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Doctors online: Learning using an internet based content management system

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ABSTRACT

The past century has seen spectacular gains in the breadth and depth of medical knowledge, but the potential of these gains has been hampered by a slow system of disseminating knowledge. Over the course of medical education numerous technologies and methods have been used to deliver continuing medical education (CME) to health care professionals (HCPs). These methods have included postal correspondence, two-way radio conferencing, video conferencing and in the last decade the Internet. The emergence of the World Wide Web (WWW) in the early 1990s, coupled with increasing computer processing power, reduced computing costs and more creative content management systems have led to more CME materials and resources going 'online'. This has in turn greatly sped up the dissemination of medical knowledge. This paper reports on a contemporary study that assessed the pedagogical and instructional design (e-pedagogy) effectiveness of online CME courses offered by one large Australasian continuing education provider.

Keywords: *Web-based learning; continuing medical education (CME); educational technology; distance learning; e-learning; World Wide Web*

INTRODUCTION

Continuing medical education (CME) for health care professionals (HCPs) is a vital requirement for practitioner development and registration (Steinman, Landefeld & Baron 2012). It is also of strategic importance for improving the health of patients and communities. Add to this, health care recipients (patients) and legislators are demanding more clinical and fiscal accountability for the type and cost of care that is provided. This necessitates HCPs to keep their knowledge of contemporary practices up-to-date (Todd & Bonnie 2011). Over the years, various learning technologies and methods have been applied to address the CME requirements of health care professionals. This has included mail correspondence courses, audio teleconferencing, face-to-face lecture style meetings, and video conferencing. The emergence and rapid growth of the World Wide Web, and Internet based content management systems have introduced new opportunities for providing CME.

Internet based technologies permit the widespread distribution of digital content to many users simultaneously anytime and anywhere. For busy HCPs the ability to study when they can or need the information is highly desirable. This convenience factor coupled with the benefits that come from using a content management system such as standardising course content and delivery, automated tracking and reporting of learners' activities lessen the administrative burden on CME providers. Moreover, internet based content management systems can be designed to include outcomes assessment to determine whether learning has occurred and direct learners to other areas for further information of clarification if needed. These advantages in learning enhancement are perhaps less well recognised but potentially more revolutionary to those related to learning delivery. For HCPs learning online offer CME providers and accreditation agencies a new paradigm based on adult learning theory, which states that adults learn by relating new learning to past experiences, by linking

learning to specific needs, and by practically applying learning to real world clinical parameters, resulting in more effective and efficient learning experiences.

The primary purpose of CME is to help keep practitioners up-to-date with content knowledge and procedures related to areas of practice. The introduction of online CME via the Internet provides opportunities to address the challenges faced by both HCPs and CME providers. For HCPs, the Internet provides an effective way to access the latest information, technology, and procedures in a place and time that is of convenience to them, and when they require it- in essence just-in-time learning. Internet based technology also offers educational providers another delivery format option to provide a service to their students. The evolution of online CME is reliant on the ongoing evaluation of the learners' needs and experiences. In effect online CME offers the potential to affect how HCPs learn, whilst improving the quality of that learning through peer-assisted learning and mass-dissemination of a shared knowledge base. To that end the purpose of this study was to evaluate both the process and outcomes of 42 online CME courses offered to HCPs in Australasia by a private industry accredited educational provider.

Medical education is not unlike other educational fields for other disciplines in that the purpose or challenge of CME lies in practitioners accessing timely and appropriate course material. This material is prepared by accredited peers and is based upon sound industry and current legislative requirements and best practice methods (Farrow, Gillgrass, Pearlstone, Torr & Pozniak 2012). This process of CME quality assurance relies on practitioner accreditation and regulatory bodies determining appropriate content and evaluative processes which courseware providers can then use to build their courses around. In Australia CME for general practitioners and physicians is regulated by the Royal Australian College of General Practitioners (RACGP) and the Royal Australian College of Physicians (RACP). Both of these bodies had approved the 42 CME courses offered by the provider utilized in this study.

The 42 CME courses examined in the study could be defined as asynchronous distance learning as the education took place at both a time and location distant to the teacher or providing institution (Phipps & Merisotis 1999). Over time there have been many evaluations of the effectiveness of distance learning programs, which concluded that effective learning can occur via distance learning (Abrami, Bernard, Bures, Borokhovski & Tamim, 2011; Banda, Franco, Simpson, Brennan, McKanry & Bragg 2012). These reports do, however, indicate that the methodological quality of such research studies are often poor, indicating that the results should be interpreted with care (Barnes, 1998, Pullen, 2012). As a result of these studies, health care professionals and continuing medical education providers are questioning the value and/or effectiveness of some forms of education, particularly in the complex world of information, communication technology supported learning (or e-learning).

RESEARCH QUESTIONS

This study was designed to provide a better understanding of HCPs' experiences learning online and to determine the effectiveness of this technology as a learning medium for CME. Therefore, this study explored two broad research questions--first to *quantify the overall effectiveness of the web-based CME instruction*. Through this question answers were sought to will learners have a positive experience; learn from the course and apply that knowledge into their clinical practice. Research question 2 sought answers to *assessing the influence of several factors (moderators) that were predicted to influence the effectiveness of the online learning event*. The moderators were particular to the courses examined and related to the pedagogical and instructional design characteristics embedded in the online courses, as

indicated in Table 1.

Table 1: *Moderator and hypothesis examined*

Moderator – description
Moderator 1 -Web-based education will be effective when feedback is provided.
Moderator 2 -Web-based education will be effective when immediate feedback is provided.
Moderator 3 - Web-based education will be effective when the course allows the learner the opportunity to apply the new knowledge to clinical or question-type responses.
Moderator 4 - Learner ability to break lesson material down into learner-managed components will be viewed favorably by the learners.
Moderator 5 - Learner opportunity to apply course content into practice has been found to be beneficial in face-to-face education and, for the purposes of this study, the opportunity to apply course content to practice or to actively learn will be positively viewed by learners.
Moderator 6 - Learner opportunity for autonomy or self-pacing of course material has been found to be beneficial in the classroom setting and this study examined whether self-pacing is beneficial to Web-based learning.

THE EDUCATIONAL PROVIDER AND CONTENT

The educational provider began delivering CME to HCPs in 1994 and in 2002 commenced offering CME courses online. The educational content delivered by this provider is divided into 25 therapeutic areas, for example nutrition, pediatrics and mental health to name just 3 areas. The 25 therapeutic areas combined provide over 150 hours of continuing accredited medical education. The provider currently has over 39,000 registered users, of which just over 8,000 were Doctors (family doctors or general practitioners), enrolled in at least one their online CME course. All courses could be considered to be asynchronous in that any direct human feedback was delayed, with interactive feedback only being available to those courses which contained multiple choice type question and answers.

MATERIALS AND METHOD

The study used both qualitative and quantitative techniques to describe and analyse learners' attitudes towards web-based instruction, from the perspective of effective instructional and pedagogical design. It also examined the interaction and instructional methods, strategies and activities associated within each web-based CME course. The research questions--methods, strategies and activities--were clustered into four major themes, three of which were centered on Kirkpatrick's (1987, 1996, 1998) multilevel assessment criteria: (Level I) *learners' reactions to learning*, (Level II) *achievement*, and (Level III) *application into practice*. The fourth area (level IV) investigated instructional design and pedagogical influences on the other three levels. The underlying objective of the study was to examine if HCPs had a positive reaction to and acquired knowledge from the web-based CME learning experience. In addition, the study sought to identify effective and efficient online pedagogical strategies which were utilized in the online course design.

Instructional effectiveness was evaluated by several criteria, including learning (cognitive) achievement (Level II), participant satisfaction with instructional courseware (Level I), retrospective self-reported performance change (Level III), and instructional transitions occurring through the use of the courseware. The following electronic quantitative evaluation

instruments and qualitative methods were used for collecting data:

1. *Demographic Profile Survey* (DPS) - collected data on demographics, computer experience, computer access, and computer usage by participants. The DPS was a subset of the *Courseware Evaluation Survey* (CES) (Level I) and survey data were tallied using descriptive statistics.

2. *Pre-test and post-test* (learner achievement --Level II) – evaluation of the pre- and post-test scores allowed for comparison of learning outcomes and were assessed using a paired t-test as an objective measure of achievement for the material.

3. *Post-learning Performance Self-Assessment Survey* (Level III) – participants self-reported if and how they had used course knowledge and materials in their clinical practice. This was a retrospective question and results were tallied using descriptive statistics. In addition 24 of the 42 examined courses used material, such as diagnostic screening tools or differential diagnostic charts, for participants to take away and use with their patients in the clinical setting. This material was termed clinical tools. The self-reported behaviour change of participants undertaking courses which used either a course with a clinical tool or a course without a clinical tool was measured using correlation statistics.

4. *Courseware Evaluation Survey* (CES--Level I) was designed to collect information on the participants' perceptions of the quality and effectiveness of the Internet delivered course. The survey included 39 items, distributed among 8 evaluative categories that were derived from the instructional design and pedagogical characteristics of the learning site and supporting literature review. The categories included content, navigation and organisation, overall impressions, media utilisation and learning style. Each category included 1 to 18 evaluative statements, which participants were asked to rate on a Likert scale from strongly positive to strongly negative. All statements were positively worded. The survey also included one open-ended item to elicit additional comments or suggestions. The reliability of the 39 Likert type items was determined by calculating the inter-correlations (Cronbach's alpha) for those statements, refer to Table 2, which gave a mean inter-correlations value of 190.9 with an estimated Cronbach alpha reliability of 0.92. According to Nunnally[1] (1978), this was significant; therefore, the CES was considered statistically very reliable.

Table 2: *Level I inter-correlations and Cronbach alpha reliability*

RELIABILITY ANALYSIS -SCALE (ALPHA)

N of Cases = 168.0

N of Statistics for Scale	Mean	Variance	Std Dev	Variables
	190.8571	343.4645	18.5328	39

Item Means	Mean	Minimum	Maximum	Range	Max/Min	Variance
	4.8938	2.4821	5.7619	3.2798	2.3213	.7050
Item Variances	Mean	Minimum	Maximum	Range	Max/Min	Variance
	.8941	.1825	3.7565	3.5740	20.5844	.7480
Inter-item Covariances	Mean	Minimum	Maximum	Range	Max/Min	Variance
	.2082	-.2964	2.0657	2.3621	-6.9690	.0346
Inter-item Correlations	Mean	Minimum	Maximum	Range	Max/Min	Variance
	.3249	-.1298	.8936	1.0234	-6.8865	.026

Analysis of Variance

Source of Variation	Sum of Sq.	DF	Mean Square	Q	Prob.
Between People	1470.7326	167	8.8068		
Within People	8853.3333	6384	1.3868		
Between Measures	4500.6612	39	118.4385	3245.3563	.0000
Residual	4352.6722	6346	.6859		
Total	10324.0659	6551	1.5760		

Grand Mean 4.8938

Reliability Coefficients 39 items

Alpha = .9221 Standardized item alpha = .9494 SPSS V 16.0

PARTICIPANTS

Participants were all health care professionals enrolled in one of the forty-two online CME courses. The number of responses varied from survey to survey. The reason for this variance was due to the self-pace nature of the courses. Participants could complete course material over a matter of hours or over a period of several months. The results reported in this paper occurred over a 4-month period in which 168 participants completed the Level I survey, 313 participants completed the Level II survey, and 330 participants completed the Level III survey.

COURSE SELECTION AND PROGRESSION

All participants once enrolled in the course of their choosing received an emailed password to use to open and engage with the course instructions, learning objectives and content within a purpose made content management system (CMS), which interface wise was very similar to other CMS such as Blackboard. Once in the CMS participants' first task was to introduce themselves to the course facilitator and fellow participants through an online discussion board. Participants then undertook the Level II survey which was a pre-test of their subject knowledge for the course that they had enrolled in. Pre-test knowledge tests were closed question type responses in which participants chose between multiple-choice responses. Pre and post-tests were consistent within each course. Once pre-testing was completed participants were able to proceed into the course content. The learning material covered clinical theory and best practice case studies and descriptors, including treatment

and prognostic options. Each course utilized video and clinical file notes to discuss the theme area being studied. From the 42 available courses 24 used diagnostic screening and testing tools (patient survey forms; diagnostic assessment proformas/flow charts etc. that were designed to be used with or given to patients by their doctor to explain their condition and treatment option/plans) as a specific teaching component of the course. These clinical tools were designed to assist participants with the course material and best practice approaches being studied whilst online and when dealing with patients in the real-world clinical setting.

Following completion of the course participants completed a post-test of knowledge (Level II). This information was then used in conjunction with the pre-test scores to provide a comparison of learning outcomes, or learning that was derived from the course. Following completion of the post-test participants completed a course evaluation survey (CES Level I) which asked them to comment from strongly agree to strongly disagree on 8 categories which ranged from instructional design characteristics through to course content and learning material. Incorporated in the CES were questions that asked the participants if and how they had used the knowledge gained from the course and clinical tools, for the 24 courses that incorporated such tools, in their professional clinical practice. This information was used to address the evaluation Level III criteria of application of knowledge and bahaviour changes into practice. Data obtained from this component of the survey were reported descriptively.

RESULTS

A timed convenience sample of responses was chosen from the CME provider, which provided online continuing medical education courses. The timed convenience sample occurred over a period of 4 months. During this period, 1428 pre-tests were undertaken, which represented 789 individual users, as some participants could and were enrolled in more than one course at the same time. During the same time period, 703 post-tests were completed, representing 330 individual users. From the initial 789 individual pre-test participants, 40% (n = 313) completed both the pre-test and post-test (Level II). The Level I participant satisfaction survey was completed by 51% (n = 168 of the individual 330 participants) of individual post-test participants. The Level III survey was completed by 100% of the individual post-test participants (n = 330). As previously indicated, the participants could choose to complete the course at their own pace, and this extended to the survey tools which could be completed at the key learning course milestones or during their next logged-on session. All the survey tools, apart from the Level I course evaluation survey, were required to be completed before the participant could progress--to the next learning area.

The first research question was to quantify the effectiveness of the web-based CME courses from the perspective and achievement of the learners. This objective was concerned with ascertaining whether students enrolled in the online educational environment acquired knowledge (Level II), applied that course knowledge into their professional practice (Level III) and, in general, quantified their reactions to studying in an online environment (Level I). Whilst the evaluation criteria levels go in numerical order from Level I through to Level III, the surveys were not implemented in that order and so will not be discussed in numerical order. Instead, they will be discussed in the order the participants encountered them in their courses.

Learner achievement (Level II) data revealed whether *learners enrolled in the web-based CME courses acquired the knowledge disseminated through the educational experience (Level II).* Table 3 shows pre- and post-test differences indicating that on average participants scored significantly higher on the post-tests. Upon completion of the post-tests, participants were asked to complete the CES (Level I); DPS and Level III application of

content and material into practice – as measured by self-reported behaviour and practice changes following the studying of the course.

Table 3: *Summary of means for pre-and post-course test of knowledge*

Learning module	Pre-test mean	*SD*	Post-test mean	*SD*	*t*-test	*p*
n = 42	78.5	18.8	94.5	8.6	-5.2	< 0.0005

Application of knowledge and behaviour change into practice (Level III)

Answers to the questions about self-reported behaviour or practice change together with self-reported clinical assessment tool use, for those courses that incorporated the use of a clinical tool (*n* = 24) were asked of participants following completion of the course, this is presented in Table 4.

Table 4: *Practice behavior change with and without tool use*

Behaviour % (n=303)	**Practice unchanged**	**Confirmed practice**	**Reviewed practice**	**Modified or changed practice**
Learning module Total	*3%*	*28%*	*39%*	*30%*
Without tool (n=18)	5%	34%	36%	25%
With tool (n=24)	2%	24%	39%	33%
Reasons for and against tool use in practice	**Not interested/helpful**	**Maybe use**	**Probably use**	**Definitely use or are using**
	3%	4%	37%	56%

An examination of the correlation between behaviour responses and tool usage was investigated using Pearson product–moment correlation coefficient. A preliminary analysis was performed to ensure that no violation of the assumptions of normality, linearity and homoscedasticity etcetera occurred. Findings revealed a Pearson correlation of 0.750 at the 0.01 level of significance, indicating that learning did occur from the commencement of the course to the completion of the course. Furthermore, as shown in Table 4, those courses which utilised a clinical or diagnostic tool as a key component of the learning within the course achieved a higher level of behavioural modification as compared to courses that did not utilise a clinical tool. Further validation of the association between behaviour change and courses which used a clinical tool were obtained from examining the statistical significance of the difference between the two correlation coefficients, behaviour change and tool usage, subsequent Z_{obs}^2 analysis revealed a Z_{obs} value of 3.8 which indicated that those courses that utilised a clinical tool as component of the course learning achieved better results, or changes in participant behaviour, than those courses which did not utilise a tool.

Learner satisfaction (Level I) and Demographic Profile Survey (DPS)

A post-course, demographic survey (conducted at the completion of the course at the request of the provider) and a learner satisfaction survey were used to investigate research question 1--*quantify the overall effectiveness of the web-based CME instruction*. The

demographic characteristics, as reported in Figures 1 and 2 indicate that participants were evenly distributed between age, gender and self-reported IT skills, with general practitioners (family doctors) being the largest group of users.

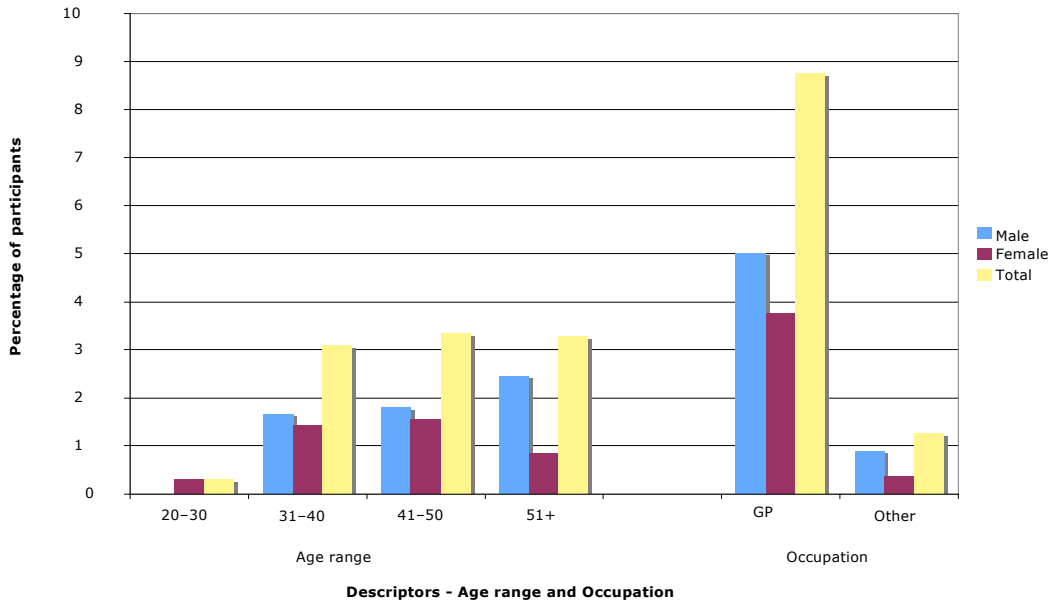

Figure 1: *Demographic characteristics of participants*

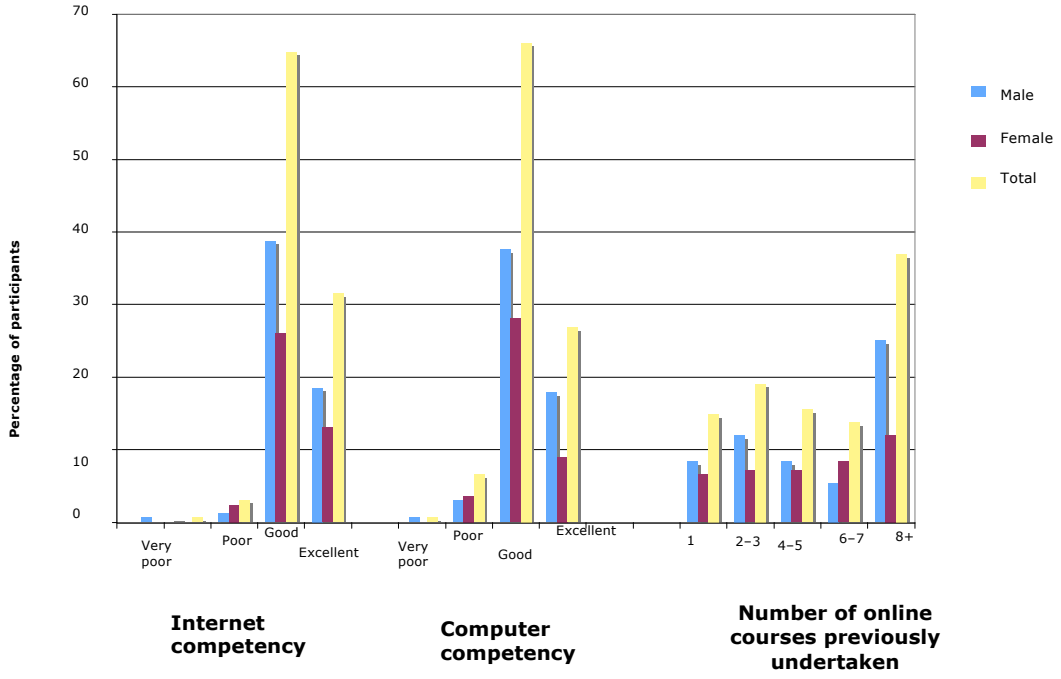

Figure 2: *Self-reported information technology proficiency and previous online CME experience*

In relation to participant satisfaction experiences with the courses studied 87% of participants agreed with positive statements regarding the instructional design--course structure (descriptive categories 1,3,5-7 in Table 5)—and learning effectiveness--content (95%, descriptive category 2) and supporting a problem based learning style (73%)—of the courses examined. Participants general experience with online CME, are shown in Table 5 indicates that overall participants felt engaged with the CMS and that they could learn using this medium.

Table 5: *Level I Course Evaluation Survey (CES) – percentage of participants strongly agreeing or agreeing with issues relating to the 8 descriptive categories and 39 Likert type responses*

Descriptor	Percentage of participants strongly agreeing/agreeing[3]
1. Course structure –	**96**
* Objectives clear	93
* Organisation clear/appropriate	99
2. Content –	**95**
* Content appropriate to my profession	99
* Relevant to my practice	97
* Based on Problem Based Learning (PBL)	96
* Builds on my current knowledge level	94
* Builds on my experience level	90
3. Graphics/media –	**76**
* Purposeful	66
* Appealing presentation	79
* Well organised	84
4. Medium –	
* Most effective	Text 75
* Least effective	Hyperlinks 49
5. Instructional design –	**91**
* Rate of course progression appropriate	97
* Pacing – allowed me to progress at own pace	96
* Interactivity of material appropriate	82
* Organisation of material appropriate	92
* Easy navigation through site/material	95
* Purposeful design	83
6. Home page -	**97**
* Organisation well designed	98
* Instructions easy to follow	96
7. Impressions –	**73**
* Future participation	100
* Effective way of learning	97
* Appealing way to learn	92
* Favorable way of learning	97
* Easy to use	97
* Increased my confidence in using this learning medium	73
* Feedback from providers appropriate to my queries	59
* Above feedback timely	55
* Interaction with others improved the course	69
* Interaction with others was appropriate	66
* Interaction with others timely	54
* Course offered value for money	83
* More effective than face-to-face courses	54

Descriptor	**Percentage of participants strongly agreeing/agreeing**[3]
* Very usable format for learning * Course layout appealing * Course content of high academic standard * Learning objectives appropriate	65 54 61 56
8. Learning style supported The course made me adopt a: * Problem based learning style * Strategic learning style * Surface learning style * Would you choose to learn online again?	 73 24 3 **100 Yes**

FINDINGS

Most of the participants (85%) in this study had undertaken an online CME course prior to undertaking the current one. Over 96% of the participants reported that their Internet skills were good to excellent and that the majority (93%) had good to excellent computer skills. This finding may support the assumption that having previous good experiences learning online supports future studies online; it may also indicate a preference for those with good computer skills to enroll in courses which utilize this technology.

Health care professionals in this study did learn from this educational format as indicated by pre and post test scores. Additionally, the vast majority (95% - as indicated by descriptive category 2 findings) agreed that their knowledge of the course area increased. The course material was useful and applicable to their clinical practice, and was conducive to higher order learning (73% indicated the online course supported their adoption of a problem based learning style). In addition, courses that incorporated a clinical or diagnostic tool as key component of their online learning program increased participants practice changes more so than those courses which did not utilize a similar learning tool (Z_{obs} value of 3.8). This indicates that the use of such clinical and diagnostic tools improves the learners' ability to learn and apply that new knowledge to their clinical practice. In relation to the moderators and their anticipated effect on participant learning the study found that all six moderators were supportive of student learning, as shown in Table 6.

Table 6: *Instructional and pedagogical design influences on student learning and satisfaction*

Moderator – description	**% of participants Strongly agreeing / Agreeing with moderator (n=168)**
Moderator 1 -Web-based education will be effective when feedback is provided.	74%
Moderator 2 -Web-based education will be effective when immediate feedback is provided.	95%
Moderator 3 - Web-based education will be effective when the course allows the learner the opportunity to apply the new	99%

knowledge to clinical or question-type responses.	
Moderator 4 - Learner ability to break lesson material down into learner-managed components will be viewed favorably by the learners.	97%
Moderator 5 - Learner opportunity to apply course content into practice has been found to be beneficial in face-to-face education and, for the purposes of this study, the opportunity to apply course content to practice or to actively learn will be positively viewed by learners.	97%
Moderator 6 - Learner opportunity for autonomy or self-pacing of course material has been found to be beneficial in the classroom setting and this study examined whether self-pacing is beneficial to Web-based learning.	96%

These findings were consistent across all 42 courses examined in this study. The continuing medical education provider utilised the same instructional design and delivery methodology across all of its courses offering participants consistency of approach but also a sense of familiarity for those who had previously studied with this provider. Such an approach ensured that instructional design and pedagogy were kept consistent between courses, despite their differing coverage of content or therapeutic areas. The information gained from this study is helpful, but limitations do exist which are associated with case studies and the small number of participants who undertook the courses during the data collection period. However, this study was effective in evaluating personal experiences of the study group with online CME and provides insight into helpful instructional design and online pedagogical approaches.

The development, use, and evaluation of online CME for health care professionals, and other adult learners, is essentially still in its infancy, and many options exist for future evaluation studies. The primary purpose of the current study was to assist the educational provider to ascertain how successful they have been in their instructional and pedagogical course design. To this end they have largely ensured that learners were indeed learning content knowledge through their online courses. However what was surprising is that in an online environment the use of hyperlinks within the courses was not viewed as being positive. Perhaps the inference here is that learners would prefer to have access to all of the content in one place rather than being redirected to other areas of the page or to other web pages. This finding has implications for how future courses could be constructed and taught. Whilst this evaluation study assisted the educational provider with assessing their own online courses, similar evaluations using larger, random samples would allow for greater generalizations to be made about the Internet and content management systems for online CME and learning in general.

ENDNOTES

[1] Nunnally recommended a minimum level of 0.7; reliability values range from 0 to 1, with higher values indicating greater reliability.

[2] "Behaviour (no tool)", **r**–value = **0.863** (***r*1**), "behaviour with tool" ***r***–value =**0.750** (***r*2**). Transformation of ***r*** to ***Z*** values as indicated by Cohen (1988) and McCall (1990) gives ***r*1** is ***Z*1 = 1.313**, ***r*2** is ***Z*2 = 0.973** and **n** values as ascertained were ***n*1 = 205** and ***n*2 = 306** respectively. The transformation of ***r***–values into a standard score value (***Z*** values) is done to ensure that the sampling distributions are approximately normal (Cohen, 1988; McCall, 1990). The formula then used was:

$$Z_{obs} = Z1 - Z2 / \sqrt{1/(N1 - 3) + 1/(N2 - 3)}$$

[3] The number in bold is the overall percentage of participants agreeing with the questions covered by the descriptor.

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