

Design and evaluation of Antibiotic Prophylaxis in Web-based dental continuing education course based on the constructivist

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Abstract

This study aimed at design and evaluation of web-based continuing education for physicians based on constructivist theory in Mashhad University of Medical Sciences during the summer of ۲۰۱۲. Research population included ۳۰ continuing education courses and the sample Antibiotic Prophylaxis course was randomly selected. All general dentists registering (۴۰ dentists) in the course during the summer of ۲۰۱۲. By using the table of random digits, they divided into ۲ groups each with ۲۰ ones, one as the control group and the other as the experiment group. The study method was experiment. The independent variable was the instructional design pattern based on constructivist theory and the dependent variables included satisfaction, attitude and learning rate. For estimating satisfaction and attitude, a researcher-made questionnaire was used for evaluating satisfaction. The reliability of the questionnaire was $\alpha=0.93$. Karami's (۲۰۰۷) scale with the reliability of $\alpha=0.92$ was applied for evaluating attitude. A teacher-made pre-test post-test with kuder-richardson reliability of 0.80 was used for evaluating learning rate. The validity of these questionnaires and test were confirmed by some specialists. Data was analyzed by using descriptive statistics and inferential statistics (MANOVA and ANCOVA). Results showed that the participants' mean scores in all satisfaction components and all attitude components were significantly

higher in experiment group than control one. This was true in the case of learning rate. Then experiment group had more satisfaction, more positive attitude and higher learning rate than control group. It can be concluded that applying the constructivist theory for web-based learning environments in physicians' continuing education makes these environments more effective due to its compatibility with the constructivist principles.

Keywords: educational design– Web based learning – constructivist theory – physicians' continuing education

Introduction

Increasing development of Information & Communication Technology (ICT) in ۳rd millennium has created many challenges for organizations. In order to dealing efficiently with these challenges, effective management of human resource development considered as one of the most important factors in competitive market (Majumder, ۲۰۱۲). Staffs needs learning new things continually and there are always demands for consistent learning (Westley, ۲۰۰۵). One of the best ways for increasing chance of learning in current era is application of modern methods of distance teaching such as electronic & web-based learning. Electronic learning includes variety of electronic media such as multimedia, virtual classes, interactive television, video and web-based conferences. This study focused on web-based learning with a subset of e-learning. Web-based learning with internet is applied in order to increase learning and some of experts applied this kind of learning with computer aided learning or online learning (Wolbrink & Burns, ۲۰۱۱). Internet and World Wide Web have presented flexible, easy & interactive learning for learners and Physician's continual education is also one of these learning methods application advocates. A lot of physicians use internet in order to search medical information and one of the reasons for the application of internet among physicians is their need to extensive amount of complicated information (Curran & Fleet L, ۲۰۰۵). Another reason based on the studies is because of accelerated increasing of patients' problems & questions, and that's why, one of the main physicians' challenges is to access to the right information in low time responding to their patients' increasing questions (Barnes, ۱۹۹۸, Peterson et al, ۱۹۹۹). Physicians' continuing teaching based on the web is presented in different formats on website including reading, listening to learning materials & combination of these ways, and sometimes implemented with an attractive exam. Important problem is that learning design should be such that learning became easy & effective, high quality could provide professional web-based learning opportunities and physicians' could have new options for access to the best medical learning programs (Sikorski & Peters, ۱۹۹۸). Nowadays, web-based learning should resolve daily problems of medical services in an appropriate time & learning method (pelayo et al, ۲۰۰۱; Havens, Furuya & Tan, ۲۰۰۱). Also, effectiveness problem of these learning is a concern which highlighted with increasing application of these web-based methods (Cook et al, ۲۰۱۰). For example, in research and development section of continuing education in medical university of Mashhad, after launching ۱۰ months of e-learning courses for continuing education population, only ۸۲۴ out of ۲۲۳۶۲ people participate in these courses equivalent with ۵ percent of the population. This problem indicates that there are barriers and problems which learners encounter in these courses (Ebrahimi Kooshk Mahdi & Asadi, ۲۰۱۲). One of the important factors for effective teaching in web based courses is application of appropriate educational design pattern based on

learning theories. According to this, Almala (۲۰۰۵), Koohang et al (۲۰۰۹), Reigeluth (۱۹۸۳), Moallem (۲۰۰۱), Morphew (۲۰۰۰) & Fardanesh (۱۳۸۷) state that learning in electronic & web-based courses occurred properly when designing these educational courses based on constructivist's learning theories emphasized on knowledge construct based on person's previous experiences. Also based on knowledge acquisition continuum delivered by Jonassen & Macalhce & Duffy (۱۹۹۳), phases for learning is depicted which leads person to novice to expert. In this theory learning steps specifies with knowledge growth. These steps include novice, advanced & specialist. They state that, since each of knowledge acquisition steps are appropriate with special kind of learning with special approach, preliminary knowledge by educational techniques based on traditional models of educational design (Behaviorism & cognitivism) is better applied rather than constructivism educational design models. On the contrary, constructivist educational environments are effective for advanced knowledge acquisition step which this level exists in most of universities. So, educating specialist persons by constructivist educational design is better performed. Educational design can be known as prescription or anticipation of optimum educational methods in order to achieve given changes in knowledge, trends and skills (Reigeluth, ۱۹۸۳). In constructivist's viewpoint which caused by postmodern epistemology, knowledge is yielded by meaning construction process in extended mind, educational design includes acquisition of learning resources & processes in order to facilitate pupils' learning which is meaning creation in their minds (Fardanesh, ۲۰۰۱; ۲۰۰۸). Researches about application of constructivism in educational design performed generally (Fardanesh, ۱۹۹۹, ۲۰۰۱, ۲۰۰۸; Ghazi Tabatabaei et al, ۲۰۰۹, Karami, ۲۰۰۸, ۲۰۱۱; Reigeluth, ۱۹۸۳) and about application of constructivism in web-based educational design (Almala, ۲۰۰۵, Jonassen, ۱۹۹۴, Koohang, ۲۰۰۹ & Morphew, ۲۰۰۰). Browsing literature by researcher shows that there is an experimental gap which is the impact of web-based continuing education design based on constructivism theory. Web-based continuing educations of physicians which is new in Iran Mashhad Medical University on the one side, importance of this educational method for physicians on the other side increased this research importance. This research is performed for the first time in Medical University of Mashhad Study & Development Center of Education. Continuing Education Office with random selection of Antibiotic Prophylaxis course in dental which was one of thirty courses of continuing education of physician in ۲۰۱۲, performed with designing & measurement of web-based course of Antibiotic Prophylaxis in dental. This research designed to exam assumptions below: "Application of constructivism theory in designing web-based course of Antibiotic Prophylaxis for physicians will cause better attitude & satisfaction of learners" and "Application of constructivism theory in designing web-based course of Antibiotic Prophylaxis for physicians better learning of learners". Current research results help these course policymakers & programmers for decision making & programming, next programs become more effective accordingly.

Research Method

This research is applied by purpose and is experimental by research method and pretest- posttest is used for evidence group (Pic. ۱).



Picture ۱: Research design

Research population include ۳۰ courses of virtual continuing education in ۲۰۱۲ summer which one of them called "Antibiotic Prophylaxis course for dental" from continuing education system of Medical University of Mashhad is selected randomly as sample for society under continuing education for designing based on constructivism theory & effectiveness measurement. In predefined period of time,

۴۰ people registered in this course which divided into two groups (experiment & control) contained ۲۰ people with random table of numbers.

Effectiveness measurement performed with learning amount, attitude & satisfaction of learners of course, so data collection is used with three tools. **Amount of learning tool:** this variable measured by pretest & posttest which made with course teacher & his/her partners. Test prepared ۲۰ questions contains four options and appropriated with educational course purposes. Reliability of questionnaire counted with **kuder-richardson** method and $KR^{۲۰}$ formula equivalent to ۰,۸۰. **Attitude measurement tool:** In order to measurement of learners attitude to courses, a questionnaire prepared by Karami (۲۰۰۷) used. This questionnaire include ۳۹ questions with ۴ values close answer (from ۱ as the least to ۴ the most score) which measured learners attitude to course. This questionnaire reliability is reported in Karami (۲۰۰۷) with Chronbach's Alpha Coefficient, and this research questionnaire's reliability accounted ۰,۹۳ with Chronbach's Alpha test. **Satisfaction measurement tool:** for satisfaction measurement of learners, researcher made questionnaire is used. This questionnaire created based on research literature and with inspiration on Wang (۲۰۰۳) and Katsidis, Anastasiades & Zacharopoulos (۲۰۰۸) designed questionnaires. Designed questionnaire include ۳۹ questions with ۴ values close answer (from ۱ as the least to ۴ as the most score). First section of questionnaire include general information such as gender, work experience, kind of education document (general & special) and participation experience in web-based courses & experience of passing similar courses. Second section of questionnaire includes ۳۹ questions related to learners' satisfaction of this course. Questionnaire reliability assigned with Chronbach's Alpha test equivalent to ۰,۹۴. Validity of mentioned questionnaires assigned with application of ۱۰ people from Psychology, Education & Medical Sciences experts viewpoints, which most of them had activities in virtual education domain.

Educational design based on Constructivism principles

There are two main approaches in educational design: Systematic viewpoint, and Constructivism viewpoint. Systematic viewpoint assumes education as one process including input, process & output. In this approach which is based on Positivistic epistemology and, behaviorism & cognitivism, which one of the most fundamental assumptions of this viewpoint is acceptance of knowledge separately and independently out of learner's mind. Based on this viewpoint, the most important works which performed in educational design is very complete & exact analysis of education matter to its components and categorization of these components based on one of the most common categories for educational purposes & then assigning delivery of education to each purpose. Education outputs or results are defined very strictly & methods for teaching-learning activities predicted accordingly to achieve goals (results) by doing them with student. In constructivism viewpoint which is resulted from postmodern epistemology knowledge is resulted by the process of creating meaning in learner's mind, constructivism discourse is in learning & cognitivism psychology which believes that knowledge is created by person. In other word, it is the student with his/her previous experiences & knowledge interprets new position and because of interaction with environment, shapes his/her new knowledge. In first process, new information will be added to cognitive construct and in second state, cognitive construct changes in order to absorb new information. Piaget is known as the father of constructivism (Fardanesh, ۲۰۰۱; ۲۰۰۸). Karagiorgi & Symeou (۲۰۰۵), state that application of constructivism in educational design has specific benefits such as meaningful learning, problem solving ability, more flexibility in both educational design & activity, so, learner would be able to select an appropriate path with his/her situation. One of designer's duties is to create rich ground which could be meaningful by negotiations.

Learners interpret information in the field of their experiences. Their interpretation whatever is an individualistic path. Educational material is designed objectively for learning by teacher. Learners will interpret them in their experiences and knowledge format and tailored with their need, fields and personal interest to make special meaning. Evaluating constructive learning activities is evaluating based on learning efficiency. It is necessary that evaluators emphasis on learning efficiencies. Constructive learning of environmental efficiencies should meet high level thinking like Gane cognitive strategic level & Bloum cognitive field combination level. Principle criteria for measuring

each of efficiencies in knowledge construct, innovation & originality. There are also different models in constructivism (such as participatory learning, learning based on project or problem) but all of these following concepts is used as a pivot in educational design:

- Learning is stemmed in a rich problem solving environment;
- Original versus academic beds is provided for learning;
- Considerations for controlling learning dispose to learners;
- Errors like a mechanism is used for providing feedback in pervasive understanding;
- Learning is stemmed in social experiences (Karami, ۲۰۱۰).

In order to designing course, ten basic constructive environment design elements extracted from this field experts with literature review. According to experts such as Khan (۲۰۰۵), educational course design should be designed by an expert team including content specialists, virtual education system manager, computer engineer and education expert. So, team working with design team with mentioned members' existence established and for each of elements considered an activity (Tab. ۱)

Table ۱. Antibiotic Prophylaxis course design based on constructive elements

Constructive theory elements	Application of elements in educational design
Basic Problem	Content designed based on problems related to course purposes with expert help. Problems included in a fictional text with picture and voice for attractiveness. Real problems are designed with application of action & scientific experience in dental. With application of fictional text, a theme which problem is occurred in it is described completely
Emphasis on previous knowledge	Content designed with expert help with learners' previous knowledge. In order to calling preliminary knowledge in advance, a set of slides including basic content delivered to learners.
Application of Original assignments	In course content of assignments which derivate form a real environment with a dental clinic, tried to regard this principle, It means that items questioned from learners that in a real work environment will be encountered. With real examples helped to simulation of environment & facilitating learning. Tried to put learners in a position that is unique for learning experience to dispose problems derivate from reality.
Formative Evaluation	Learner response to questions included in text in course period & at the same time receives feedback, and according to registering these results, learner could observe results to evaluate himself/herself.
Considering different viewpoints	Experts problems in such a way that learners should notice each problem in at least three different viewpoints: first, illness recognition viewpoints, second, viewpoints to patient systematic circumstances, and third, kind of needed treatment
giving ownership of learning process to learner	In according to disposal of this course completely by internet, every learner followed contents appropriate to him/her learning speed. Different resources with combination of text, voice and image for learners provided in order to create knowledge

	appropriated to their learning style.
Considering knowledge construct by learner	By disposing different information resources, search possibility of new scientific resources, online feedback clipboard, post box tool for interaction with teacher and other learners, link tool to current learners in course and interaction with them and forum tool for discussion with other learners tried to construct knowledge with these possibilities. Lack of certain response to predefined questions
Persuasion for team working & thought exchange between people	Possibility of online feedback clipboard, post box tool for interaction with teacher and other learners, forum tool for discussion with other learners and considering special score for learners that use from these interactive tools.
Including learning in real social fields	Application of original & real problem in a working life which learners encounter with them. Application of interactive tools such as online feedback, post box tool for interaction with teacher and other learners, forum tool for discussion with other learners and in order to interact with others and personal knowledge construct
Facilitating role of teacher	Application of feedback for learners which don't reach to right response including a set of guiding for learners delivered by teacher. Possibility of application of post box tool for interaction with course teacher for navigation & guidance
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In order to avoiding threatening factors for validity of research in implementation phase, a teacher out of design group educated for this purpose, and participators was also unaware of experimental action on the other side which called single blind method. In this method just teacher knew about experimental action and learners didn't know about experiment. This action will lead to least threatening factors effect (Shuttleworth, ۲۰۰۸). Experiment situations also were same for learners & teachers because each person from living or working place attended in these two courses. Then courses located in website & participants passed during two weeks for each groups.

According to this note that in this research used satisfaction & attitude dependent variables, for analyzing data & first hypothesis test MANOVA statistical method used. In order to testing second hypothesis test which pay to courses efficiency from learning amount, pretest from learners used with

ANCOVA statistical method. Pretest used as a covariate for omitting random variable effect. It should be mentioned that all of statistical operations with SPSS ۱۸ software.

Research findings

Hypothesis ۱: Application of constructive theory in designing web-based educational courses for physicians causes better attitude and satisfaction of learners.

In order to test hypothesis Levin test is used for variance equivalence which its results showed that two groups variance in all of scales for attitude, satisfaction & learning was equal, because p gained more than ۰,۰۵ so, zero hypothesis states that variances are equal confirmed.

In order to measure difference between satisfaction & attitude experiment and control groups, MANOVA is used. Wilks Lambda equal to ۰,۱۵ is significant ($F(۲, ۳۷) = ۲۸/۳۰, p = ۰/۰۰۰$). Results of MANOVA showed that there is significant difference between experiment and control groups from satisfaction & attitude variables (Tab. ۲). According to Table ۲ results which shows descriptive indicators of satisfaction & attitude, in each of both variables, means experiment group is significantly more than control group ($p < ۰,۰۰۱$).

Table ۲. Results of MANOVA test based on experiment & control groups in satisfaction & attitude

Sig.	F	MM	df		M & SD control	M & SD tests	Dependent Variables	source
۰۰۰/۰	۶۶/۳۸	۱/۹۰,۶۰	۱		۵۶/۱۵±۶۰/۱۹	۰۵/۱۵±۷۰/۱۲۱	Satisfaction	Group
۰۰۰/۰	۳۳/۴۷	۴/۸۲۹۴	۱		۶۱/۱۳±۴۵/۷۶	۸۴/۱۲±۲۵/۱۰۵	attitude	

Hypothesis ۲: Application of constructive theory in designing web-based educational courses for physicians causes better learning for learners. Descriptive statistics related to research respondents scores in Antibiotic Prophylaxis course in pretest & posttest phase is presented in table ۴.

table ۴. Descriptive indicators scores gained from pretest & posttest

most	least	M & SD	frequency	group	Phase
۱۰	۲	۴۱/۲±۶۵/۵	۲۰	test control	Pretest
۹	۰	۸۳/۲±۳۵/۵	۲۰		
۲۰	۱۳	۱۹/۲±۹۰/۱۷	۲۰	test Control	Posttest
۲۰	۱۲	۳۰/۲±۲۰/۱۶	۲۰		

As can be seen in Table ۴, mean and standard deviation of Antibiotic Prophylaxis course of experiment group members in pretests phase is similar to some extent. Two groups from Prophylaxis course in posttest phase have sensible difference with each other and experiment group members have higher scores than control group.

In order to test above hypothesis & comparison of experiment & control groups subjects scores in this phase, because of possible effect of pretest to posttest and more accurate investigation, Covariance analysis method used for posttest data analysis. F amount gained from comparison of posttest between two groups is ۵,۸۸ and Etha square is ۰,۱۴, so, with $p = ۰,۰۲$ could conclude that learning scores amount of subjects of experiment and control group after implementing independent variable which is web-based continuing education course based on constructive theory, with fixing subjects' scores before intervention implementation, there is significant difference and ۱۴% of their changes is due to participation in web-based continuing education course based on constructive theory. So, second hypothesis confirmed and according to descriptive Table ۴ with comparison of two groups' means, we

can say that learning amount in experiment group was more than control one. As expected, both hypotheses confirmed.

Conclusion

According to busy and sensitivity of physicians work and new information, questions & problems of patients, application of web-based education has been welcomed by them. Web is used as a tool and it should be used design principles & learning theories for effectiveness of this learning method. Results of these educations lead to educate people who encourage thinking & acting independently, and participate in knowledge construct proactively. They are mainly motivated from inside not by outside pressures so, web-based continuing education course based on constructive theory will have direct & indirect benefits for learners, teachers & society. This study performed with the purpose of designing & measuring web-based continuing education of physicians for Antibiotic Prophylaxis course based on constructive theory in Medical University of Mashhad.

According to research findings, both of hypotheses confirmed which means that application of constructive theory in designing web-based continuing education of physician, increases amount of satisfaction, attitude and learning of learners.

In defining learners' satisfaction from designed course, it can be said that according to literature, in educational design based on constructive principles for designing attractive learning environments interactions with quick feedback considered, learners have more satisfaction from this kind of representation accordingly. Results of this section of research is alongside with researches of Maloney et al (۲۰۱۲), Detlefs (۲۰۰۲), Brooks (۲۰۱۰), Curran et al (۲۰۱۰), Zolfaghari et al (۲۰۱۰), Chow & Sit (۲۰۰۶). They founded in similar researches which investigating constructive learning environment impact on learning consequences resulted satisfaction and motivation of learners in such learning environments is promoted significantly. This finding is also aligned with Wessa et al (۲۰۱۱) & Girvan & Savage (۲۰۱۰) which showed impact of virtual environment impact on increasing learners' satisfaction. As traditional and teacher-based education method in learning environment design changes into learner-base, learners have more satisfaction because in such an environment learners are noticed. In defining more positive attitude of experiment group rather than control group, we can say that findings of this section of research is aligned with Maloney et al (۲۰۱۲), Amanloo & Didehdar (۲۰۱۱), Sthapornnanon et al (۲۰۰۹), Jafari et al (۲۰۰۹), Karami (۲۰۰۷). In similar researches, they investigated impact of constructive learning environment on learning consequences found that learners' attitude & motivation in such learning environments promote significantly. Ghazi Tabatabaei et al (۲۰۰۹) in a research investigated three learning theories (behaviorism, cognitivism & constructivism) impact on learners attitude and stated that constructive theory cause formation of more positive attitude into educational course accordingly. In this method, learners are not concerned that they should memorize teachers' content more or less but, he/she is responsible for information resources and teacher's guidance for knowledge and it causes to learners' calmness in course period and positive attitude of learners indeed.

Researchers lik Girvan & Savage (۲۰۱۰) & Wessa et al (۲۰۱۱) stated that having active interaction & community in constructive environments leads to learners' positive attitude of course. Defining this subject is that having interaction with learners & teachers, and among learners in learning period, changes cold and abstract learning environment into attractive with discussion & expression and criticism of subjects. According to second hypothesis, learning amount in experiment was more than control group. Aligned with Girvan & Savage (۲۰۱۰) & Wessa et al (۲۰۱۱) in their research found that discussion and interaction in constructive model, pervasive try for knowledge construct cause deeper learning. Kala et al (۲۰۱۰) also found that application of web-based constructive principles in education for nurses society lead to simulation of clinical situations in real one, and students with simulated virtual environments will achieve valuable experiment in this field.

There are a lots of medical education in clinical treatments and they could not been educated actually on human kind so, application of web possibilities with constructive principles will be very effective which leads to creation of basic & real learning environments. In confirmation with researcher such as

Jafari et al (۲۰۰۹), Alonso et al (۲۰۰۹), Almala (۲۰۰۵) in their research results in medical domain gained similar results.

This finding support from knowledge acquisition continuum theory of Jonassen et al (۱۹۹۳). According to this theory, constructive learning environments are effective for advanced knowledge acquisition phase. This level have application for learners that have special knowledge and try to update, such as society under inclusion of physicians' continuing education.

Findings of this research state that successfulness of application of constructive learning environments for physicians' web-based continuing education is affective in increasing satisfaction, attitude & learning amount of learners. Constructive theory principles with application of web tools creates environment that helps to knowledge construction and deeper learning for learners. Interaction in this theory helps to increase learners' satisfaction and attitude because in interactive environment, learning changes to an attractive and amusing activity and learners enjoy from this activity. Also, simulation possibility in web environment approximate learning environment to real and original subjects, and indeed learners could better understand problem situation, especially in medical discipline which is not easy to examine try & error in real environment. Finally, application of theory principles such as constructivism could cause education more efficient and prevent from cost waste.

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