The effectiveness of web-based interprofessional learning modules on health professional students' behavioural intentions in relation to medication safety: A quasi-experimental study

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Abstract

Background: Safe medication practices are a key focus of the global strategy to improve patient safety. Emerging evidence demonstrates that learning experiences focusing on developing collaborative skills, such as mutual understanding of others' roles, teamwork and interprofessional communication, can enhance medication safety. However, interprofessional education for undergraduate students is limited by factors such as timetabling restrictions and curricular constraints. Web-based approaches provide the opportunity to overcome these barriers. However, currently there is little empirical evidence of the effectiveness of web-based approaches in changing the behaviour of health professional students in relation to medication safety and collaborative practice.

Aim: To examine the impact of web-based interprofessional learning modules on health professional students' behavioural intentions in relation to medication safety and teamwork.

Methods: A quasi-experimental approach was employed to evaluate the effectiveness of the learning modules, and 320 undergraduate health professions students were recruited. Students were allocated to either an experimental (n=155) or control group (n=165). Participants in the experimental group completed a multimedia web-based learning module. The purpose-designed Theory of Planned Behaviour Medication Safety Questionnaire was used to compare behavioural intentions, attitudes, subjective norms and perceived behavioural control in relation to medication safety between the control and experimental groups.

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Results: Participants in the experimental group demonstrated significantly greater intention to practice in a way that enhances medication safety and collaborative practice than those in the control group, as evidenced by higher scores on all outcomes: behavioural intention ($p<0.001$); attitude ($p<0.001$); perceived behavioural control ($p=0.107$); and subjective norm ($p=0.115$).

Conclusion: The web-based interprofessional learning modules were an effective learning strategy for developing the behavioural intentions and attitudes inherent in safe medication practices.

Keywords: attitudes, interprofessional education, health professional students, medication safety, theory of planned behaviour.

Background

Safe medication practices are a key focus of the global strategy to improve patient safety (Sears, Ross-White, & Godfrey, 2012; WHO, 2011). While most medications are administered safely, evidence suggests that as a result of medication errors, only between 4% and 21% of patients achieve optimum therapeutic benefit (Garfield, Barber, Walley, Willson, & Eliasson, 2009). Despite the various efforts to address the problem, the prevalence of medication incidents is unacceptably high. Medication related incidents remain the second most common type of incident reported in Australian hospitals (De Winter et al., 2010) with reports indicating error rates of up to 18% (Johnson, Tran, & Young, 2011). In the Australian public health system alone, medication adverse events cost approximately $6 billion dollars per year and inappropriate use of medicines $380 million (National Health and Hospitals Reform Commission, 2008). Such figures are not unique to Australia, with research undertaken by the National Health Service in the UK (Smith, 2004) and the Institute of Medicine (2007) in the US reporting similar figures. However, it is likely that the available data underestimates the magnitude of the medication errors due to the fact that many incidents are never discovered, acknowledged or reported. Emerging evidence suggests that interprofessional communication and collaborative skills, such as mutual understanding of others' roles and ability to appreciate one another's skills and contributions, can enhance medication safety practices (Courtenay, 2013; Taylor, Yuen, Hunt, & Emond, 2012). This is not surprising considering that safe, timely and efficient use of medicines is an interdependent process requiring effective interprofessional collaboration between all members of the medication team (Madegowda, Hill, & Anderson, 2007).

Ideally, communication and collaboration skills are best learned when students from various professions undertake structured and facilitated interprofessional education (IPE) experiences during clinical placements (Anderson & Thorpe, 2010; Eccles et al., 2006; Godin, Bélanger-Gravel, Eccles, & Grimshaw, 2008; Ward, 2013). However, opportunities for health professional students to experience collaborative learning in a systematic and consistent manner are limited by the constraints imposed by a lack of clinical placement availability, timetabling of placements across programs and large numbers of students (Levett-Jones & Bougeois, 2011). As a result, undergraduate education tends to be delivered mainly in an on-campus discipline-specific mode

providing limited opportunities for students to appreciate the roles and responsibilities of other health professionals (Ateah et al., 2011). This can, in turn, lead to the development of profession-specific stereotypes that might not necessarily be a reflection of the realities of contemporary medication practices.

Improvements in outcomes related to collaborative practice have been demonstrated through IPE experiences involving face-to-face methods such as case studies, workshops and seminar formats (Ateah et al., 2011; MacDonnell, Rege, Misto, Dollase, & George, 2012; Wellmon, Gilin, Knauss, & Inman Linn, 2012). However, the wide-scale integration of these approaches is constrained by the pragmatic constraints inherent in university programs, such as timetabling restrictions, rigid curriculum, balancing of student numbers and lack of physical space (Lapkin, Levett-Jones, & Gilligan, 2012). These challenges necessitate the development of alternative and innovative learning approaches in order to prepare students for their future roles in the medication team (National Medicines Safety and Quality Scoping Study Steering Committee, 2008; WHO, 2011).

Emerging evidence suggests that web-based IPE experiences can contribute to an improved understanding of professional roles and responsibilities, enhancement of students' attitudes towards one another, enhanced interprofessional communication and improved preparation for working effectively in interprofessional teams (Atack, Parker, Rocchi, Maher, & Dryden, 2009; McKee, Goodridge, Remillard, & D'Eon, 2010). Although these studies provide some evidence of attitudinal changes after online IPE interventions, they each had methodological limitations, such as small sample sizes and one group design with no control groups. It is also unclear if the reported improvements in outcomes can translate to changes in clinical behaviour.

Evaluation of the impact of educational initiatives provides information about teaching effectiveness and whether students are achieving intended learning outcomes, and it is one of the most important activities educators can undertake (Trottera, 2006). The measurement of health professional students' actual clinical behaviour remains challenging, however, making it difficult to draw accurate conclusions regarding the effectiveness of these online IPE experiences. Currently available evaluation instruments, such as the Readiness for Interprofessional Learning Scale (RILP) and the Interdisciplinary Education Perception Scale (IEPS), and available evidence of the effectiveness of IPE tend to focus on lower levels of learning outcomes on Kirkpatrick's (1967) Levels of Evaluation model. These include outcomes such as participant satisfaction, attitudes and knowledge acquisition. This study attempts to address the gap in the IPE literature by using the Theory of Planned Behaviour—Medication Safety Questionnaire (TPB-MSQ). This is an instrument designed to measure behavioural intentions as a proxy for actual changes in clinical behaviours, representing level three on Kirkpatrick's model.

Although the measurement of changes in actual clinical behaviour remains difficult, various authors have suggested that use of social psychology, cognitive, behavioural and other empirically validated theories can help understand the process of learning involved in IPE experiences (Mann et al., 2012; Reeves & Goldman, 2011; Sargeant, 2009). The theory of planned behaviour (TPB), for example, is one of the most widely

used frameworks for understanding human behaviour across behavioural and social domains, including social and cognitive psychology, advertising, marketing, healthcare and communications (Alt & Lieberman, 2010). The number of TPB citations per year in scholarly databases has increased from 22 in 1985 to 4550 in 2010 (Ajzen, 2011). The theory posits that behavioral intentions are the main determinants of behavior. Intentions are in turn determined independently by three domains: attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991). Attitudes are the positive or negative evaluations held by an individual about performing particular target behaviour (Ajzen & Fishbein, 1980). Subjective norms refer to perceptions about how others would judge a person for performing the behaviour (Casper, 2007). Perceived behavioural control refers to one's perceived ease of performing a behaviour (Ajzen, 2002).

The assumption behind the TPB is that aggregating these variables provides a valid measure of underlying behavioural disposition (Ajzen, 1991). Evidence from two systematic reviews indicates that measures of behavioural intention are a valid proxy measure for behaviour (Eccles et al., 2006; Godin et al., 2008). Examples of how the TPB has been used in healthcare include: evaluating mental health practitioners' intentions to implement new techniques (Casper, 2007), predicting and explaining university students' class attendance (White, O'Connor, & Hamilton, 2011), and evaluating health professional students' behavioural intentions in relation to infection prevention and control precautions while on clinical placements (Ward, 2012).

The study profiled in the current paper forms one component of a funded teaching and learning project that sought to develop web-based multimedia resources that were designed to engage students with interactive and authentic "patient journeys" and enhance their interprofessional skills related to safe medication practices. This paper presents the results of a quasi-experimental study that evaluated the effectiveness of the web-based resources in influencing students' intentions to behave in a way that promotes medication safety and collaborative practice, using a questionnaire that was based on the TPB framework. We hypothesised that students who viewed the module would demonstrate greater intention to practise in a way that enhances medication safety and collaborative practice than those in a control group.

Method

Study design

A quasi-experimental approach was employed to enable comparison between the control and experimental groups. The participating universities in Australia and New Zealand were divided into two groups (control or experimental) based on their geographical location. Electronic mail messages (emails) were sent to the heads of schools of the targeted universities. The email included a detailed cover letter explaining the importance of the research and an information statement with a hypertext link to the secure web-based survey. The heads of schools were asked to forward the email and accompanying documents to nursing, pharmacy and medical students in their

second year of enrolment or later. Confidentiality and anonymity of data collected were maintained throughout all phases of the study. The study was approved by the University of Newcastle Ethics Committee.

Intervention

Participants in the experimental group were asked to work through one of the web-based multimedia medication safety IPE learning modules developed for the broader project. The web-based module was based on an actual clinical scenario described in a coroner's report in which a serious clinical error occurred. The module was reviewed by key stakeholders, including nursing, pharmacy and medicine academics, clinicians, students and patient representatives. The scenario was designed to be clinically authentic and demonstrated key learning issues in relation to communication and teamwork; it also provided a stimulus for critical thinking. The module took an hour to complete and was an asynchronous, extracurricular, self-directed learning activity.

The IPE module depicted a 65-year-old male who was brought to the emergency department following a motor vehicle accident. The patient was taken to theatre and underwent internal fixation of a fractured femur. Despite guidelines to the contrary, preoperative orders did not include chemical or mechanical venous thromboembolism (VTE) prophylaxis. Although circulation observations and pneumatic calf compression were performed during surgery, no orders were given to continue this post-operatively as per evidence-based VTE guidelines (NHMRC, 2009).

The module was designed to demonstrate elements of professional communication based on a modified version of the Oxford Non-technical Skills (NOTECHS) framework (Levett-Jones, Gilligan, Lapkin, & Hoffman, 2012). A combination of digital video, audio and text was used for the module in order to provide participants with insights into how a series of communication errors that occurred between the healthcare professionals led to a serious clinical error. Demonstrations of clinical behaviours were followed by critical thinking questions asking students to reflect on how improvements in teamwork and clinical practice could promote medication safety. In this way, the modules highlighted the inextricable link between medication safety, communication and collaborative practice. Students were also provided with supporting documents, including VTE prevention guidelines, risk assessment tools and the coroner's report on which the module was based. A panel comprised of expert clinicians and academics ensured content validity and clinical authenticity of the module. The video component of the module was 15 minutes in duration, with an additional 30–45 minutes allocated for students to read the additional resources provided and to reflect on the critical thinking questions. Participants in the experimental group were required to complete the IPE module in an asynchronous, self-directed way. The TPB-MSQ then took approximately 10 minutes to complete. Participants in the control group did not receive any intervention; however, they were given access to the module once data collection was complete to ensure equity.

Data collection

Participants' behavioural intentions in relation to medication safety were measured using the Theory of Planned Behaviour Medication Safety Questionnaire (TPB-MSQ). Those in the experimental group completed the TPB-MSQ after finishing the web-based IPE module, while the control group participants completed the same questionnaire without having access to the module. The development of the TPB-MSQ was informed by guidelines for the construction of the TPB questionnaires developed by Francis et al. (2004) and the essential elements of questionnaire design and development suggested by Rattray and Jones (2007).

The TPB-MSQ consists of four scenarios and 46 items including demographic questions. The four scenarios in the questionnaire focused on behaviours related to: (1) managing medication errors, (2) open disclosure, (3) managing interruptions during prescribing and administering, and (4) person-centred care in relation to educating patients about their medications. For each scenario, up to four items assess each of the following domains: attitudes, behavioural control and subjective norms in relation to medication safety and collaborative practice, and a single item measures behavioural intention in relation to that scenario. In total, 4 items measured behavioural intentions; 16 measured attitudes; 14 measured perceived behavioural control; and 12 measured subjective norms in relation to medication safety and collaborative practice. Initial testing of the entire TPB-MSQ with a sub-sample of nursing, medicine and pharmacy undergraduate students revealed a Cronbach's alpha of 0.854. The reliability of the subscales within the TPB-MSQ demonstrated Cronbach's alpha coefficients of 0.602 for attitude, 0.761 for perceived behaviour control and 0.580 for subjective norm.

The 42 items for three variables—attitudes, perceived behavioural control and subjective norms—were scored using a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree) with higher scores indicating a stronger intention to perform the target behaviour. Overall scores for attitude, subjective norms and perceived behavioural control were obtained by calculating the mean of the individual items used to measure these three variables, each rated on 7-point unipolar scales ranging from 1 to 7. The four intention questions were scored using binary response options ("yes" or "no"), and the total number of "yes" answers was calculated to obtain the overall intention score.

Data analysis

Statistical analysis was conducted using the Statistical Package for the Social Sciences statistical software package version 20.0 for Mac OS X (SPSS Inc., Chicago, IL, USA). Demographic data relating to gender and previous IPE experience were analysed using the chi-square test. Independent t-tests were used to compare overall scores for intention, attitude, subjective norms and perceived behavioural control between the control and experimental groups. A p-value of less than 0.05 was considered statistically significant for the outcome variables.

Results

A total of 320 undergraduate health professional students from 11 universities participated in the study. Most were from nursing (89%; n=284), with smaller numbers from medicine (6%; n=16) and pharmacy (5%; n=15). Participants' demographic characteristics are summarised in Table 1. No significant differences existed in regard to gender and previous IPE experience between the groups at baseline.

Tables 2 provides details of the overall mean score and standard deviation for each item. Further analysis indicated that participants in the experimental group reported a stronger intention to practise in a way that enhances medication safety, as demonstrated by statistically significant intervention effects on the measures of intention [t (290) = -4.723, p=0.000)] and attitudes [t (290) = -4.203, p=0.000)]. The results also indicate that students in the experimental group had higher mean scores in perceived behavioural control [t (290) = -1.616, p=0.107)] and subjective norm [t (290) = -1.579, p=0.115)], although these differences were not statistically significant (Table 3). Gender and previous interprofessional education experiences did not have significant effects on any outcomes.

Table 1

Demographics of the Participants (N=320)

Demographic characteristic	Control (n=165)	Experimental (n=155)	Difference between groups
Gender			
Male	14	20	Chi-square (1) = 0.98, p=0.754
Female	96	122	
Previous IPE experience			
No	86	104	Chi-square (1) = 0.567, p=0.451

Table 2

Mean Scores for TPB-MSQ for Control and Experimental Groups

Variable	Control Mean ± SD	Experimental Mean ± SD
Scenario 1		
Intention: Item 1	0.64 ± 0.48	0.71 ± 0.46
Attitude: Item 1	4.13 ± 2.08	4.18 ± 1.89
Attitude: Item 2	4.05 ± 2.21	3.87 ± 2.09
Attitude: Item 3	6.40 ± 0.93	6.56 ± 0.84
Perceived behavioural control: Item 1	5.13 ± 1.44	5.17 ± 1.28
Subjective norm: Item 1	6.35 ± 0.88	6.43 ± 0.84
Subjective norm: Item 2	5.22 ± 1.47	5.52 ± 1.21
Perceived behavioural control: Item 2	5.06 ± 1.44	5.41 ± 1.45
Perceived behavioural control: Item 3	4.41 ± 1.69	4.46 ± 1.68

Perceived behavioural control: Item 4	4.83 ± 1.48	5.19 ± 1.32
Perceived behavioural control: Item 5	5.27 ± 1.51	5.82 ± 1.17
Perceived behavioural control: Item 6	4.95 ± 1.26	5.26 ± 1.15
Attitude: Item 4	3.81 ± 1.73	3.04 ± 1.61
Attitude: Item 5	4.83 ± 1.51	4.89 ± 1.51
Scenario 2		
Intention: Item 2	1.00 ± 0.00	0.99 ± 0.08
Attitude: Item 6	6.44 ± 0.70	6.61 ± 0.68
Attitude: Item 7	6.80 ± 0.48	6.81 ± 0.54
Attitude: Item 8	4.85 ± 1.57	5.35 ± 1.27
Subjective norm: Item 3	6.03 ± 0.95	6.03 ± 1.11
Subjective norm: Item 4	5.77 ± 1.07	5.69 ± 1.24
Subjective norm: Item 5	5.40 ± 1.41	5.66 ± 1.38
Perceived behavioural control: Item 7	6.63 ± 0.70	6.56 ± 0.76
Perceived behavioural control: Item 8	4.76 ± 1.62	4.94 ± 1.51
Perceived behavioural control: Item 9	5.00 ± 1.55	5.33 ± 1.36
Scenario 3		
Intention: Item 3	0.85 ± 0.36	0.94 ± 0.23
Attitude: Item 9	5.64 ± 1.44	5.98 ± 1.16
Attitude: Item 10	5.31 ± 1.55	5.68 ± 1.31
Attitude: Item 11	4.94 ± 1.69	5.21 ± 1.58
Attitude: Item 12	5.96 ± 1.17	6.16 ± 1.27
Subjective norm: Item 6	4.02 ± 1.78	4.53 ± 1.66
Perceived behavioural control: Item 10	5.41 ± 1.31	5.82 ± 1.12
Subjective norm: Item 7	4.53 ± 1.73	4.89 ± 1.54
Subjective norm: Item 8	5.12 ± 1.43	5.37 ± 1.24
Subjective norm: Item 9	4.85 ± 1.75	5.23 ± 1.46
Perceived behavioural control: Item 11	5.43 ± 1.49	5.83 ± 1.23
Perceived behavioural control: Item 12	5.45 ± 1.27	5.64 ± 1.26
Scenario 4		
Intention: Item 4	0.92 ± 0.33	0.93 ± 0.26
Attitude: Item 13	6.39 ± 0.82	6.62 ± 0.68
Attitude: Item 14	3.79 ± 1.96	4.23 ± 1.73
Attitude: Item 15	5.74 ± 1.18	5.83 ± 1.11
Attitude: Item 16	5.15 ± 1.64	5.40 ± 1.39
Subjective norm: Item 10	5.78 ± 1.42	6.13 ± 1.03
Subjective norm: Item 11	5.73 ± 1.05	5.91 ± 0.96
Subjective norm: Item 12	4.59 ± 1.56	4.16 ± 1.55
Perceived behavioural control: Item 13	4.98 ± 1.48	3.82 ± 1.49
Perceived behavioural control: Item 14	4.78 ± 1.70	4.80 ± 1.60

Table 3

Effects of Module on TPB Variables

Variable	Control (N=144) (Mean ± SD)	Experimental (N=148) (Mean ± SD)	t-test for equality of means		
			t	df	Sig. (2-tailed)
Intention	2.93 ± 1.15	3.47 ± .77	-4.72	290	0.00
Attitude	5.27 ± .61	5.55 ± .51	-4.20	290	0.00
Perceived behavioural control	5.12 ± .73	5.25 ± .67	-1.62	290	0.11 (NS)
Subjective norm	5.36 ± .64	5.48 ± .63	-1.58	290	0.12 (NS)

Discussion

The TPB-MSQ was designed to evaluate underlying behavioural, normative and control beliefs that are known to impact on behavioural intentions related to medication safety and collaborative practice. The findings demonstrate that the web-based interprofessional learning module had a positive impact on participants' behavioural intentions, with participants in the experimental group having a stronger intention to behave in a way that enhances medication safety after undertaking the module.

The higher mean behavioural intention scores for the students in the experimental group imply that these students were more likely to practise in a way that enhances medication safety than those in the control group. The experimental group participants also demonstrated positive attitudes towards the target behaviour, as demonstrated by higher mean attitude scores after exposure to the learning module. Participants who completed the module had higher subjective norm scores, reflecting greater social pressure from other health professionals, patients and patients' families to practise in a way that enhances medication safety. Lastly, the higher mean perceived behavioural control scores for participants in the experimental group indicated that, overall, these participants perceived that they have the capability and skills required for practising in a way that enhances medication safety after undertaking the module.

The results of this study are consistent with previously reported improvements in students' attitudes towards interprofessional collaboration after exposure to IPE experiences (Barr, 2009; Lapkin, Levett-Jones, & Gilligan, 2013). However, the present study has gone somewhat further than the majority of studies that mainly evaluated students' attitudes towards interprofessional collaboration. The TPB-MSQ was designed to evaluate the impact of educational interventions on the behavioural intentions of health professional students. According to the TPB, the more favourable the attitude and the subjective norm, and the greater the perceived control, the stronger the person's intention to perform the behaviour in question should be. The results, therefore, provide evidence of positive behavioural intentions in relation to medication safety and collaborative practice after exposure to a web-based interprofessional learning module.

Implications for education

This study has demonstrated that positive changes in behavioural intentions can be obtained when using web-based IPE experiences. Web-based experiences provide new platforms for teaching and learning through interactive processes that can overcome many of the barriers to face-to-face IPE. They also have the potential to be delivered asynchronously to large student numbers at different locations thus presenting a cost-effective intervention (West, 2012). In addition, web-based interventions provide an opportunity for data collection to occur as part of the educational process. Such self-report approaches are convenient, economical, simple to administer and can reach a significant number of participants. More importantly, web-based IPE can provide health professional students with opportunities to learn from and about each other even when they do not have the opportunity to learn with students from other health professions.

Implications for research

While we evaluated the effectiveness of web-based interprofessional learning modules by assessing behavioural intentions immediately following the intervention, a longitudinal study examining the relationship between the variables over time would be valuable. By conducting such a study, researchers could attain rich and meaningful data and further validate the utility of the TPB in examining health professional students' behavioural intentions in relation to medication safety and collaborative practice.

Limitations

Whilst relying on the best currently available evidence, the premise that positive change in behavioural intention will result in improved clinical behaviour in relation to medication safety cannot be fully supported solely on the basis of this study. Further research is required in this area. Direct observation of participants' clinical behaviour, although more complex, expensive and impractical in many clinical settings, would more fully explore the transferability of IPE outcomes into clinical practice. Longitudinal studies examining the relationship between behavioural intentions and actual clinical behaviours would therefore be valuable in order to substantiate the effectiveness of web-based IPE experiences.

There are additional limitations in this research that warrant further discussion. Firstly, a convenience sampling method was used, and the majority of the participants were nursing students. Therefore, the ability to generalise to other health professionals involved in the medication process is limited. Another limitation is the potential for selection bias associated with the use of convenience samples. In addition, completion of the learning modules and questionnaire was voluntary, and it is possible that the opinions reported may not be representative of all health professional students. However, this research attempted to minimise selection bias by recruiting participants from multiple universities and different professions. Lastly, the study findings may also be limited by the use of self-report, though this was minimised through the anonymity of responses.

Conclusion

Despite the limitations outlined above, the study results have demonstrated that the innovative and cost effective web-based modules developed as an intervention did achieve significant changes in health professional students' intentions to practise in a way that enhances medication safety by increasing behavioural intentions, attitudes, behavioural control and perceived control belief. The TPB posits that intention, as the immediate antecedent of behaviour, can act as a proxy to measuring actual behaviour. Our study, therefore, provides evidence that an online module is effective in preparing health professional students for safe medication practices and working collaboratively with other healthcare professionals in the future.

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