objectives of the Millennium Development Goals (MDG's). Three significant reports have highlighted the importance of health professionals receiving educational instruction, such as through workshops, with the aim of improving their work-related knowledge (Frenk et al., 2010). They are the Taskforce for scaling up and saving lives, World Health Report and Joint Learning Initiative (Frenk et al., 2010). All three reports emphasized that well-trained health professionals are central to achieving global health outcomes. In addition, the shortages of health professionals, poor implementation, financial difficulties and lack of commitment results in a failure to achieve the MDG's (Fehling et al., 2013). It is with the aforementioned in mind, that the necessity of the DPRM is realized.

1.2 Background

The DPRM was established by Associate Professor Rother in partnership with the Food and Agriculture Organization of the United Nations (FAO) and the Swedish Chemical Regulatory Agency (KemI) in 2009 (Rother, 2011). The DPRM was designed to equip graduates from the program to handle all aspects of pesticide risk management, with specific emphasis on the International Code of Conduct on Pesticide Management (the Code). The pesticide discussion forum is a 'live chat' seminar which takes place every two weeks through UCT's internet platform named Vula.

Vula is UCT's student internet based educational portal, which is an electronic platform known as the Sakai Community Project used to support UCT courses. The DPRM program makes use of this platform for its E-learning component. Vula has a set of fundamental elements which are incorporated to enhance this platform. These include blogs, resources, electronic mail (e-mail), announcements, tests, quizzes and chat rooms or discussion forums. The purpose of Vula is to provide a Collaboration and Learning Environment (CLE). The Sakai Partners extended this community project to a number of other academic institutions around the world seen in the number which incorporate this method as the foundation for their distance learning collaborations (Sakai, 2013). UCT uses a blended learning approach which includes face-to-face and e-learning. Through this platform, an online pesticide discussion forum was established in 2009 for regular real-time discussions. This format of learning was established to accommodate distance learning students who were finding regular face-to-face contact sessions costly (Rother, 2011). In addition it is used as a supplementary resource to provide forum users with information to apply in their studies or workplace. It simulates a physical lecture through the use of skilled facilitators, the provision of course materials and live interactions between participants.

The discussions focus on topics proposed by members of the forum or experts in the field of pesticide management and regulation. Topics include Improving the Efficiency of Existing Vector Control (IVM), Container Management Systems and Minor Use Pesticides: Identifying the Question and the Answer to name a few. Participants of the forum occupy positions such registrars, consultants, scientists, United Nations (UN) officials, prominent researchers and academics. Most of the students in the DPRM, are from Southern Africa as well as other African countries. The experts who chair and facilitate the fora are highly qualified professionals, such as medical entomologists for the World Health Organization (WHO), advisors for internal affairs, and leaders in their respective fields hailing from countries such as Italy, The Netherlands, Sweden and England. The topics are generally aimed at LMICs resulting in the exchange of ideas and experiences, which participants find informative and refreshing.

On the main page of the pesticide discussion forum the basic structure of the pesticide discussion forum is presented (see Figure 1). The pesticide discussion forum is not only a platform for online discussion, but is the foundation of all aspects related to the course. Collaborations between participants, sharing documents for practical application, regular updates, current information on pesticide risk management and mapping academic performance over the course of the two years are all done with aim of fully equipping participants (see Figure 2). The discussions are an opportunity for participants to unpack the topics which are outlined in the news bulletins for every discussion. Participants can share what they have read from prescribed course materials. In so doing, issues can be investigated and solutions offered for problems which participants may encounter. Information disseminated can contribute to DPRM assignments and exam preparations. All content and discussions are conducted in English.
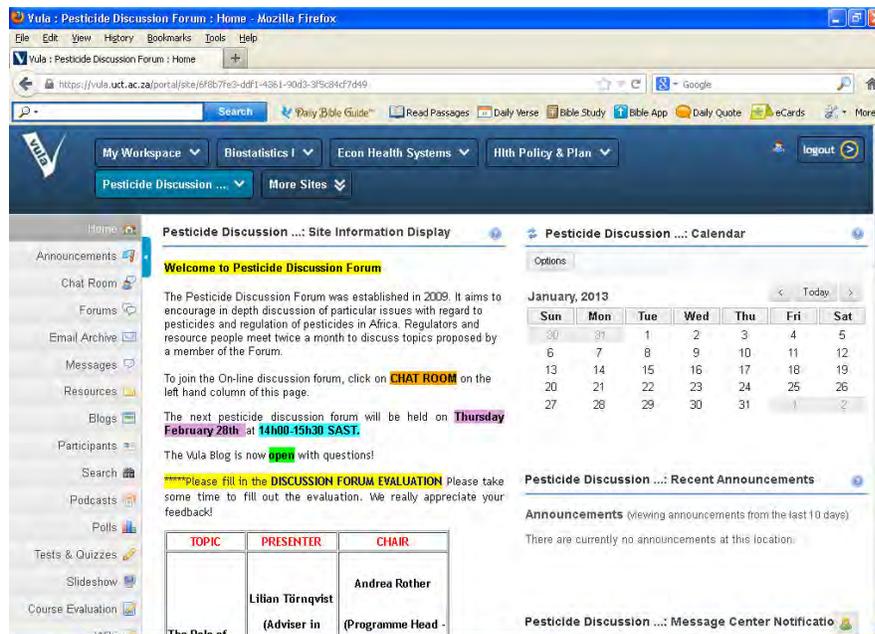
Figure 1: Main Page of Pesticide Discussion on Vula
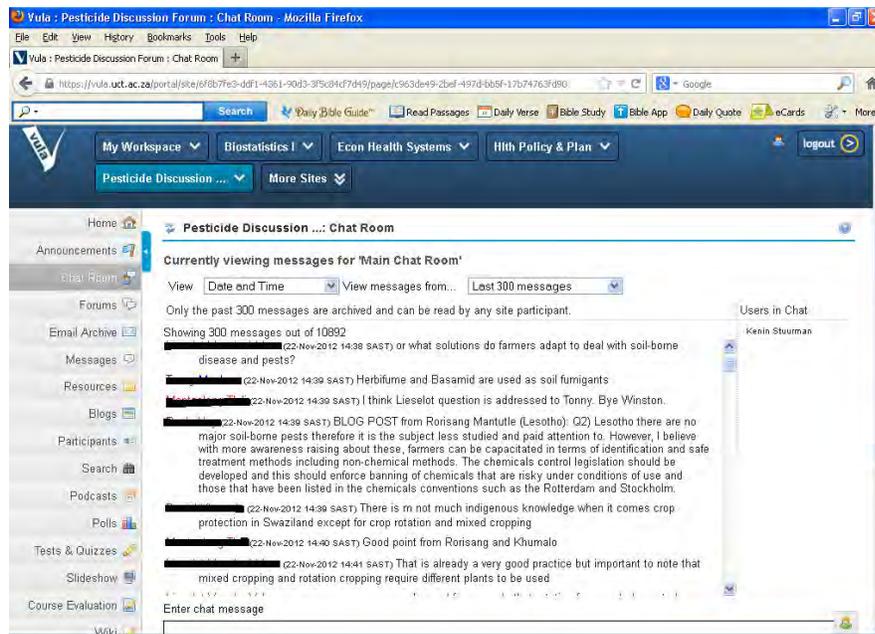
Figure 2: Example of Real-time Pesticide Discussion Forum

The expansion of information and communication technologies (ICT's), and e-learning platforms has since become an important means through which universities in Africa carry knowledge across. These universities have adopted the former platform to improve the delivery of postgraduate programmes such as DPRM and a *Postgraduate Diploma in Public Health at UNISA* (UNISA, 2013). The result of ICT use can be seen in Tanzania, where learner enrolment escalated, allowing qualified candidates to receive tertiary level education via distance learning (Nagunwa & Lwoga, 2012).

1.2.1 Challenges of distance learning

Distance learning poses a number of problems in African countries (Bediang et al., 2013) due to the following: regulatory challenges of telecommunications and information technology (IT) policies (such as advocating clear policies for the use of broadband and the necessary support measures), inadequate human resources, poor infrastructure at higher institutional levels, and mismanagement of funds (Bediang et al., 2013; Nwagua & Abanihe, 2006; Nsengiyumva and Habumuremyi, 2009). Muwanga-Zake (2009) states that distance education through E-learning is

undermined by language barriers, unreliable connectivity, as well as the inability to access reliable and effective technology.

Muwanga-Zake (2009) mentions that capability and culture are two issues which add to existing problems in LMICs. Other problems include people's unwillingness to use e-learning due to their age, their level of education as well as prevailing attitudes towards technology. This can be seen amongst older individuals who may be more comfortable applying their skills in a habitual manner. Poor infrastructure, the delivery of content as well as the ability to use and navigate different platforms are known barriers (Mapuva, 2009). It is my observation that at times a lack of infrastructure negatively thwarts the envisioned progression of a programme. Other factors such as a sense of isolation, poor self-discipline and disinterest due to slow assignment feedback or assistance for projects contribute to the challenges posed by distance learning (Potashnik & Capper, 1998). Therefore it is important that individuals have virtual support from peers enrolled in the programme.

1.2.2 Success of distance learning

Due to the increase in technological advancements, distance learning has allowed students, especially in Africa to gain access to courses and information. This can be seen in cases when physical access is a problem. This is ideal for public health or environmental health candidates who enrol for a course in another country but cannot afford to leave their profession for full-time study (e.g. due to financial implications involved in relocating to their educational institution of choice). In addition, distance learning makes a number of contributions which include and are not limited to accessibility of information, on-demand availability of information and reduced costs (Bhuasiri et al., 2012). Furthermore it allows for quality resources, such as presentations or journal publications, to be delivered to the students. These resources are measured according to their completeness, accuracy, relevance and ease of understanding (Chiu et al., 2007). The use of online resources addresses the barrier of classroom congestion (Ahmed, 2013) as well as increased convenience for both

student and facilitator (Bhuasiri et al., 2012). Cooper and colleagues (2007) state that for e-learning to be successful, accessibility and usability issues need to be addressed. Figure 3 illustrates the interaction in an e-learning environment and shows how problems in distance learning can be minimized through the use of messages between facilitators and students, for example, text chats or e-mails, through the use of a well-designed course structure (Roblyer and Wiencke, 2003).
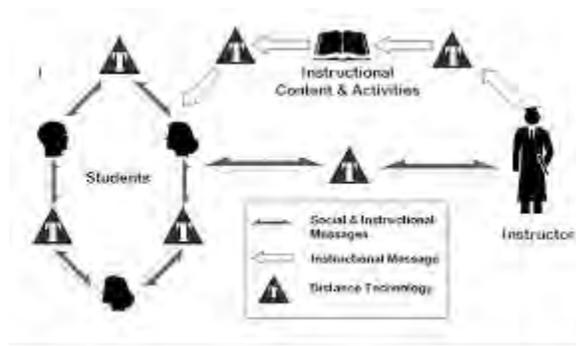
Figure 3: The image shows the communication channels between facilitators and students (Source: Robyler & Wiencke, 2003)

Through the use of the latter platforms, public health professionals and students have access to the latest protocols and guidelines, allowing them to interact and engage with one another and faculties related to public health for the purpose of improving communication and primarily education (Grossberndt et al., 2010). In a South African context, the University of the Western Cape showed that distance learning can be successful by facilitating simultaneous knowledge with practice. This was accomplished through projects and assignments in which students had to apply their new learnt concepts (Alexander et al., 2009). Additionally, there was also constant communication between course facilitators and students, as well as between students which negated the feeling of isolation. This made students feel involved and part of the programmes. This was reflected by testimonies from students emphasizing how their skills and understanding of their public health positions was enhanced (Alexander et al., 2009).

1.3 Problem Statement

The Department of Education (DoE) emphasized in the e-Education Bill (Department of Education, 2004) that ICTs are forging unique learning avenues, with the capacity to strengthen the level of education in South Africa. With the coverage of globalization, integration through distance learning has necessitated survival in the modern era or risk isolation. Due to globalization the use of ICT's has been promoted in all facets of life, whether it is work, home, education or recreation. In addition, the strategic placement of South Africa in relation to the international and continental community, embracing this approach should ensure the future of this region.

According to Mutula (2003), the number of students from impoverished backgrounds who have registered for courses at higher learning institutions has increased. For example, between 1993 and 1999 the number of distance learning students increased by a combined figure of almost 500% at the Universities of Stellenbosch and Pretoria (Ravjee, 2007). Takalani (2008) concurs and states that *"e-learning is becoming one of the most common forms"* of education for impoverished learners based on or off campus due to its flexibility. For this reason, student registration for distance learning in public health programmes has surged. According to Alexander and colleagues (2009) at the University of the Western Cape, the number of applicants for the public health programme has increased fourfold than what the university is able to accommodate. Due to the opportunities which distance learning brings, it is an ideal instrument for educating public health learners (Alexander et al., 2009).

The focus of this study is to evaluate the DPRM students learning experiences and their application of information discussed in the online forum to their work setting. Due to the uncertainty of the effectiveness of the forum, this study seeks to explore the assumptions of whether e-learning is a useful means of addressing barriers to learning. Other assumptions are that e-learning provides opportunities to people in LMICs. Furthermore, there appears to be small number of universities which offer e-learning using platforms like Sakai, Moodle and Lore. No studies have determined the

effectiveness of the forum for the DPRM to date. Therefore, this study aims to appraise the impact of the forum and how information provided via the forum is applied in work settings.

1.4 Research Question

What is the impact of UCT's Pesticide Discussion Forum on the decision-making processes of health and environmental professionals working in pesticide risk management programmes?

1.5. Sub-questions

The study will determine whether the Forum helps professional to work more efficiently, reduce pesticide risks and achieve goals set by governing bodies such as the FAO. It also seeks to determine how discussion forums compliment e-learning. In order to measure this impact, the following questions will be addressed in the questionnaire (see Appendix 2):

- How are decisions influenced through the knowledge gained in forum discussions?
- To what extent can the information discussed in the forum be applied in the student's work environment?
- How does the Forum help professionals address contextual issues related to pesticide risk management?
- What contributions has the Forum made to enhance the skills of public and environmental health professionals in order to help them execute their duties more efficiently?
- How does the discussion facilitate interactions between students and professionals in order to promote knowledge sharing and improved communication?

1.6. Literature Review

E-learning has become a significant feature in teaching and mentoring of students in the last ten years. According to Ahmed (2013), e-learning is altering academic instruction at tertiary level institutions. Hassanzadeh and colleagues (2012) assert that with exponential development of ICTs, internet-based technologies and online tools have undergone a miraculous transfiguration in international educational faculties.

There is a significant difference between conventional classroom learning and learning using e-learning modalities. One such modality is the use of online forums. Although it may appear less captivating than other modalities, it is certainly a powerful tool in the context of sub-Saharan Africa. The reason why it is so powerful is because it requires basic technology and a fairly reliable connection. However, there are some parties who have raised concerns about the feasibility of e-learning as a means to bridge the distance learning gap (Johnson et al., 2011). These concerns include insufficient competencies and standards relevant to participant job descriptions, lack of direction for e-learning programmes, lack of moderators to facilitate discussions, and lack of faculty resources which adversely affect the quality of e-learning (Thomas et al., 2010). Therefore, in order for students to get the most out of e-learning the aforementioned concerns have to be addressed.

With the advent of social media platforms, the Forum is not as demanding, in terms of its technological requirements. In other words, the forum does not require a significant amount of bandwidth to operate, which may lead to unstable connectivity (Suresh et al., 2013). It is a reality that not everyone in a sub-Saharan country has access to or can afford high-end hardware. Therefore, the Forum is powerful in its capacity to operate as a platform for knowledge dissemination with relatively low hardware capabilities.

1.6.1 Framework of Forum Evaluation

Yosef (2009) defines a conceptual framework as a portrait of a research study. The framework for the forum evaluation is presented below in Figure 4. The key variables being studied are whether discussions held in the forums are being applied by participants in their respective positions as environmental or public health professionals. In light of the objectives for this study, the framework is based on McDonald and colleagues (2001) demand-driven learning model. This conceptual framework illustrates how improving the effectiveness and influence of information platforms facilitates and increases their use among students, graduates and alumni. The elements of the framework focus on how decisions are influenced. This framework also asks participants to give their perceptions and experiences regarding the relevance of discussions of the DPRM forum as a whole. The distinct aim is to enhance the quality of the forum discussions and resources in order to improve the participant's learning experience. This will be done to enhance the effectiveness of the programme, quality of learning and application of information gained in the forum.

The framework looks at three areas: Forum Content, Delivery and Programme Outcomes. Firstly, Forum Content will focus on how relevant the information being shared in the Forum is to workplace scenarios. It will also evaluate whether topics discussed are current and complete. Secondly, Delivery of the Forum will assess how peers communicate with one another and the ease of understanding of the various topics. In addition, the accessibility of materials relevant to the programme will be evaluated. This is important because participants in the Forum need to be able to apply the information in respective positions. Finally, the Programme Outcomes will be evaluated. The purpose is to determine whether the participant's skills improve and how effectively they are able to apply the knowledge from the Forum in their work environment to the benefit of their respective institutions and organizations. The results from the study will be utilized to adapt and revamp the programme for future users of the Forum.

DPRM Forum Evaluation

Forum Content:

- Relevant

- Current

Delivery:

- Accessibility of materials

- Communication with peers

Programme Outcomes:

- Improved learning

- Application of knowledge

Result:

Annual adaptation and improvement of program
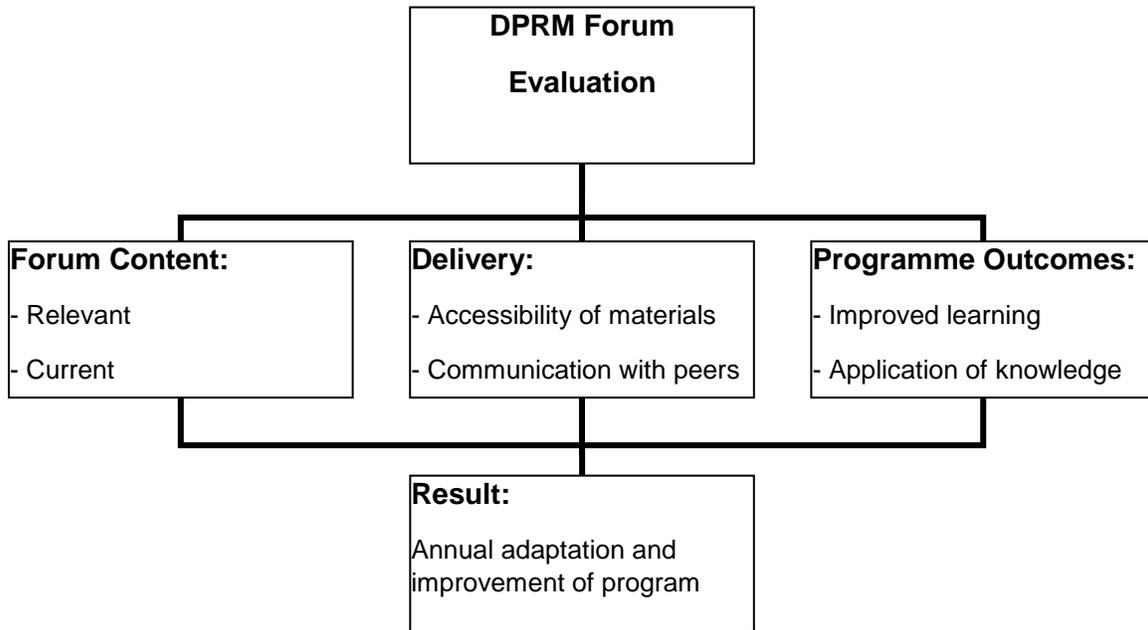
Figure 4: Framework for evaluating forum effectiveness

1.7 Gaps in Literature

Studies in both medical and non-medical fields have generated positive results amongst learners regarding satisfaction using e-learning as an alternative or in conjunction with traditional learning (Waldorff et al., 2008). Numerous studies have been done on online discussion forums and the impact it has on the students, officials, managers, scientists and policy makers in the field of health sciences (Bezuidenhout, 2009; McNamara and Brown, 2009; McDermott, 2011). Many studies have also been done to evaluate how these forums expose students to current issues and protocols in their field (Cain & Policastri, 2011) as well as how they can apply this information. According to Smithson and colleagues (2012) health professionals and health organizations also recognize the need for collaborative learning using online tools in order to improve their skills and decision-making. Although there are many studies which only focus on short-term evaluations, not enough focus on the long-term

implications have been done on the impact of these technology platforms (Guri-Rosenblit, 2009).

A number of studies have been done on ICT's in South Africa. These studies are focused on policy and higher education institutions in a broad sense. Thus, there is a need for a study to look at the nature of a programme at a particular institution at individual level (Czerniewicz and Brown, 2009). In addition, there is a need to determine how the real-time forum discussions and resources associated with the forum translate to effective implementation. It is also important to understand whether effective behavior change can be brought about, as in the case of face-to-face programmes over extended periods.

2. Methodology

The Forum is housed on the UCT student portal (VULA) and is for students in pesticide risk management related fields. These students are from LMICs predominately in Africa. Students' perceptions, use of the forum content and other information will be collected through an electronic (online) survey.

2.1 Research Approach

Qualitative research methods have been chosen for this study because this method investigates the *why* and *how* of decision-making not just *what*, *where* and *when*. This method is exploratory. Furthermore, qualitative analysis allows the researcher to understand reasons and opinions. Qualitative analysis has been chosen due to the small sample size. Thematic analysis will be used to generate themes. Themes will be summarized and interpretations will be drawn from the results.

2.2 Population and sample

Thirty eight DPRM students enrolled between 2011 and 2013 will be surveyed. Only students will be sampled for the purpose of assessing whether they were able to implement what they learned in their work setting, decision-making and/or policy formulations. These students predominantly come from sub-Saharan African countries.

2.2.1 Recruitment

Once approval for the study has been granted by UCT's Faculty of Health Sciences Human Ethics Review Committee, recruitment will commence. All students will be contacted via e-mail by the researcher inviting them to participate and explaining the purpose of the study. If they agree to participate they will be given a link to complete the online survey.

2.3 Data Collection and Analysis

The methods used to collect data in this study will be through literature studies, surveys and document reviews. Data analysis will start as soon as all questionnaires have been completed. The results from the completed questionnaires will be analysed using software provided by Survey Monkey. The researcher will systematically work through the questionnaire data by converting it into.

2.3.1 Questionnaire

This research will utilize an electronic internet based questionnaire (Appendix 2) with a combination of open-ended and scale rating questions. The questionnaire is housed on secure site which can only be accessed by the primary researcher and the participants. Participants will be required to sign the questionnaire electronically for consent purposes. Open-ended questions will constitute the majority of the questionnaire and will allow participants an opportunity to express their views. The questionnaire focuses on how effectively knowledge is translated from the forum, to

the participant's work environment. All questions will be conducted in English. The main sections of the questionnaire are as follows:

- Biographical details: gender, country of origin, job title, place of work and year of registration
- Participant experience: frequency of forum attendance, relevance of discussions, networking with other participants and quality of supplementary resources
- Topics: participants discuss which topics were most useful and how new knowledge was applied
- Implementation: participants present examples of how they are able to apply the information and they provide details on how their skills were enhanced
- Suggestions: how the forum can be improved to enhance future participants learning experience and the overall quality of the forum

2.3.2 Document reviews

Documentation relevant to this study will be used. These include news bulletins from the DPRM forum, public and environmental health journal articles and policy reviews. In using this research tool, the aim is to answer any questions relevant to the impact which this forum has on facilitating positive behavior change, in the decision-making process of pesticide risk management.

2.4 Data Management

All data from this research shall be locked in the researchers' office. All questionnaires will be stored on the principal researchers' computer. The same researcher will commence analysis as soon as data is collected. The original questionnaires will be backed up and kept on the researcher's computer to ensure that data is not lost, as technical failures are possible.

2.5 Ethics

Ethical approval will be acquired from the Human Research Ethics Committee of UCT. The study raises no risks to participants. Anonymity of the obtained data will be ensured by the researcher. Participants are required to complete a letter of consent before completing the survey (Appendix 1 and 2). The information obtained from this survey will be used to enhance the discussion forum for future participants. The participants are notified that they can withdraw at any time without any penalty. The data obtained from the study will be used to make improvements to topics relevance and usability of online forum discussions.

2.6 Dissemination of data

Data will be disseminated by thesis and journal publication.

3. Timeline

2013/2014	March	April	May	June	July	August	September	October	November	December	January
Develop questionnaire	▓	▓	▓								
Research Protocol			▓	▓	▓	▓					
Literature review					▓	▓					
Participant recruitment						▓	▓	▓			
Ethics review								▓	▓		
Data collection									▓		
Data Analysis									▓		
Write up dissertation									▓	▓	
Hand in dissertation										▓	
Journal Publication											▓

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PART B: STRUCTURED REVIEW

1. INTRODUCTION

1.1 Background

Pesticide risk management (PRM) is an important pillar of public and environmental health because it mitigates the harmful effects of pesticides on people and the environment. As stated by Goldman (2007), the management of pesticides is a sizable and convoluted trade. Furthermore, pesticide management comprises of multiple activities including: proper handling, legislation, regulation, use, distribution, storage and disposal of pesticides to curtail the detrimental effects on human and environmental health (Goldman, 2007). In LMICs, professionals such as researchers, registrars, legislators and inspectors face challenges in controlling and regulating health risks related to the use of pesticides. These challenges include reducing injury or death due to exposure or self-poisoning, registering and categorizing pesticides, access to good surveillance data, limiting the illegal use of pesticides, lack of access to appropriate personal protective equipment, and discontinuing the circulation of old and unsafe pesticides (Alavanja et al., 2013; Rother 2012; Goldman, 2007). Unfortunately, these challenges have not been addressed due to lack of human capacity (Forde et al., 2011). It is evident that capacity building in the form of skills provision is required to prevent and reduce pesticide risks to humans and the environment (Rother, 2011). However, in order to develop these essential skills, an environment providing to access to vital pesticide management information is necessary.

Pesticide risk managers, including healthcare personnel working with pesticide poisoning cases, need an environment where they can learn and gain access to diverse pesticide risk management information (Rother, 2011). In an educational setting this could occur through interaction with fellow students and experts in pesticide risk management or electronic learning (e-learning). Current e-learning education efforts focus on integrating learning strategies for delivering course content effectively, allowing students to engage in an active learning environment, while already engaged in the workforce (Bjork et al., 2008).

E-learning can be defined as the use of technological tools that are based online, to improve the user's educational opportunities (Moore et al., 2011). E-learning is especially helpful for learners who live in remote areas as it allows access to information which may not have been accessible otherwise (Freywhot et al., 2013). Although E-learning is considered useful in addressing aspects such as isolation, access to information and convenience it is not without shortfalls. Shortfalls include unreliable internet, lack of technological support to learners and inadequate technological infrastructure (Nartker et al., 2010). However, if the aforementioned elements are in place, it can aid learners in meeting their educational objectives.

The University of Cape Town (UCT) in South Africa offers a mixed instruction mode *Post Graduate Diploma in Pesticide Risk Management (DPRM)* (Rother, 2011). This programme has been developed around the International Code of Conduct on Pesticide Management (reference The Code) jointly overseen by the United Nations Food and Agriculture Organization (FAO) and the World Health Organization (WHO) in order to address the key areas in which pesticide risk managers require skills (FAO, 2014). These areas include the: testing of pesticides, regulation, distribution and trade, labelling, packaging and storage, as well as the reduction of health and environmental risks of pesticides (Code of Conduct) (FAO, 2014). The DPRM is predominately an e-learning based course which includes a bi-monthly virtual seminar in the form of an online discussion forum. In this discussion forum participants discuss current pesticide risk management topics with leading experts and fellow students. The internet discussion forum called Vula is powered by Sakai and hosted by UCT. This platform enables simulation of physical lectures such as real-time discussions and interaction with fellow participants (Sakai, 2013). This study investigated whether the discussion forum contributes to, and influences, the decision-making of professionals by equipping participants with relevant knowledge through problem-solving and exploration of pesticide risk management case studies.

1.2 Objectives of the literature review

This review covers a number of key topics: a definition of pesticides, the use of pesticides, health effects associated with pesticides, how to reduce the effects of pesticides and the field of pesticide risk management. It then moves on to discuss decision-making and capacity building through e-learning in the form of an online discussion forum.

The aim of this literature review was to assess how e-learning influences decision-making in pesticide risk management based on the perceptions of participants. The overarching questions for this literature review in addressing the research aims were the following:

1) How are pesticide risk management decisions influenced by knowledge gained from e-learning via the DPRM forum discussions?

2) What are the challenges facing the success of capacity building in pesticide risk management?

3) What contributions can e-learning make to enhance the skills of public and environmental health professionals in order to help them execute their duties more efficiently?

4) How does e-learning help professionals address contextual issues related to pesticide risk management?

1.3 Search strategy

Online journal publications served as the main sources from which literature was gathered. Google Scholar, Biomedcentral, Pub Med and Primo UCT were used as the primary search engines.

Search strategies for this literature review used related terms for 'e-learning', including distance learning, distance education and online forums. Studies with the following terms were included: sub-Saharan Africa, LMICs, public health, environmental health, workforce, capacity building, pesticides, health effects of pesticides, pesticide management, decision-making, e-learning and virtual seminars. Studies were excluded if they were not written in English and if they were published before 1990.

2. SUMMARY OF LITERATURE

2.1 The use of pesticides

Pesticides are toxic chemicals that are used to prevent or control pests (Remoundou et al., 2014; Bethke & Cloyd, 2009). A number of studies have assessed the benefits (Aktar et al., 2009; Bethke & Cloyd, 2009) and disadvantages of pesticides (Alvanja et al., 2013; Damals & Eleftherohorinos, 2011; Aktar et al., 2009; Tesfamichael & Kaluarachchi, 2006). There are a number of uses for pesticides which are as follows: agriculture (weed control, soil treatment and crops), public health (malaria control), domestic use (insect and rodent control), mosquito control, treatment of livestock and other unregistered uses such as in fisheries (Rother 2012). Although pesticides are widely used, efforts are being made to reduce the hazardous effects it has on public and environmental health.

2.2 Effects of hazardous pesticides

In 2011, the international pesticide trade was priced at US$37.5 billion and is expected to reach US$65.3 billion in 2017 (Lehr, 2012). These figures are consistent with another report which showed that pesticide sales increased globally from US$ 31 billion to US$ 38 billion between 2005 and 2010 (PAN, 2012). Due to the extensive and increasing use of pesticides (Rother, 2012; Aktar et al., 2009; Moore, 2008), strict regulations exist for their development, distribution and use (Goldman, 2007;

Pimentel, 2005). Despite these regulations, short and long term human health effects continue and must be addressed (Rother & London, 2009; Korandsen, 2007).

These harmful effects caused by pesticide exposures, range from acute effects (e.g. nausea, diarrhoea, seizures, bleeding of the gums, nose, and mucous membrane) and chronic effects (e.g. psychiatric problems, infertility, various cancers) (Faria et al., 2014; Roberts & Karr, 2012). Poor surveillance, lack of legislation and weak regulatory oversight of pesticide use (Matthews et al., 2011), illegal use of acutely toxic pesticides (Rother, 2012), the stockpiling of obsolete and dangerous pesticides (Stadlinger et al., 2013), lack of personal protective equipment (PPE) for applicators (Faria et al., 2014; Rother & London, 2009) and ill-informed pesticide users such as farmers and farmworkers (Damalas & Eleftherohorinos, 2011) are some of the causes of these health problems.

Studies have explored the potential acute toxic effects of pesticides on peoples' health in low- and middle-income countries (LMICs), and found that those using them are at an increased risk of poisoning (Dabrowski et al., 2014). Williamson et al., (2008) studied the pesticide practice of smallholding farmers in four African countries namely Benin, Ethiopia, Ghana and Senegal. Results from this study showed that cotton farmers experienced acute symptoms due to repeated exposure to a pesticide called Endosulfan. Other studies found that health effects escalated beyond exposure related injuries to lethal accidents as a result of self-poisoning or improper pesticide management (Oesterlund et al., 2014; Rother & London, 2009). There have been approximately three hundred thousand deaths due to pesticide poisonings each year (Konradsen, 2007). However, values of pesticide poisonings and deaths may be inaccurate due limited or non-existent surveillance of pesticide in LMICs. In addition, pesticide use is increasing given sales over recent years and forecasts. Consequently, many of these deaths, poisonings and health implications could have potentially been avoided through improved management of the life-cycle of pesticides, which is the focus of the DPRM programme and the Code. If the life-cycle of

pesticides are not properly regulated, it could also lead to negative effects on the environment.

2.3 Regulations and pesticides

For pesticides to be regulated, they first need to be registered. Registration is an important component of PRM as it empowers legislative bodies to determine the following: purpose of use, quantity, frequency of use, proper labelling, packaging and the best interest of end-users (WHO, 2010). Guidance on establishing effective regulation of pesticides is provided by the Code for use within national legislation and through various FAO technical guidelines on PRM for various entities. These entities are international organizations, companies in the pesticide industry, pest control operators, traders of pesticides, public interest groups and trade unions (FAO, 2014). This document recognizes the need for professionals in government to have essential skills to manage the life-cycle of pesticides and the risk they pose. Unfortunately, due to insufficient capacity building strategies in LMICs (which will be discussed in 2.5.1), the DPRM programme was structured around the FAO guidelines to improve the life-cycle management of pesticides (Rother, 2011).

2.4 Guidelines for the life-cycle of pesticides

Experts urge professionals working with pesticides to increase their knowledge of the life-cycle of pesticides in order to reduce their harmful effects (Matthews et al., 2011). The life-cycle concept of pesticides refers to all phases from production to disposal. Pesticide life-cycle includes: registration, manufacturing, commerce, packaging, classification, housing, transport, removal, surveillance, and supervision of pesticide wastes. The Code provides standards to help governments advocate strategies which decrease the dangers for the duration of the pesticide life-cycle, ensure the effective use of pesticides, and promote integrated pesticide management (FAO, 2014). Unfortunately, there are still countries who poorly manage pesticides. Particular concerns were raised about countries with limited resources (van den Berg et al., 2011). Concern for LMICs are justified based on a global survey on pesticide

management practices, which found that 25% of 113 countries did not have legislation in place. The countries without legislation were from African and South East Asian regions (Matthews et al., 2011). Although the study does not mention these countries by name, it can be assumed that these countries do not have the commitment, infrastructure, human resources and finances to implement PRM legislation.

2.5 Decision-making and pesticide risk management

An area which is essential to PRM is sound decision-making. The need for unambiguous knowledge translation and communication among decision-makers in PRM and end users is required for effective pesticide management (Krewski et al., 2014; Rother, 2014). Studies have recognized the need for decision support tools and have shown the varying degrees of success (Huang et al., 2011; Hamouda et al., 2009). Nonetheless, these studies had different results based on varying datasets and frameworks. For example, Huang et al. (2011) showed that the complication of decisions should be weighed against scientific, social, and technical factors, which is consistent with Krewski et al. (2014). Furthermore, competency of the decision-making process and the level of accessible information about the problem should also be considered.

It is without question that professionals require decision-making tools (Liu et al., 2012), given the number of factors which need to be considered (Carriger & Newman, 2012). Due to the complexities surrounding the life-cycle of pesticides, having decision-making tools in place should make it easier for PRM professionals. It should be noted that PRM professionals is not a homogenous group, as professionals stem from different backgrounds but they are expected to manage pesticide risks. Therefore, support tools which are in-depth and easy to understand (Liu et al., 2012), would potentially improve the decision-making of PRM professionals. In so doing, positive results can be achieved in areas such as reducing pesticide related deaths/injuries.

2.6 Capacity building and pesticide risk management

Capacity building is a term used internationally to describe programmes that are introduced with the aim of improving skills, abilities and institutional operations (Schwind et al., 2014). PRM consists of a multi-faceted approach, which requires professionals to have a range of skills (Table 1) (Rother, 2011). Even though the need for capacity has already been declared, insufficiency still lingers and has culminated in a number of sub-standard interventions besides wasting resources (van den Berg, Yadav & Zaim, 2014). The result of insufficiency may lead to relationship where pesticides risks increase due to interventions which remain ineffective because of poor implementation, lack of skilled staff or limited funds.

Definition of Capacity Building for PRM	Examples of capacity building requirements
Effective pesticide legislation/ registration	Data on current registration in other countries Exposure data Appropriate risk assessment data for country context
Effective enforcement of legislation	Informed inspectors Surveillance systems particularly at borders Adequate surveillance data of incidence (environment and health) Disposal/obsolete stock management
Human skills	Trained staff in toxicology, ecotoxicology, risk management, agriculture, quality assurance, policy analysis, policy brokering, international conventions, negotiations, socioeconomic analysis, training, facilitation

	and awareness raising, risk communication, exposure assessment, economics, trade, conducting situation, gap analysis and pest management
Assessment and implementation of alternatives	*Knowledge of alternatives/pest management solutions available and substitution principles* *Economic analysis skills* *Integrated pesticide management skills* *Knowledge of sustainable/ecological agriculture*
Risk reduction management	*Skills in:* *Implementing a hierarchy of controls* *Conducting and implementing life-cycle analysis* *Management containers and obsolete stocks*
Public health pesticides management	*Skills in:* *Vector biology* *Risk management* *Integrated approach management* *Policy and international negotiations*
Training, awareness-raising and risk communication	*Skills in:* *Effective training and facilitation* *Developing culturally appropriate risk management tools* *Integrated awareness-raising programme development* *Participatory training approaches*

Table 1: Pesticide Risk Management Capacity Building (Source: Rother, 2011)

The proposed requirements in Table 1 are comprehensive and broad. Hence, sustained commitment is needed to ensure that PRM professionals are trained in these areas. Furthermore, in light of trying circumstances (for example, constrained resources) in which some LMICs find themselves, it should be expected that capacity building in PRM will be a long process. Therefore, the approach to capacity building should be diligent and objectives should be regularly assessed, to minimize and rectify pesticide risks.

2.7 Achieving capacity building

To facilitate the effective use of resources, Lansang and Dennis (2004) stated that a competent workforce needed to be developed through capacity building. Without capacity building, poor pesticide handling practices and weak governance would exist (Stadlinger et al., 2013). Additionally, capacity building enables LMICs to prioritize and develop strategies (IJsselmuiden et al., 2012). Prioritizing enables entities to maximize their approach to PRM, without wasting resources.

Studies show that capacity building can be achieved in several ways. Firstly, training more graduates to meet current requirements. One study looked at twelve sub-Saharan African countries (namely Central African Republic, Ivory Coast, Congo, Ethiopia, Kenya, Liberia, Madagascar, Rwanda, Sierra Leone, Uganda, Tanzania and Zambia) and their density of health workers (physicians and nurses) per 1000 persons in the respective populations (Kinfu et al., 2009). Adequate professionals/graduate training was a marker for meeting capacity building requirements. However, the educational institutions and training facilities in LMICs may not have a standardized approach towards training professionals/graduates (Thundiyil et al., 2008). In other words, there may be professionals/graduates who are better trained than others, which would result in different levels of the efficiency in the workplace.

Secondly, capacity building can be achieved with continuous and improved training of working professionals through e-learning (Heller et al., 2007). One study looked at

medical postgraduate trainees from Argentina, Brazil, Congo, India, Philippines, South Africa and Thailand (Kuiler et al., 2012). The experimental group received a clinically integrated e-learning programme (specifically designed for this study), whereas the control received a self-directed course, with access to a facilitator in the event that they had questions and slides (made available online) from a WHO reproductive health workshop course.   Results from this randomized control study found that postgraduate trainees in the experimental group showed a better performance in knowledge and skills than those in the control group. The authors concluded that if an institution were to undertake an e-learning based curriculum, it should be tailored to the course rather than self-directed (Kuiler et al., 2012). Similarly, a study by Awad and colleagues (2013), affirmed that using an e-learning platform strengthened the short-term knowledge gains of public health professionals. Although training graduates through an e-learning curriculum has been shown to work, a high standard of training quality is desired and a greater ratio of professionals per population is critical.

Finally, capacity building can be achieved through recalling retired professionals to improve programme delivery, maintain numbers for the workforce and guide inexperienced professionals, as was the case in Uganda (Wanyana, 2015). Appointing retired professionals or retaining those nearing retirement can help stabilize the workforce as stated by Harrington & Heidkamp (2013). It should be noted that there may be some resistance to this strategy. In some countries professionals have to retire earlier than they would like because of age limits. If recalling retired professionals is to be the norm, then the age limit for retirement will need to be changed. Legislative development and the implementation of this form of capacity building (van den berg et al., 2014) should be considered as a means to address the lack of capacity in the PRM.   A recent study illustrated that thirteen countries (Cambodia, Cameroon, Ecuador, Gambia, Guatemala, Kenya, Madagascar, Mozambique, Morocco, Oman, Sudan, Tanzania and Thailand) selected by the WHO for capacity strengthening needed legislative revision and development (van den Berg et al., 2014). Even though these countries were only able to highlight problem areas regarding pesticide management, examining the effects of the legislation is an aspect which should be monitored and assessed long-term.

2.7.1 Challenges and weaknesses of capacity building

Unfortunately, disparities in the distribution and expenditure of health services between the LMICs and HICs continue to grow as HICs spend one hundred times more on health services (Peters et al., 2008), which makes it difficult to diminish capacity building challenges. This was evident in the Democratic Republic of Congo's (DRCs) Katanga Province, where 30 trained public health professionals were deployed for a population of nine million (Heller et al., 2007). Unclear training objectives and a weak understanding of what is required for professionals compounds capacity building (Nangami et al., 2014). Chen et al., (2011) commented that this leads to graduates and professionals who are unprepared to comprehend and manage the problems which they are presented with. Thus, Mirzoev et al., (2013) were correct when stating that capacity building should embody skills, knowledge and perceptions which allow health professionals to execute their mandates in a strategic manner.

The ability to fulfil mandates are influenced by factors such as lack of human resources, poverty, infrastructure, under skilled staff and inconsistencies at countrywide tiers in the enactment of programmes have been well documented (Obura et al., 2011; Nartker et al., 2010). Despite awareness regarding these challenges, it appears to be a recurring theme in LMICs. Changes in regimes or reshuffling of ministerial cabinets may bring about disruptions in programmes, loss of focus and redefining of priorities, which further fuels these challenges. Technological advancements has brought about a reliance on computers and the internet for communication, collaboration and work in our daily lives. High income countries (HICs) have benefited from the advancements, whereas some LMICs experience difficulty in the application technological advancements, due to limited access to computers, low-bandwidth speeds and power failures (Erah & Dairo, 2008). The impacts of these challenges are far reaching because they thwart the efforts of governments and their partners in LMICs to meet their capacity building goals.

2.7.2 Success of capacity building

Ensuring that capacity building continues to progress and succeed in the face of challenges can be illustrated in the following study by Chanda et al., (2008). They showed the necessity of having a core team of professionals with the required skills. Skills were attained through National Malaria Strategic Plan (NMSP) in accordance with WHO guidelines for malaria control. These professionals (skilled in vector management and implementing protocols at national and community levels) were able to decrease death rates from 9 000 to 6 000 cases, between 2002 and 2007. The decline was attributed to a reduction in malaria related deaths per one thousand from 424 in 2003 to 358 in 2007 (Chanda et al., 2008). In addition, effective decisions were made by the core team which addressed integrated vector management. Similar successes were attained in a West African study where professionals' knowledge, attitude and skills developed and improved following a multi-stakeholder training platform (Dreschel et al., 2008). This study showed that with clear strategies, skilled professionals, improving the capacity of professionals and accurate implementation of a programme can result in achieving desired goals.

2.8 E-learning and higher education institutions

During the last decade, e-learning has made significant advances as a training platform at universities and other educational institutions to serve off-campus adult learners (Czerniewicz & Brown, 2009; Brown et al., 2008). Despite these advances, LMICs have been less successful with their e-learning programmes (Bediang et al., 2013; Nartker et al., 2010). Contributing factors include lack of programme monitoring, long term programme support, the absence of infrastructure, limited human resources and unclear implementation strategies (Nangami et al., 2014; Nartker et al., 2010). Although a number of studies have been done on e-learning in regard to medical and health professionals, the literature is not clear on e-learning in the context of PRM professionals in LMICs.

For an e-learning programme to be successful, it needs to be comprehensive and sustainable (Gray & Tobin, 2010). Two studies demonstrated that a well-structured e-learning programme is more beneficial to the learning of participants (Warnecke and Pearson, 2011; Awad et al., 2013). Awad et al., (2013) evaluated an e-learning package on 253 undergraduate students at the University of Nottingham by means of surveys on genocide in relation to public health. Results from this study showed ephemeral skill acquisitions and optimistic views towards racial killing prevention. Although the e-learning programme hinted at behaviour change, long-term studies need to be conducted to confirm if e-learning as a contributor for behaviour change. Warnecke and Pearson's (2011) conducted a similar study at the University of Tasmania, asking medical students to evaluate an e-learning package and its influence on consulting skills. Their results showed that students found the programme enjoyable which allowed for consistent interactions and made it a valuable experience. Hence, Kenicer et al., (2012) and Heller et al., (2007) were correct when they stated that programme structure course design, excellent resources/content, outstanding instructors, reliable technology and proper infrastructure culminate in a quality and long lasting programme.

2.8.1 Benefits of e-learning

E-learning has a number of benefits such as decreased need for family relocation, reduced travel costs to and from a learning institution and fewer hours spent at a learning institution (Safie & Aljunid, 2013). It is flexible, convenient and affords participants the opportunity of studying from any location, providing the individual has a reliable internet connection (Mokwena et al., 2007). It seems that e-learning makes the ideal solution for health professionals in LMICs, especially if they are deployed to rural areas to attend to cases which they may not be trained to handle (Nartker et al., 2010). Additional benefits include increased efficiency, flexibility, accessibility, consistency and improved professionals/students' performance (Borstoff & Keith, 2007; Cavus et al., 2007). The point of improved performance or at least a perceived improvement was reiterated by Mathauer and Imhoff (2006), who found that health

professionals felt an increased commitment and interest in the work after receiving training. Despite these benefits, there are challenges in e-learning which need to be addressed if it is to be a successful platform for professionals and students over a long period.

2.8.2 Challenges of e-learning

A problem with e-learning may be isolation due the lack of conventional face-to-face interactions (Bjork et al., 2008). Another disadvantage is that with projects or assignments submission, slow connection speeds and blackouts, which are common in certain LMICs, delays response times between users (Tella et al., 2012). Poor infrastructure is a recurring theme, as is lack of financial support for the continuation of a programme, lack of computer skills, timidity in using computers and e-learning programmes which do not provide the necessary skills are all barriers which exist (du Plessis, 2012). In addition, social issues such as gender suppression have been seen to be a limitation to e-learning in certain countries due to traditional male social roles regarding e-learning (Bjork et al., 2008). Other limitations which reduce the use of e-learning include disabilities such as impaired vision and hand function (Fichten et al., 2009), making it difficult to participate in an online discussion forum.

3. GAPS IN LITERATURE

There is little research pertaining to e-learning as a capacity building tool for pesticide risk management. Current literature focuses mainly on the improvements of skills amongst public health/ medical professionals through e-learning in HICs and LMICs (Awad et al., 2013; Freywhot et al., 2013, Warnecke & Pearson, 2011). Additionally, there is limited data which explores the decision-making of pesticide risk management professionals in LMICs. A number of studies have highlighted poor pesticide risk management and legislative practices, and have called for these areas to be strengthened and standardized (van den Berg et al., 2015; van den Berg et al., 2014; Stadlinger et al., 2013; Matthews et al., 2011). Carriger and Newman (2012) stated

that pesticide risk management is complex field which requires sound decision-making.

The complexity of this field can be illustrated in a study of 13 LMICs by van der Berg et al., (2014) identified numerous gaps across the entire pesticide management spectrum and listed major discrepancies in pesticide management practices between the countries which included: regulatory control, quality control, disposal and waste, pesticide poisoning/ exposure, legislation, application, storage, information exchange and public education. These are issue which have been highlighted by Rother (2011) in order to improve capacity building of PRM professionals. Van der Berg et al., (2014) concluded that poor pesticide risk management will lead to widespread problems. Furthermore, they implored government institutions, international agencies and donors to invest in strategies that would enable countries to develop and maintain sound pesticide management practices, in addition to improving the capacity of health professionals.

Although van den Berg et al.'s (2014) work provides a snapshot of the challenges faced in LMICs, to the knowledge of the author there is limited research on strategies employed amongst PRM professionals to address the aforementioned issues. Given that pesticide use is on the increase and its highly toxic effects, it is essential that PRM professionals are equipped to implement and apply sound PRM concepts in LMICs.

4. CONTRIBUTIONS TO LITERATURE

Many e-learning programmes are discontinued due to lack of infrastructure, insufficient content, poor facilitation and lack of support (Bosner et al., 2013; Abdelhai et al., 2012). The research which has been done on e-learning in LMICs focused on the impact of health professionals where resources were limited, skill improvements or as a tool for education at universities (Amde et al., 2014). This research aims to determine which skills were improved and to what extent they improved based on the

perceptions of PRM professionals. As most of the research looks at perceptions of students and professionals in medicine and public health (Muthaura et al., 2015; Amde et al., 2014; Warnecke & Pearson, 2011), this research aims to exclusively provide insight into the experiences of PRM professionals in LMICs using e-learning. Furthermore, this study aims to present the positive and negative outcomes of a PRM centred e-learning programme. Ultimately, the goal is to illustrate the effectiveness of e-learning as capacity building tool in PRM and contribute these results to the current literature.

5. CONCLUSION

Pesticides are highly toxic which may lead to a host of hazardous effects. In order, for the risks of pesticides to be reduced, pesticide risk management skills need to be employed by employers (governmental departments, non-governmental organizations, research institutions and the like) for their employees (scientist, pesticide regulators, environmental officers, etc.). These skills are broad, yet comprehensive to effectively meet health outcomes. Unfortunately in LMICs, professionals in pesticide risk management are not always equipped with these skills. This is often due to a lack of capacity building, which is essential for effective pesticide risk management. Lack of capacity is manifested in variables such as a shortage of skilled staff and poor infrastructure in LMICs. Through the use of e-learning, human capacity can be improved, to enable professionals to operate at a level in accordance with the Code of Conduct.

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PART C: MANUSCRIPT

Assessing the impact of e-learning on decision-making to reduce health risks: Perceptions from UCT's pesticide risk management cohort[1]

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Abstract

Background: There is a need to build the capacity of professionals in low- to middle-income countries (LMICs) in order to reduce pesticide risks on human and environmental health. To address these risks, the School of Public Health and Family Medicine at the University of Cape Town introduced the Post Graduate Diploma in Pesticide Risk Management (DPRM). The DPRMs' discussion forum aimed to strengthen skills in managing and reducing pesticide risks. This programme utilises a mixed teaching mode including an e-learning component which includes virtual seminars/discussion forums. Due to the shortage of skilled professionals in LMICs, e-learning can facilitate the on-going training and skills development in pesticide management to address pesticide related challenges. The study objective was evaluating the impact of the DPRM's e-learning discussion forums on the decision-making processes of professionals working in pesticide risk management in LMICs.

Methods: An online survey was distributed to past and current DPRM students (N=37). The questionnaire consisted of open-and close-ended questions and covered the following topics: biographical information, employment history, forum participation, discussion forum value, application of topics, skill enhancement and quality of the resources.

Results: Participants reported that they were able to apply information gained through e-learning in a practical and effective manner, thereby improving their skills for real world scenarios. Of the participants, 90% reported an improvement in their critical

thinking through participation in the discussion forum and 95% found the forum to be useful in knowledge exchange. Overall benefits acknowledged by participants included establishing a knowledge resource, improved communication with colleagues and stakeholders, as well as improved ability for knowledge application in their work and pesticide use context.

Conclusion: Participants' found the discussion forum to be a beneficial tool in building their pesticide risk management capacity while working full-time and reported improved decision-making ability. Critical thinking emerged as the skill that improved considerably, allowing participants to be more effective as pesticide risk management professionals.

Keywords: decision-making, discussion forum, e-learning, pesticide risk management, public health, virtual seminars, capacity building

Background

Advances in technology, such as global access to the Internet, have prompted the use of online learning, also known as e-learning. These advances have made it possible to present educational courses and provide instruction in a flexible manner [1]. Several studies have identified the need to address LMICs public and environmental health services which are overburdened by increasing disease rates, limited funding, poor infrastructure, a shortage of human resources and untrained staff to manage challenges [2-5].

The lack of skills among professionals (including health professionals) in LMICs is a recurring theme in public health [5, 6]. Further it has been shown that the incorrect use of pesticides may negatively affect people and the environment [7]. Listed negative health effects include acute toxicity and, chronic effects (e.g., neurotoxicity, endocrine disruption, cancers, immune system suppression, genotoxicity, mutagenicity), and death [8-11]. A combination of factors, such as weak infrastructure, human resource shortage and ineffective pesticide regulations, may lead to undesirable health outcomes from pesticide use in LMICs [12-14]. In order to retain health workers, one study found that continuing education and improving qualifications motivated professionals to continue in their positions for longer periods [15]. Unfortunately, upgrading qualifications and skills through conventional means is challenging due to work constraints, geographical location and resultant travel costs, professional isolation as well as the cost and difficulty attending workshops or training courses [7, 16, 17]. E-learning is seen as a tool to overcome these hurdles [18].

A skill which is important for professionals and influences a number of areas which overburden public and environmental health services is that of critical thinking [20]. Critical thinking can be defined as making an objective analysis upon which an opinion is based [19]. Critical thinking plays a crucial role in the decision-making process and this process can be time-intensive and require careful planning [13]. Additionally, by combining practical exercises and academic learning through e-learning, professionals can improve critical thinking which may lead to improved decision-making [20-22]. Considering the scale of some pesticide risk management issues, the impact of an informed decision would prevent undesirable outcomes [13].

Although e-learning has been used as a capacity building tool amongst professionals in healthcare and biomedical sciences, its use to improve pesticide risk management (PRM) skills in LMICs has not been adequately studied [23]. The Diploma in Pesticide Risk Management (DPRM) e-learning programme was established through the University of Cape Town to better the working capacity in PRM. The DPRM has a bimonthly pesticide discussion forum and is a two year part-time programme which started in 2011.

This research evaluated the perceived effectiveness and impact of the DPRM discussion forum in improving the decision-making processes of PRM professionals in LMICs. Additionally, this study evaluated whether participants of the DPRM-forum applied concepts from the discussion to real problems experienced in their countries.

Overview: PRM discussion forum

This e-learning programme consists of bimonthly discussion forums presented as virtual seminars with a number of discussion topics (Table 1). Users of the discussion forum interact with each other and moderators in a chat room. All communication was conducted in English. Duration of sessions was 120 minutes and comprised of discussing particular topics and answering questions. This e-learning tool consists of resources such as pesticide related publications and news bulletins to aid students in their learning experience by presenting a summary of the discussion highlighting students points of view. The reading materials and topic summary are sent to all participants prior to the bi- monthly discussion forum.

Table 1. Examples of Forum Discussion Topics (2014)

Enforcement in pesticide legislation
Protecting spray operators, bystanders and the local community
Integrated Pesticide management (IPM)
The "TRUE" process of pesticide regulation in developing countries
Illegal counterfeit products: How to get more engagement from policy-makers
The new pesticide code
Neonicotinoids impact on pollinators
Container management

Methods

Study population

The sample was obtained from a population of working professionals, who either completed or are currently enrolled for the DPRM programme (N=37). Twenty-two participants completed the questionnaire. The participants in the study were from Botswana, Eritrea, Fiji, Ghana, Kenya, Lesotho, Malawi, Mozambique, Nigeria, South Africa, Tanzania, Zambia and Zimbabwe. These participants were employed by governments, non-governmental organizations (NGOs), research institutes and private companies.

Data collection

All eligible participants were invited to participate in the study via e-mail. The e-mail stated the purpose of the study, the voluntary nature thereof and stressed the anonymity of the study. This email also contained a link to the online questionnaire. Anonymity was ensured by the researcher. To evaluate the effectiveness of e-learning in building capacity and promoting risk reduction, a questionnaire was electronically administered to DPRM students. The questionnaire (see Appendix 2) was drafted and piloted with two individuals who had previously been members of the discussion forum but who were no longer students and did not form part of the study cohort. Feedback from these pilots was used to improve the questionnaire. Thirty-four questions covered aspects of whether participants perceived topics in the online

discussion forum to improve their decision-making skills in their work (Table 2). These questions were a combination of open-ended and closed- questions. Multiple responses were encouraged where appropriate. The Human Research Ethics Committee of the University of Cape Town provided ethical approval on December 9th, 2013 (HREC/ REF: 636/2013). Participants completed an online consent form as a prerequisite for participation.

List 1: Survey headings

- Biographical details

- Employment history

- DPRM enrolment

- Forum participation

- Evaluating forum resistance

- Discussion forum value

- Discussion application

- Networking

- Skill enhancement

- Policy and protocol

Data analysis

A qualitative and quantitative mixed method analysis was undertaken for this study. The responses of the 22 participants, who completed the online questionnaire, were

stored and reviewed on Survey Monkey. Descriptive statistics were generated from the quantitative data. Due to the small sample size, statistical significance testing was not conducted, and variables were collapsed where responses overlapped. For example, working emergencies and personal emergencies were collapsed into emergencies. Statistical analyses were performed using Stata 12. However, no graphs are presented in this article because the small sample size did not lend to statistical significance testing to determine relationships between variables. Open-ended responses were used to ground arguments and to elaborate on the respondents experience in the DPRM forum. This allowed for a deeper understanding of how participants were able to apply the forum information in a practical manner to their decision-making in their work contexts.

Results

Biographical details

The majority of participants (65%) enrolled for the DPRM in 2011/2012. The remaining participants were from the 2012/2013 (13%) and the 2013/2014 (22%) groups respectively. Males (73%) constituted the majority of the participants. All participants were employed; the majority worked in governmental posts (74%); while 13% worked for International organizations and the remaining participants for NGOs or private companies.

Forum effectiveness

Participants' rated the discussion forum effectiveness according to a rating scale representing their understanding of pesticides. In terms of developing a better understanding of pesticides, 48% of participants perceived the discussion forum to be effective, whereas 38% stated that the DPRM forum was very effective and 14% considered it to be mostly effective.

Employment history and forum experience

Among the participants, 35% had less than five years working experience with pesticides, whereas 65% had more than five years of experience and two participants indicated ten years of experience. The discussions were mostly well attended by participants: 38% of participants attended 96-100%, 33% attended 76-95%, 19% attended 50-75% and 10% attended 25-49% of discussions. These results show a correlation between work experience and attendance frequency of the forum. Despite only 41% of participants indicating that the easy access to information on the forum enabled their learning experience, 91% cited the forum as an excellent knowledge resource.

Discussion forum and critical thinking

Most participants (90%) reported an improvement in their knowledge and understanding of pesticides after participating in the discussion forum. Critical thinking relating to knowledge application, problem solving and strategy, also improved amongst most participants (77%), especially amongst those in regular attendance. When questioned about the DPRM forum content, 95% of participants believed that it

was detailed and thorough in addressing pesticide risk management issues. This is of importance because the forum content needs to address, specific pesticide related problems areas, thereby allowing participants to apply a solutions or noteworthy suggestions in the workplace. The use of news bulletins may also contribute to the value of the discussion forum, by giving participants a comprehensive snapshot of what they could expect for each discussion. Most participants (71%) stated that they sometimes used the bulletins in the workplace, whereas 19% always referred to them and 10% rarely made use of them.

Impact of forum discussions

More than half of participants (65%) were able to obtain advice, specifically on relevant work related matters, during discussions. For example, one participant would email some members of the forum or presenters of particular topics regarding any problems. In so doing, this participant was able to find solutions based on advice from forum members and presenters. A third of participants (35%) became involved in new project opportunities as a result of the discussions and interactions that took place. According to one response, the participant was involved in implementing and strengthening the chemical conventions in Zimbabwe and was able to assist other countries in its sub-region to do the same. An unforeseen benefit of the discussion forum was the ability for some participants (10%) to find new employment opportunities through the forum.

All participants benefitted from the exchange of best practice knowledge regarding PRM-strategies. Results also indicate that 68% of participants perceived an improvement in working relationships, 37% were granted significant roles during projects, whereas as 32% were invited to speaking engagements directly related to discussion forum topics.

Contributing to policy change

An important finding was that just over half of respondents (55%) felt that they were able to contribute to policy change in their countries as a result of the discussion forum. When participants were asked if they implemented new policies as a result of the DPRM forum, 26% indicated that they had achieved this. This is an achievement since policy changes are not easily achieved.

Discussion

This study provided an understanding of the experiences of PRM professionals. To the authors' knowledge, this is the first study, which evaluated the perceptions of PRM professionals in LMICs using e-learning. Despite study limitations (see 'Limitations of study' below), there are themes which emerged. Furthermore, results show that PRM professionals perceived the online discussion forums to be effective in improving their critical understanding of pesticides. Participant engagement and feedback suggests that a deep level of learning was fostered and that the discussions served as a viable supplementary resource.

Decision-making and knowledge acquisition

Discussion forums can be a powerful tool for education and training when engaged by participants [28]. Participant engagement in the discussion forum suggests it allowed for active learning, thus acting as a complement to the core DPRM programme [26]. Moreover, active knowledge acquisition through e-learning has a place in health related professions but requires careful planning, implementation and support [33, 34]. These three elements were present in the PRM e-learning programme.

The importance of attendance has been highlighted by previous research showing that participants gain the most benefit by attending discussions regularly [21, 22]. In this study, 73% of participants indicated a perceived improvement in decision-making. This finding is consistent with other studies [21, 22, 24], which demonstrated that participants who use an e-learning platform, can improve their professional decision-making and knowledge in the short-term. It is also consistent with a previous study, showing it to be useful and effective resource to varying degrees [25]. Participant engagement in the discussion forum suggests it allowed for active learning, thus acting as a complement to the core DPRM programme [26]. In this study the perceived increase in knowledge seemed to correlate with attendance frequency in the forum discussions, where participants who attended more than 75% of the discussions found it to be more beneficial than those who did not.

The following quotes illustrate how the knowledge acquired in the forum assisted participants in making effective decisions:

"There was a project in which the counterpart left for greener pastures, so his subordinate was not aware of the project activities. Now, with my knowledge gained from the DPRM, the discussion forum enabled me to continue my work without a hitch." (Respondent Q)

"At our management meeting we allow external companies to conduct presentations… I challenged the company owner with regard to active ingredients and it was clear that the product was not as safe as the company claimed. The outcome was that the product was not considered by the municipality." (Respondent R)

From the above, it is evident that knowledge gained from the discussions assisted these participants in making valuable contributions in the workplace. Attending discussions regularly, seems to have allowed participants the opportunity to offer and find solutions to work-related matters, network with experts and peers for work purposes, which may not otherwise have been possible. Furthermore, these respondents were able to make improved decisions, implement pesticide management programmes and influence policy for the benefit improved programme outcomes. This is important as several studies have highlighted the need for health professionals to be equipped in order to address the challenges they face [5,17, 27].

Skill improvements and discussion application

The discussion forum did appear to influence the effectiveness of decision-making amongst professionals with greater work experience; particularly principal environmental health practitioners and senior crop production officers. Participants in leadership positions or those with a minimum of five years' of pesticide experience seemed to benefit the most from the forum in terms of implementing new or amending existing programmes.

It is not surprising that 77% of participants indicated an improvement in critical thinking, because this was a goal of the forum. Participants also noted an improvement in their critical understanding of pesticides as illustrated by the following respondents:

> *[The discussion forum provided] …"better understanding of pesticide uses…and…better decision-making at inspection points." (Respondent S)*

> *"It allowed me to better understand some issues and to take better decisions… and when I had to analyse one subject, I had a much better view of it." (Respondent T)*

Given the varying job positions held by participants, 55% were able to develop strategies for pesticide management based on the topics covered during the

discussion forums. Even more encouraging was that 25% improved their ability to negotiate. This perhaps indicates that this is a skill which developed with time and experience, and is associated with confidence. Therefore, negotiating should be included and evaluated in a follow-up study, with a larger group and improved qualitative analysis.

Additional forum resources

A way in which e-learning barriers can be overcome is by providing additional paper-based resources such as news bulletins summarizing discussions [5, 22]. Most respondents (77%) reported that they used the news bulletins more frequently than expected for the completion of course assignments and to share information among colleagues. These news bulletins were distributed after the DPRM forum, and contained information about the content of the discussion, resources and the current situation in the different countries represented. Participants' also reported that these bulletins were helpful during meetings when needing to reference contentious issues. Further it aided during peer-education on a specific topic, which was reported as an empowering experience. Combined with the discussion forum content, participants' indicated that they were well equipped to improve how they operated in the workplace, as reflected in the following quote:

> *[The discussion topics helped me in]…"Making informed decisions in terms of toxicological evaluation of pesticides." (Respondent Y)*

This reinforces the purpose of the virtual seminar for pesticide regulators to discuss topics that are relevant to pesticide management and find appropriate solutions [23].

DPRM forum and contextual issues

Forty-one percent of participants reported that information was easy to access. Reasons for this may be due to the participants' location (i.e. rural area) where issues such unreliable grid power and internet connectivity exist due to poor infrastructure [35]. These are issues which one can expect to be present. Therefore, a way in which e-learning barriers can be overcome is by providing additional paper-based resources [5, 22]. However, due the distance learning aspect of the DPRM programme, supplementary resources such as the new bulletins were sent electronically to forum participants prior to each discussion.

Another aspect which can influence capacity building is consistent attendance. The results of this study show that participants were more likely to attend an online forum consistently if proper infrastructure was in place, regular feedback from moderators is provided, the content and resources related to the forum are pertinent, and regular interaction with forum members occurs [29, 30]. The lack of these modalities have been a common complaint about virtual seminars in LMICs [17]. However, there were participants who did not attend regularly and still found the discussion forum useful. These were participants that had a fair amount of experience which could mean that they only attended those discussions which were of interest to them.

These were participants that had a fair amount of experience which could mean that they only attended those discussions which were of interest to them. Generally, all e-learning based discussions should inform participants of: current health and environmental research, biocides, alternative approaches, training and conferences, funding, contemporary international legislation of pesticides and pertinent United Nations conferences [31]. Results support the latter as participants reported making informed decisions and offering counter arguments in cases where they objected or differed from policy, protocol or projects [32].

Contributions to policy change

Policy change and implementation can often be a lengthy and challenging process. It is encouraging that 55% of respondents' amended existing policy, were in the process of amending policy or introduced new policies as a result of applying what they learnt in the discussion forum. What was promising was that a small number of participants were able to implement new policies as a result of participation in the forum eventhough policy work is time consuming. Based on feedback, some participants managed to develop and implement some noteworthy policies as seen in the following comments:

> *"I am implementing the Pesticides Stock Management System; a web based whole life tracking system for pesticides pioneered by FAO. I developed the Pesticide legislation using knowledge gained on the course and forum. Funded a research institution to do analysis on lead in paint. Development of a*

framework guideline for toxicological evaluation of pesticides (Respondent W -

DPRM Class 2011/2012; >10 years work experience)

"I have been trying to solve issues at operational level and was reasonably

successful. The discussion outcomes made it clear that to create sustainable

pesticide reduction systems I needed to influence on a policy level, as policies

determine operations." (Respondent X - DPRM Class 2013/2014; >10 years of

work experience)

Policy amendments and programme implementation are significant because sound

legislation is vital for improving pesticide regulations and practices [36]. This in turn

will lead to reductions in pesticides related injuries and illnesses, which is one of the

goals of PRM.

Conclusion

To the best of my knowledge, no previous studies have addressed e-learning in

relation to the environmental health concern of pesticide risk management and

decision-making in LMICs. The outcome of the DPRM forum was that participants

were empowered to make effective decisions, yet applicable to the context of their

respective countries. Respondents indicated that they were able to implement new

polices and amend existing ones as a result of attending the DPRM e-learning

program. Therefore, it would be prudent to conduct a further study to investigate the

impact of these policies and programmes, as they are directly linked to the DPRM forum.

Limitations of the study

No statistical inferences could be drawn from the data due to the small sample size. As the programme had only been in operation for four years it was not possible to determine the long-term and sustainable impact of the discussion forum in decision-making processes and policy implementation. A follow-up study with a longer time horizon should be carried out to determine whether the impact of the discussions continue to be found beyond the time period of this study.

Competing interests

No competing interests.

statistical analysis. The author also wishes to thank Lyndsey Petro, Lydia Searle and Mieke Willems for reviewing and editing drafts, and for providing insightful comments.

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PART D: APPENDICES

APPENDIX 1. Consent Form

My name is Kenin Richard Stuurman. I am Masters of Public Health student at the University of Cape Town. The purpose of this research project is to evaluate the impact e-learning on professionals and students. This research project is conducted under the direction my supervisor, Associate Professor Hanna-Andrea Rother, Program Head of Health Risk Management of UCT. You are invited to participate in this research project because you are or were registered for the Post Graduate Diploma in Pesticide Risk Management programme at UCT.

Your participation in this research study is voluntary. You may withdraw at any time and you will not be penalized. There are no identified risks or discomforts if you decide to participate. The benefits of participating are that the forum will be improved in terms of delivery of industry leading discussions and resources. Participation involves completing an online survey that will take approximately 30 minutes. Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address. The survey questions will be about your experience using the forum, applying and the knowledge you gained to your work. All data is stored in a password protected electronic format. The data will be used to assess the effectiveness of the pesticide discussion forum as an E-learning tool.

Once the study concludes all findings will be disseminated by thesis and journal publications. If you have any questions about the research study, please contact me at +27 21 903 5562 or alternatively at +27 74 132 0536. This research has been reviewed according to UCT ethics procedures for research involving human subjects.

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

• you have read all the above information

• you voluntarily agree to participate

• you are at least 18 years of age

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

APPENDIX 2. Study questionnaire

Biographical Details

1. What is your gender?

• Male

• Female

2. What country are you from?

3. What is your age range?

• 18 - 25

• 26 – 35

• 36 – 45

• 46 – 55

• 56 – 65

• 66+

Employment History

4. What kind of organization do you work for? Academic, government, IGO, NGO, consultant, etc.

• Academic

• Governmental

• International

• NGO

- Private company

- Consultant

- Other

5. What is your current job title?

6. How long have you worked in this position?

- < 1 year

- 1 - 3 years

- 3 - 5 years

- 5 - 7 years

- 7 -10 years

- 10 years

DPRM Enrolment

7. How long have you been a discussion forum member?

8. Which DPRM programme year are/were you a part of?

- 2011/12

- 2012/13

- 2013/14

9. Would you have been able to do this programme if it was not E-learning based? Please explain why or why not.

10. What do you think of the bi-monthly pesticide discussion as a learning tool? For example: using the information in the bi-monthly pesticide discussion forum to make informed decisions; sharing information with colleagues to assist them in their decision making.

Forum Participation

11. Rate the percentage of attendance in the bi-monthly pesticide discussion forum while you were a student?

•   Never attended

•   < 25%

•   25 – 49%

•   50 – 75%

•   76 – 95%

•   96 – 100%

12. How has your participation in forum discussions improved the way you engage in situations at your job?

•   No contribution

•   Making valuable contributions in meetings

•   Creating a framework that will assist you in meeting your programme

        outcomes

•   Taking a leadership role in projects

•   Improved critical thinking

13. If you did not participate regularly in bi-monthly forum discussions, what were your main reasons for not doing so?

•   Work commitments

•   Time constraints

•   Inconvenient time slot

•   Fatigue

•   Work emergency

•   Personal emergency

14. What contribution(s) has the bi-monthly discussion forum made to your learning experience?

•   No contribution

•   Easy access to information

•   Greater knowledge resource

•   Cost effective

•   Networking opportunities

•   Improved professional perspective

Evaluating Forum Resources

15. Have these resources from the bi-monthly discussion forum been helpful for you in a professional environment? For example: in preparing for a formal meeting or discussion in your job.

•   Unsatisfactory

•   Inadequate

•   Adequate

- Good

- Excellent

16. How often do you apply the information from News Bulletins in your current job?

- Never

- Rarely

- Sometimes

- Always

17. In which of the following situations do you reference the information from the News Bulletins?

- No reference in any situation

- Assignments and Projects

- Policy planning

- Protocol adaptations

- Meetings and conferences

- Sharing amongst colleagues

Discussion Forum Value

18. How effective have the bi-monthly discussions been with regard to improving your critical understanding of pesticides?

- Ineffective

- Sometimes effective

- Effective

- Mostly effective

- Very effective

19. Do the bi-monthly discussions provide you with sufficient information in order to do your work better?

- Yes

- No

If yes, then please specify.

20. List three examples of how the bi-monthly discussions have contributed to solving any problems that you encountered in your job.

21. How useful were the bi-monthly discussions as a supplement for your distance learning?

- Not useful

- Sometimes useful

- Useful

- Mostly useful

- Very useful

Discussion Application

22. What percentage of topics were completely new to you?

- None

- 1 – 5%

- 6 – 20%

- 21 – 35%

- 36 – 50%

- 51 – 75%

- 76 – 100%

23. What percentage of topics were you able to apply in your job?

- None

- 1 – 5%

- 6 – 20%

- 21 – 35%

- 36 – 50%

- 51 – 75%

- 76 – 100%

24. What is the most significant lesson that you've learned during your participation in the bi-monthly discussion forum?

Networking

25. Have you networked with any of the experts on the bi-monthly discussion forum for professional reasons?

- Yes

- No

If yes, then please specify.

26. What benefits does the discussion forum provide? Please select one or more options.

•   No benefits

•   Advice on work related matters

•   New project opportunities

•   Exchange of best practice knowledge

•   New employment opportunities

27. How has the discussion forum enhanced your working relationships with colleagues and/ or stakeholders?

•   Did not enhance

•   Improved working relationship

•   Invitation to speaking engagements

•   Greater responsibility during projects

•   Increased funding

Skill Enhancement

28. Please provide an example of where you overcame a problem using the information from the bi-monthly discussion forum.

29. Which skills have improved since you started participating in the pesticide discussion forum?

•   None

•   Portfolio management

- Critical thinking

- Developing strategies

- Communication

- Negotiating

- Implementing programme goals

30. Did you implement any programmes as a result of what you learned in the discussion forums (e.g. new policies, regulations, community intervention, inspection)?

- Yes

- No

If yes, briefly provide an example.

Policy and Protocol

31. Have you been able to change current public health and/ or environmental policies in your job for the better?

- Yes

- No

If yes, then please specify.

32. Have you been able to implement new public health and/or environmental policies in your job?

- Yes

- No

If yes, then please specify.

33. Which topic(s) from the bi-monthly discussions enabled you to give practical advice to a colleague or fellow professional regarding a policy or protocol?

APPENDIX 3. Letter of approval from Research Ethic Committee

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences

Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6338 • Facsimile [021] 406 6411
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/research/humanethics/forms

09 December 2013

HREC REF: 636/2013

A/Prof A Rother
Public Health and Family Medicine
Falmouth Building

Dear A/Prof Rother

PROJECT TITLE: ASSESING THE IMPACT OF THE UNIVERSITY OF CAPE TOWN'S E-LEARNING ON THE DECISION MAKING PROCESS OF HEALTH PROFESSIONALS WORKING IN PESTICIDE RISK MANAGEMENT

Thank you for your letter to the Faculty of Health Sciences Human Research Ethics Committee dated 26th November 2013.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study. We acknowledge that the student Mr Kevin Stuurman is also involved on this project.

Approval is granted for one year until the 30th December 2014

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period. (Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC reference no in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical
Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.
The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

APPENDIX 4. Human Resources for Health instructions to authors

Source: http://www.human-resources-health.com/authors/instructions/research

Submission process

Manuscripts must be submitted by one of the authors of the manuscript, and should not be submitted by anyone on their behalf. The submitting author takes responsibility for the article during submission and peer review.

Please note that Human Resources for Health levies an article-processing charge on all accepted Research Articles; if the submitting author's institution is a BioMed Central member the cost of the article-processing charge may be covered by the membership (see About page for detail). Please note that the membership is only automatically recognised on submission if the submitting author is based at the member institution.

To facilitate rapid publication and to minimize administrative costs, Human Resources for Health prefers online submission.

Files can be submitted as a batch, or one by one. The submission process can be interrupted at any time; when users return to the site, they can carry on where they left off.

See below for examples of word processor and graphics file formats that can be accepted for the main manuscript document by the online submission system. Additional files of any type, such as movies, animations, or original data files, can also be submitted as part of the manuscript.

During submission you will be asked to provide a cover letter. Use this to explain why your manuscript should be published in the journal, to elaborate on any issues relating to our editorial policies in the 'About Human Resources for Health' page, and to declare any potential competing interests.

Assistance with the process of manuscript preparation and submission is available from BioMed Central customer support team.

We also provide a collection of links to useful tools and resources for scientific authors on our Useful Tools page.

File formats

The following word processor file formats are acceptable for the main manuscript document:

- Microsoft word (DOC, DOCX)

- Rich text format (RTF)

- Portable document format (PDF)

- TeX/LaTeX (use BioMed Central's TeX template)

- DeVice Independent format (DVI)

TeX/LaTeX users: Please use BioMed Central's TeX template and BibTeX stylefile if you use TeX format. During the TeX submission process, please submit your TeX file as the main manuscript file and your bib/bbl file as a dependent file. Please also convert your TeX file into a PDF and submit this PDF as an additional file with the name 'Reference PDF'. This PDF will be used by internal staff as a reference point to check the layout of the article as the author intended. Please also note that all figures must be coded at the end of the TeX file and not inline.

If you have used another template for your manuscript, or if you do not wish to use BibTeX, then please submit your manuscript as a DVI file. We do not recommend converting to RTF.

For all TeX submissions, all relevant editable source must be submitted during the submission process. Failing to submit these source files will cause unnecessary delays in the publication procedures.

Preparing main manuscript text

General guidelines of the journal's style and language are given below.

Length of article

Reviews should be approximately 3000 words.

Overview of manuscript sections for Reviews

Manuscripts for Research Articles submitted to Human Resources for Health should be divided into the following sections (in this order):

- Title page

- Abstract

- Keywords

- Introduction

- Review

- Conclusions

- List of abbreviations used (if any)

- Competing interests

- Authors' contributions

- Authors' information

- Acknowledgements

- Endnotes

- References

- Illustrations and figures (if any)

- Tables and captions (if any)

- Preparing additional files

The Accession Numbers of any nucleic acid sequences, protein sequences or atomic coordinates cited in the manuscript should be provided, in square brackets and include the corresponding database name; for example, [EMBL:AB026295, EMBL:AC137000, DDBJ:AE000812, GenBank:U49845, PDB:1BFM, Swiss-Prot:Q96KQ7, PIR:S66116].

The databases for which we can provide direct links are: EMBL Nucleotide Sequence Database (EMBL), DNA Data Bank of Japan (DDBJ), GenBank at the NCBI (GenBank), Protein Data Bank (PDB), Protein Information Resource (PIR) and the Swiss-Prot Protein Database (Swiss-Prot).

Title page

The title page should:

- provide the title of the article

- list the full names, institutional addresses and email addresses for all authors

- indicate the corresponding author

Please note:

- the title should include the study design, for example "A versus B in the treatment of C: a randomized controlled trial X is a risk factor for Y: a case control study"
- abbreviations within the title should be avoided
- if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the "acknowledgements" section in accordance with the instructions below. Please note that the individual names may not be included in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

Abstract

The Abstract of the manuscript should not exceed 350 words and must be structured into separate sections: Background, the context and purpose of the study; Methods, how the study was performed and statistical tests used; Results, the main findings; Conclusions, brief summary and potential implications. Please minimize the use of abbreviations and do not cite references in the abstract. Trial registration, if your research reports the results of a controlled health care intervention, please list your trial registry, along with the unique identifying number (e.g. Trial registration: Current Controlled Trials ISRCTN73824458). Please note that there should be no space between the letters and numbers of your trial registration number. We recommend manuscripts that report randomized controlled trials follow the CONSORT extension for abstracts.

Additional non-English language abstract

An additional non-English language abstract can be included within the article. The additional abstract should be placed after the official English language abstract in the submitted manuscript file and should not exceed 350 words. Please ensure you indicate the language of your abstract. In addition to English, we can support German, Spanish, French, Norwegian and Portuguese abstracts.

Keywords

Three to ten keywords representing the main content of the article.

Background

The Background section should be written in a way that is accessible to researchers without specialist knowledge in that area and must clearly state - and, if helpful, illustrate - the background to the research and its aims. Reports of clinical research should, where appropriate, include a summary of a search of the literature to indicate why this study was necessary and what it aimed to contribute to the field. The section should end with a brief statement of what is being reported in the article.

Methods

The methods section should include the design of the study, the setting, the type of participants or materials involved, a clear description of all interventions and comparisons, and the type of analysis used, including a power calculation if appropriate. Generic drug names should generally be used. When proprietary brands are used in research, include the brand names in parentheses in the Methods section.

For studies involving human participants a statement detailing ethical approval and consent should be included in the methods section. For further details of the journal's editorial policies and ethical guidelines see 'About this journal'.

For further details of the journal's data-release policy, see the policy section in 'About this journal'.

Results and discussion

The Results and discussion may be combined into a single section or presented separately. Results of statistical analysis should include, where appropriate, relative and absolute risks or risk reductions, and confidence intervals. The Results and discussion sections may also be broken into subsections with short, informative headings.

Conclusions

This should state clearly the main conclusions of the research and give a clear explanation of their importance and relevance. Summary illustrations may be included.

List of abbreviations

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations can be provided, which should precede the competing interests and authors' contributions.

Competing interests

A competing interest exists when your interpretation of data or presentation of information may be influenced by your personal or financial relationship with other people or organizations. Authors must disclose any financial competing interests; they should also reveal any non-financial competing interests that may cause them embarrassment were they to become public after the publication of the manuscript.

Authors are required to complete a declaration of competing interests. All competing interests that are declared will be listed at the end of published articles. Where an

author gives no competing interests, the listing will read 'The author(s) declare that they have no competing interests'.

When completing your declaration, please consider the following questions:

Financial competing interests

• In the past five years have you received reimbursements, fees, funding, or salary from an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? Is such an organization financing this manuscript (including the article-processing charge)? If so, please specify.

• Do you hold any stocks or shares in an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? If so, please specify.

• Do you hold or are you currently applying for any patents relating to the content of the manuscript? Have you received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript? If so, please specify.

• Do you have any other financial competing interests? If so, please specify.

Non-financial competing interests

Are there any non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript? If so, please specify.

If you are unsure as to whether you, or one your co-authors, has a competing interest please discuss it with the editorial office.

Authors' contributions

In order to give appropriate credit to each author of a paper, the individual contributions of authors to the manuscript should be specified in this section.

According to ICMJE guidelines, An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; 3) have given final approval of the version to be published; and 4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Each author should have participated sufficiently in the work to take public

responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

We suggest the following kind of format (please use initials to refer to each author's contribution): AB carried out the molecular genetic studies, participated in the sequence alignment and drafted the manuscript. JY carried out the immunoassays. MT participated in the sequence alignment. ES participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

All contributors who do not meet the criteria for authorship should be listed in an acknowledgements section. Examples of those who might be acknowledged include a person who provided purely technical help, writing assistance, or a department chair who provided only general support.

Authors' information

You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

Acknowledgements

Please acknowledge anyone who contributed towards the article by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include the source(s) of funding for each author, and for the manuscript preparation. Authors must describe the role of the funding body, if any, in the writing of the manuscript; and in the decision to submit the manuscript for publication. Please also acknowledge anyone who contributed materials essential for the study. If a language editor has made significant revision of the manuscript, we recommend that you acknowledge the editor by name, where possible.

The role of a scientific (medical) writer must be included in the acknowledgements section, including their source(s) of funding. We suggest wording such as 'We thank Jane Doe who provided medical writing services on behalf of XYZ Pharmaceuticals Ltd.'

Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section.

Endnotes

Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

References

All references, including URLs, must be numbered consecutively, in square brackets, in the order in which they are cited in the text, followed by any in tables or legends. Each reference must have an individual reference number. Please avoid excessive referencing. If automatic numbering systems are used, the reference numbers must be finalized and the bibliography must be fully formatted before submission.

Only articles, datasets, clinical trial registration records and abstracts that have been published or are in press, or are available through public e-print/preprint servers, may be cited; unpublished abstracts, unpublished data and personal communications should not be included in the reference list, but may be included in the text and referred to as "unpublished observations" or "personal communications" giving the names of the involved researchers. Obtaining permission to quote personal communications and unpublished data from the cited colleagues is the responsibility of the author. Footnotes are not allowed, but endnotes are permitted. Journal abbreviations follow Index Medicus/MEDLINE. Citations in the reference list should include all named authors, up to the first 30 before adding 'et al.'..

Any in press articles cited within the references and necessary for the reviewers' assessment of the manuscript should be made available if requested by the editorial office.

Style files are available for use with popular bibliographic management software:

- BibTeX
- EndNote style file
- Reference Manager
- Zotero

Examples of the Environmental Health reference style are shown below. Please ensure that the reference style is followed precisely; if the references are not in the correct style they may have to be retyped and carefully proofread.

All web links and URLs, including links to the authors' own websites, should be given a reference number and included in the reference list rather than within the text of the

manuscript. They should be provided in full, including both the title of the site and the URL, in the following format: The Mouse Tumor Biology Database [http://tumor.informatics.jax.org/mtbwi/index.do]. If an author or group of authors can clearly be associated with a web link, such as for weblogs, then they should be included in the reference.

Examples of the Human Resources for Health reference style

Article within a journal

Smith JJ. The world of science. Am J Sci. 1999;36:234-5.

Article within a journal (no page numbers)

Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. BMC Medicine. 2013;11:63.

Article within a journal by DOI

Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. Dig J Mol Med. 2000; doi:10.1007/s801090000086.

Article within a journal supplement

Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. Blood 1979;59 Suppl 1:26-32.

Book chapter, or an article within a book

Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. International review of cytology. London: Academic; 1980. p. 251-306.

OnlineFirst chapter in a series (without a volume designation but with a DOI)

Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. Top Curr Chem. 2007. doi:10.1007/128_2006_108.

Complete book, authored

Blenkinsopp A, Paxton P. Symptoms in the pharmacy: a guide to the management of common illness. 3rd ed. Oxford: Blackwell Science; 1998.

Online document

Doe J. Title of subordinate document. In: The dictionary of substances and their effects. Royal Society of Chemistry. 1999. http://www.rsc.org/dose/title of subordinate document. Accessed 15 Jan 1999.

Online database

Healthwise Knowledgebase. US Pharmacopeia, Rockville. 1998. http://www.healthwise.org. Accessed 21 Sept 1998.

Supplementary material/private homepage

Doe J. Title of supplementary material. 2000. http://www.privatehomepage.com. Accessed 22 Feb 2000.

University site

Doe, J: Title of preprint. http://www.uni-heidelberg.de/mydata.html (1999). Accessed 25 Dec 1999.

FTP site

Doe, J: Trivial HTTP, RFC2169. ftp://ftp.isi.edu/in-notes/rfc2169.txt (1999). Accessed 12 Nov 1999.

Organization site

ISSN International Centre: The ISSN register. http://www.issn.org (2006). Accessed 20 Feb 2007.

Dataset with persistent identifier

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (Sorghum bicolor). GigaScience Database. 2011. http://dx.doi.org/10.5524/100012.

Preparing illustrations and figures

Illustrations should be provided as separate files, not embedded in the text file. Each figure should include a single illustration and should fit on a single page in portrait format. If a figure consists of separate parts, it is important that a single composite illustration file be submitted which contains all parts of the figure. There is no charge for the use of color figures.

Please read our figure preparation guidelines for detailed instructions on maximising the quality of your figures.

Formats

The following file formats can be accepted:

- PDF (preferred format for diagrams)
- DOCX/DOC (single page only)
- PPTX/PPT (single slide only)
- EPS
- PNG (preferred format for photos or images)
- TIFF
- JPEG
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Figure legends

The legends should be included in the main manuscript text file at the end of the document, rather than being a part of the figure file. For each figure, the following information should be provided: Figure number (in sequence, using Arabic numerals - i.e. Figure 1, 2, 3 etc); short title of figure (maximum 15 words); detailed legend, up to 300 words.

Please note that it is the responsibility of the author(s) to obtain permission from the copyright holder to reproduce figures or tables that have previously been published elsewhere.

Preparing a personal cover page

If you wish to do so, you may submit an image which, in the event of publication, will be used to create a cover page for the PDF version of your article. The cover page will also display the journal logo, article title and citation details. The image may either be a figure from your manuscript or another relevant image. You must have permission from the copyright to reproduce the image. Images that do not meet our requirements will not be used.

Images must be 300dpi and 155mm square (1831 x 1831 pixels for a raster image).

Allowable formats - EPS, PDF (for line drawings), PNG, TIFF (for photographs and screen dumps), JPEG, BMP, DOC, PPT, CDX, TGF (ISIS/Draw).

Preparing tables

Each table should be numbered and cited in sequence using Arabic numerals (i.e. Table 1, 2, 3 etc.). Tables should also have a title (above the table) that summarizes the whole table; it should be no longer than 15 words. Detailed legends may then follow, but they should be concise. Tables should always be cited in text in consecutive numerical order.

Smaller tables considered to be integral to the manuscript can be pasted into the end of the document text file, in A4 portrait or landscape format. These will be typeset and displayed in the final published form of the article. Such tables should be formatted using the 'Table object' in a word processing program to ensure that columns of data are kept aligned when the file is sent electronically for review; this will not always be the case if columns are generated by simply using tabs to separate text. Columns and rows of data should be made visibly distinct by ensuring that the borders of each cell display as black lines. Commas should not be used to indicate numerical values. Color and shading may not be used; parts of the table can be highlighted using symbols or bold text, the meaning of which should be explained in a table legend. Tables should not be embedded as figures or spreadsheet files.

Larger datasets or tables too wide for a landscape page can be uploaded separately as additional files. Additional files will not be displayed in the final, laid-out PDF of the article, but a link will be provided to the files as supplied by the author.

Tabular data provided as additional files can be uploaded as an Excel spreadsheet (.xls) or comma separated values (.csv). As with all files, please use the standard file extensions.

Preparing additional files

Although Environmental Health does not restrict the length and quantity of data included in an article, we encourage authors to provide datasets, tables, movies, or other information as additional files.

Please note: All Additional files will be published along with the article. Do not include files such as patient consent forms, certificates of language editing, or revised versions of the main manuscript document with tracked changes. Such files should be sent by email to EnvironHealth@biomedcentral.com, quoting the Manuscript ID number.

Results that would otherwise be indicated as "data not shown" can and should be included as additional files. Since many weblinks and URLs rapidly become broken, Environmental Health requires that supporting data are included as additional files, or deposited in a recognized repository. Please do not link to data on a personal/departmental website. The maximum file size for additional files is 20 MB each, and files will be virus-scanned on submission.

Additional files can be in any format, and will be downloadable from the final published article as supplied by the author. We recommend CSV rather than PDF for tabular data.

Certain supported files formats are recognized and can be displayed to the user in the browser. These include most movie formats (for users with the Quicktime plugin), mini-websites prepared according to our guidelines, chemical structure files (MOL, PDB), geographic data files (KML).

If additional material is provided, please list the following information in a separate section of the manuscript text:

•   File name (e.g. Additional file 1)

•   File format including the correct file extension for example .pdf, .xls, .txt, .pptx (including name and a URL of an appropriate viewer if format is unusual)

•   Title of data

•   Description of data

Additional files should be named "Additional file 1" and so on and should be referenced explicitly by file name within the body of the article, e.g. 'An additional movie file shows this in more detail [see Additional file 1]'.

Additional file formats

Ideally, file formats for additional files should not be platform-specific, and should be viewable using free or widely available tools. The following are examples of suitable formats.

- Additional documentation

- PDF (Adode Acrobat)
- Animations
- SWF (Shockwave Flash)
- Movies
- MP4 (MPEG 4)
- MOV (Quicktime)
- Tabular data
- XLS, XLSX (Excel Spreadsheet)
- CSV (Comma separated values)

As with figure files, files should be given the standard file extensions.

Mini-websites

Small self-contained websites can be submitted as additional files, in such a way that they will be browsable from within the full text HTML version of the article. In order to do this, please follow these instructions:

1. Create a folder containing a starting file called index.html (or index.htm) in the root.

2. Put all files necessary for viewing the mini-website within the folder, or sub-folders.

3. Ensure that all links are relative (ie "images/picture.jpg" rather than "/images/picture.jpg" or "http://yourdomain.net/images/picture.jpg" or "C:\Documents and Settings\username\My Documents\mini-website\images\picture.jpg") and no link is longer than 255 characters.

4. Access the index.html file and browse around the mini-website, to ensure that the most commonly used browsers (Internet Explorer and Firefox) are able to view all parts of the mini-website without problems, it is ideal to check this on a different machine.

5. Compress the folder into a ZIP, check the file size is under 20 MB, ensure that index.html is in the root of the ZIP, and that the file has .zip extension, then submit as an additional file with your article.

Style and language

General

Currently, Human Resources for Health can only accept manuscripts written in English. Spelling should be US English or British English, but not a mixture.

There is no explicit limit on the length of articles submitted, but authors are encouraged to be concise.

Environmental Health will not edit submitted manuscripts for style or language; reviewers may advise rejection of a manuscript if it is compromised by grammatical errors. Authors are advised to write clearly and simply, and to have their article checked by colleagues before submission. In-house copyediting will be minimal. Non-native speakers of English may choose to make use of a copyediting service.

Help and advice on scientific writing

The abstract is one of the most important parts of a manuscript. For guidance, please visit our page on Writing titles and abstracts for scientific articles.

Tim Albert has produced for BioMed Central a list of tips for writing a scientific manuscript. American Scientist also provides a list of resources for science writing. For more detailed guidance on preparing a manuscript and writing in English, please visit the BioMed Central author academy.

Abbreviations

Abbreviations should be used as sparingly as possible. They should be defined when first used and a list of abbreviations can be provided following the main manuscript text.

Typography

- Please use double line spacing.

- Type the text unjustified, without hyphenating words at line breaks.

- Use hard returns only to end headings and paragraphs, not to rearrange lines.

- Capitalize only the first word, and proper nouns, in the title.

- All pages should be numbered.

- Use the Environmental Health reference format.

- Footnotes are not allowed, but endnotes are permitted.

- Please do not format the text in multiple columns.

- Greek and other special characters may be included. If you are unable to reproduce a particular special character, please type out the name of the symbol in full. Please ensure that all special characters used are embedded in the text, otherwise they will be lost during conversion to PDF.

Units

SI units should be used throughout (liter and molar are permitted, however).