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Individual Learner Differences In Web-based Learning Environments: From Cognitive, Affective and Social-cultural Perspectives

Mustafa KOC
Ph.D Candidate

Instructional Technology
University of Illinois
at Urbana-Champaign
Urbana, IL - USA

ABSTRACT

Throughout the paper, the issues of individual differences in web-based learning, also known as online instruction, online training or distance education were examined and implications for designing distance education were discussed. Although the main purpose was to identify differences in learners' characteristics such as cognitive, affective, physiological and social factors that affect learning in a web-enhanced environment, the questions of how the web could be used to reinforce learning, what kinds of development ideas, theories and models are currently being used to design and deliver online instruction, and finally what evidence for the effectiveness of using World Wide Web (WWW) for learning and instruction has been reported, were also analyzed to extend theoretical and epistemogical understanding of web-based learning.

Keywords: **Individual differences, World Wide Web, Social-cultural Perspectives, Cognitive, Web-based learning, Web-based Learning Environments**

INTRODUCTION

Web-based learning has become an increasingly important aspect of higher education as it meets the needs of an expanding pool of nontraditional students who find education necessary for jobs in today's information age, and provides a convenient, flexible and manageable ways to the learning. Through various approaches to learning and thinking, educators and researchers are now actively engaged in attempting to understand and identify how people learn online and how this learning could be enhanced by incorporating new ideas and currently available technological tools into the instruction. Although neuroscience has provided us with an increasingly rich and accurate descriptive theory of learning within the brain, we still need theories and models of how to maximize the efficiency and capacity of human learning, especially in today's popular learning: online learning in which the learner usually works autonomously and independently of others. In this case, the consideration of learner orientations and adaptation of the environment to the learners` needs and preferences become vital in the process of designing online instructions.

Throughout this paper, I will be examining the issues of individual differences in web-based learning, also known as online instruction, online training, distance education and so on. Although the main purpose is to identify differences in learners' characteristics such as cognitive, affective, physiological, and social factors that affect learning in a web-enhanced environment, the questions of how the web could be used to reinforce learning, what kinds of development ideas, theories and models are currently being used to design and deliver

online instruction, and finally what evidence for the effectiveness of using World Wide Web (WWW) for learning and instruction has been reported, will also be analyzed to extend theoretical and epistemogical understanding of web-based learning. In order to achieve this, I refer to the body of empirical research and reviewed papers that have been conducted and published. While it is difficult to summarize all of the findings, there are three major areas of learner differences in the studies worth mentioning: a) cognitive characteristics, b) affective characteristics, and c) social-cultural characteristics.

COGNITIVE CHARACTERISTICS

Despite the differences including structure, delivery, location etc. among the learning environments, it is a well-known fact that success in any kind of learning environments is influenced by what the learner brings and contributes to the instruction. While describing a model of the effective dimensions of interactive learning on the WWW by referring Carroll's (1963) model of school learning, Reeves stresses the importance of language comprehension and learning skills as imperative variables and individual differences that may account for learning when WWW used as a vehicle. He further explains that individuals with better learning skills would be able to decrease the amount of time they require for learning, thereby, increase their aptitude for learning. Similarly, Jonassen and Grabowski (1993), in their book on individual differences in cognitive and motivational functions with respect to learning and instruction, maintained that individual differences such as locus of control, learning styles, anxiety, and tolerance for ambiguity, prior experience, interests, attitudes, and disabilities play an important role in learning.

Perhaps, the most important cognitive characteristic is the learner's preferred learning style. Although learning style theory is widely accepted among the educational theorists regarding traditional classroom environments, there is still little research on individual styles in online learning environments. Research has shown that people learn differently. They process and represent knowledge in different ways. Their performance is related to how they learn, consequently, they learn more effectively when taught with their preferred methods. Several studies diagnosing learning styles in web-based learning have been conducted to provide educators with prescriptions. Holt and Oliver (2002) conducted a case study of web-based learning in a postgraduate dental public health course. They developed two learning modules by using WebCT, a commercially available package designed for development and management of online courses. In the fist module, the information is presented in five text-based learning units including preliminary, core and supplementary reading lists followed by practical exercises. For the latter, problem-solving approach was adopted. Three postgraduate students with basic computer skills but not prior experiences of computer-based learning were selected for this study. The student who felt comfortable with the asynchronous discussion and had meticulous or methodical approach to learning learned most from web-based learning.

This may mostly because of the flexibility that the Web provides learners with a record of previous discussions and enables them to think about, analyze and respond to comments regardless of how much time has elapsed since the original posts. This characteristic of the Web is also much related to student's learning style. On the other hand, the student with an ability to think quickly and to lead group discussions had a difficult time to use his strengths in this environment, thereby, benefited much less from online instruction. Finally, the third student who needed a high degree of support was able make good progress with an additional face-to-face meetings and supports from the instructor. The result is very consistent with the one Crown (1999) found in his analysis of web-based multimedia instruction. He concluded that some students did not achieve well in the parts where "interpersonal connectivity with the instructor" was limited.

These cases show another important factor that online course developers need to consider. Using Web as the exact substitution of an instructor may not work well for every student, especially for those who need more learner-instructor type interactions. Student-teacher interaction is always an important factor in traditional learning environments (face-to-face classes) for success of the learner because of the fact that the teacher may easily determine the preferred learning style of each student by observing his/her reaction to different activities. However, this may not be accomplished easily in web-based learning. Therefore, there should be a kind of tool programmed and embedded into the instruction in order for students to find out their own learning styles. Instructional designers should also avoid applying only one type of activities; rather, employ various learning activities so that each student with a different learning style could have an opportunity to benefit as much as possible from the learning units.

There were several attempts at incorporating different learning styles into web-based instruction to enhance students` learning. The study by Carver, Howard and Lavelle (1996) is the most commonly cited in the literature. They developed an adaptive hypermedia interface that tailored the presentation of course materials based on the individual student's learning styles. Different interfaces with various learning tools (graphs, sound files, digital videos, hypertext etc.) into the course were dynamically generated based on the students` learning styles and they were allowed to navigate the environment with their own learning style. According to the authors:

> ***The underlying idea of adaptive hypermedia based on learning styles is quite simple: adapt the presentation of course material so that it is most conductive to each student learning the course material. To a certain extent, each student is taking a different course based on what material is most effective for each student. This tailoring allows for efficient and effective student learning in the shortest possible period of time. (p. 122)***

Shany and Nachmias (2000) studied the relationship between students' performance in a virtual course and students` thinking style in information and communications technology. Students with the liberal thinking style were most successful than other students in the study. Students with the external style performed better than those with the internal style, and, similarly, students whose learning style is local functioned better in the course than those whose style is global. It is suggested that virtual education can provide opportunities for different kinds of learners, though such opportunities may be greater for some kinds of learners than for others. The results also indicate that students with a liberal thinking style might well become active users of asynchronous communication channels, while students whose thinking styles are global, local, internal, or external are likely to perform well in tasks related to searching for information and integrating various pieces of information in their work.

Similar to Carver et. al. (1996), Bajraktarevic, Hall and Fullick (2003) carried out an empirical analysis of the experimental study relating to the application of learning styles in educational hypermedia and their effects on learning outcomes. They developed two different versions of same web-based courseware; one version matched the students` preferred learning styles, and the other did not. Global and sequential learning styles were incorporated into the hypermedia courseware by considering the way in which the information is formatted and structured and how individuals process the given information.

The participants of the study comprised 22 14-year-old students in the first year of geography class. Students were asked to complete a number of tasks including browsing,

reading, searching and memorizing information, and then answer a series of questions to test their recall of the supplied information. Students were much more successful when working on matched session than mismatched version. From the analysis of the study, one can also infer that students with a global learning styles prefer instructional designs in which table of contents, examples, summaries, diagrams etc. are clearly presented; since they want to see a kind of map showing what they are working on and what they are expected to accomplish at the end of the process. Sequential learners, on the contrary, prefer designs in which the whole information is organized into more manageable chunks with a text-based layout and step-by-step instructions. Moreover, Mehlenbacher, Miller, Covington, and Larsen (2000) found suggested that reflective learners who prefer personal introspection and work alone over stretches of time were more successful in Web-based instruction than active learners who prefer to process information through engagement in physical activity, through discussion, or in groups.

The literature suggests taking into account prior experience and self-regulation in order to control for learner differences, and examine the interaction of individual differences with Web-based modules in student performance. Learners who are more experienced and knowledgeable with characteristics of web-based learning may benefit more from the instruction. There is evidence that expertise is the most important factor in accounting for differences in performance with educational hypermedia (Dillon & Weston, 1996; Dillon & Gabbard, 1998). In a study by Vrasidas and McIsaac (1999), it was found that experience with the technology leaded to success in online interaction that plays an important role in ensuring student success in an online course. Shany et. al. (2000) found the similar results with regards to relationship between experience and performance. The students who completed the course most successfully (as measured by their grades) were those who had prior experience in information technology.

The amount of experience is correlated with almost all the aspects of performance that the study examined. Therefore, students who do not have enough expertise either should be helped by teaming with an experienced user or supplemented with help in using technology.

Self-regulation refers to learners' ability to understand and control their learning. Particularly, distance education requires that students be self-regulated. Self-regulated learners actively control the interactions between themselves, their learning, and their environment (Bandura, 1986). They actively control their own learning by employing a range of cognitive strategies assisting in the construction of meaning and retention of information. They use meta-cognitive strategies, for instance, planning and monitoring to manage their own progress. Furthermore, they are intrinsically motivated, focused upon the task at hand, and thoughtfully control emotional difficulties (Zimmerman, 1994).

The empirical studies showed mixed results for this characteristic. McManus (1996) found that high self-regulated learners performed better in a web-based hypermedia-learning environment. However, in his later research, he found that students who tested as high self-regulating did not score significantly better than those who tested as medium or low self-regulating (McManus, 2000). He argued that learners` prior experience with the learning environment might have affected their scores. The study also revealed that there was an interaction between self-regulation and nonlinear design that requires learners to take more active role in organizing the information in the instruction. Highly self-regulating learners performed poorly in the environment with the lowest level of nonlinearity, while medium self-regulating learners fared poorly in the highest nonlinear treatment. What this finding indicates is that the more nonlinear the design, the more responsibility is placed on the learner, as a result, not all learners are able to perform the tasks equally well in the instruction.

AFFECTIVE CHARACTERISTICS

Although most of the research in the literature regarding individual differences addressed the issue of differences in the way people learn by focusing on cognitive factors (thinking and information processing), there are also several areas of research that point towards the important effect of emotions, intensions and a set of key psychological factors, such as passion, dislike, fear, satisfaction, frustration and so on. The evidence suggested that recognizing a more comprehensive set of common learner attributes, such as those influenced by emotions and intentions, is useful in guiding the design of instructional solutions and environments that enhance the overall learning experience.

Martinez and Bunderson (2000), in their study of learning orientations including transforming, performing, and confirming profiles, investigated the influence of these orientations on satisfaction, learning efficacy, intentional learning performance, and achievement. Participants were randomly assigned to one of three research groups. Each research group received the instruction in a Web learning environment that matched one of the three learning orientations. The identification of learning orientations in the research design reflects that not all individuals have similar emotions and intentions to learn. The combined results indicated the likelihood that learners enjoyed greater success in learning environments that adapted and supported their individual learning orientation. In contrast, the learners adapted less positively in the unmatched environments that conflicted with their learning orientation. These findings suggest that learning environments influence learning outcomes depending on how it matches the learning orientation. Recognizing a more comprehensive set of common learner attributes, such as those influenced by emotions and intentions is useful in guiding the design of instructional solutions and environments. Martinez (2001) suggests designing environments that are a) sophisticated, discovery-oriented, supported by complex problem solving activities for transforming learners, b) project oriented, energizing, interactive for performing learners, and c) simple, scaffolded, structured for conforming learners.

Perhaps, frustration is the major obstacle and affective aspect for learning environments where students are away from traditional classrooms. It is known that high levels of anxiety decrease the storage and processing capacity of working memory and impede making inferences. High frustration can demotivate students as well. Several studies were conducted to find out the reasons for frustration in Web-based learning. Hara and Kling (1999) accomplished a qualitative case study of a Web-based distance education course regarding the issue of students` frustration at a major U.S. university. Participants were six master students enrolled in a distance education course related to general view of computer-enhanced language learning and the place of the WWW in the language-learning classroom. It appears that there are two foci of frustration. The first focus is technological problems; students without access to technical support are especially frustrated. Students whose computer skills are inadequate also face persistent technological problems. The second focus involves the course content and the instructor's practices in managing her communications with her students. Students may also get frustrated because of a lack of immediate feedback from the instructor and ambiguous instructions on the Web and via e-mail.

Not interestingly, gender differences exist in Web-based learning just as they would in traditional learning environments. Gender based social relationships, interaction styles and inequities that exist in traditional learning situations correspond fairly closely to those found in computer-supported environments. Barrett and Lally (1999) identified common differences in the behavior of male and female students in technology based instructions.

These differences include self-reported levels of confidence in ability to work successfully with technology, use of support systems and patterns of interaction. They found that women talked less, contributed less frequently, did not receive positive feedback to their contributions and did not appeal to the same sources of support. Similarly, Gunn and McSporran`s (2003) study found gender differences in motivation, confidence level, flexibility and access. Men stated that they were very confident that they would enjoy using the online materials whereas women stated they were apprehensive about using the materials and about their overall ability for the technical aspects of the course. In addition, women reported that they had more problems with access such as having to share the computer with other family members or friends. Another area in which the differences emerge is support mechanism that students utilize when they need to clarify something related to course materials. Women mainly send e-mail to the lecturer while men contact to their peers. There are also several research studies that found gender differences in the learning outcomes. However, these studies show mixed results. Some found that women are more successful in web-based learning while others found men performed well (McSporran & Young, 2001; McSporran, Dewstow &Young, 1999; Mehlenbacher et. al, 2000).

SOCIAL-CULTURAL CHARACTERISTICS

The research on learning preference by culture in Web-based learning environments is limited but does reflect some of the tenets suggested by Hofstede (1997), Marcus and Gould (2001). Sanchez (1996) examined US adult Hispanic learning styles and subsequent implications for Web-based learning. She examined motivation maintenance level, task engagement level, and cognitive processing level of 240 adult learners. She found that Hispanic learners preferred evaluative feedback, active participation, collaboration, and concrete and practical material. Learners tended: to retain facts well, use elaborative processing, have a positive attitude about learning, exhibit self-discipline and diligence, attend closely to tasks at hand, use "imagery, verbal elaboration, comprehension monitoring and reasoning" (p.58), identify the main idea, apply effective test-taking strategies and reflect on accuracy of information. The Hispanic learners preferred active experimentation and tended to use judgment (thinking of feeling) when interacting with others. Sanchez and Gunawardena (1998) make the following recommendations for distance learning for Hispanic adults, cautioning that they are not intended to perpetuate stereotypes or disallow for factors that might vary cultural traits but rather as a strategy to consider different options in course design:

- **Provide a variety of instructional strategies that can be supported through a variety of media, allowing students to choose among activities that have one objective.**
- **Provide consistent, clear, and frequent feedback in a variety of formats.**
- **Provide opportunities for collaboration.**
- **Encourage and provide opportunities for reflection.**
- **Design curriculum that engages learners in making connections amongs the theory and practice using higher order thinking.**

Chin, Chang and Bauer (2000) conducted a quantitative study to examine the learners` cultural background on their perception of Web-based learning. They administred a survey of an on-line course linking the students' cultural background to usage patterns, attitudes towards Web-based learning in tertiary education and students' learning experiences. The participants comprised of a total of 196 students that could be categorized into either Anglo-Saxon countries (Australia, England, Northern Ireland, New Zealand and Scotland) or Asian cultural countries (Singapore, Malaysia, Indonesia, Hong Kong, India, Philippines, Korea, Taiwan, and Thailand) according to proximity clustering within Hofstede's (1986) model of

cultural differences. They compared and tested the collected data for significance through Chi-squared tests of contingency tables to find out whether differences between two groups exist. The results indicated that Anglo-Saxon students appeared to be more confident in using the Web-based materials despite the fact that both groups perceived Web-based learning as an innovative idea to facilitate learning. There was also difference existed in the number of access to the Web-based materials. Asian students recorded fewer access to the materials than Anglo-Saxons did. In addition, the Asian students in the study seemed to have significantly more trouble related to the tasks of Web-based learning than their Anglo-Saxon classmates. According to authors, the findings indicates that Anglo-Saxon students are more accustomed to student-centered situations whereas Asian students prefer a teacher-centred approach.

In another study exploring distance learning issues on the dimension of cultural variation, Anakwe, Kessler, and Christensen (1999) found that motives and communication patterns of learners from individualist cultures were supported in a distance learning environment more so than learners from a collectivist culture. The favorite characteristics of distance learning, self-reliance and independence, were not conducive to the collectivist culture. The authors believe that this may reflect a cultural predisposition toward technology. When used as a medium to work alone and compete against others it may appeal to individualistic learners but when technology is used to communicate and collaborate it may appeal more to collectivist learners. On the other hand, instructor-centered teaching and style is more acceptable in a collectivist culture, and learner-centered teaching is more natural in an individualistic culture.

DISCUSSION AND CONCLUSION

As educators and designers, we need to do more research to explore new characteristics of the Web that enable us to create student-centered, collaborative and authentic learning environments in which students engage in critical thinking and problem solving. Research clearly suggests that intended audience to whom the instruction is designed is the most important component in the Web-based learning. Learners with different characteristics learn in different ways and show different reactions to the instruction. Therefore, designers should consider the individual differences to better suit the learning environment in order to reach and serve each learner's needs. In order to match various learning and thinking styles, tailoring instruction may be an effective way; because Web-based instruction offers an ideal platform for tailoring instruction to fit different styles. Unlike the classroom environment, it is much more easier to design and implement the instruction according to the learners` preferences. Integrating various media elements such as, text, sound, video and dynamic illustrations can foster the elaboration of complex subject matters. However, the cost and time required for this type of design should be deeply investigated and estimated.

Studies also show that, in addition to cognitive factors, affective characteristics such as frustration, motivation, fear, desire, gender, etc. play crucial roles in Web-based learning and should be taken into account in developing online instructions. Gender and age differences in the use and application of technology should be considered. Learners with certain attributes would like to know what is expected of them and the exact steps that they have to follow to fulfill the course objectives. Designing well-planned and structured lessons with clear and concise instructions, lists of required readings, explanations and informative course syllabus may diminish the level of learners` anxiety and enable them to accomplish the task more easily. Another important issue is the loss of motivation and interest of learners towards the learning activities. Instructors should not forget that each learner attends the course with different background and interests. Therefore, instruction should include a variety of engaging activities and the relevant contents with their educational

backgrounds so that they could become motivated and encouraged to find the learning enjoyable and build confidence. Assignments should be neither so easy nor so difficult. If the course requires the learners to write a final paper or design a project, the selection of the topics, area of study and methods should be left for learners` aspiration.

Prior knowledge is another essential factor to be successful in any type of learning, because most of the time, learning occurs when a person combine new information with previous knowledge to construct and use new awareness. As Jonassen (1991) points out that how we construct knowledge depends upon what we already know which depends on the kinds of experiences that we have had, how we have organized those experiences into knowledge structures, and our beliefs that are used to interpret objects and events that we encounters in the world. This is also true for online learning. The learning environment has to consider the conditions that allow the learner to accumulate new information to his/her own prior knowledge. Fortunately, the structure of the Web, hyper linking, provides unique opportunity to easily achieve this cognitive flexibility in web-based environment unlike the traditional classroom settings. Many files, documents, images, graphs etc. related to prior knowledge available on the Internet can be linked anytime into any parts of the new content, and this allows the learner to access information as needed in any order pertinent to his/her needs. Other possible ways to activate prior knowledge might be integration of advanced organizers, evaluation of learners' knowledge by the tutor and use of chat rooms.

Just like prior knowledge, previous expertise in Web-based environments is an influential factor in learning outcomes. Familiarity with technology can reduce the cognitive load. A considerable amount of research indicates that the more experiences learners have with technology prior to instruction, the more likely they are to persist and perform better through the course. Learners facing with technology problems tend to experience high stress levels and frustration causing dramatic decrease in interaction with their instructor, peers and content itself. Therefore, learners` skills with technology should be measured and necessary actions, such as providing interactive tutorials, online orientation, FAQ pages, instant feedback, online help desks, should be taken before and during the instruction.

Finally, the emerging area that the educators need to further pay attention is cultural and social differences that may influence Web-based learning. This becomes even more critical in our global world and culturally diverse learning environments as universities start offering online courses to anybody in any parts of the world. Being aware of cultural differences in technology can help instructional designers and trainers to build more culturally and socially sensitive educational materials.

BIODATA AND CONTACT ADRESSES OF AUTHOR

Mustafa Koc received his B.Sc degree in Mathematics Education from Selcuk University, Turkey. Having acquired a full scholarship from the Ministry of Education in Turkey, he earned his M.Ed degree in Information Science and Learning Technologies with an emphasis in Educational Technology from the University of Missouri. He is currently a Ph.D candidate of Instructional Technology at the University of Illinois at Urbana-Champaign. His areas of interest include but not limited to: constructivist and collaborative learning environments in distance education, critical analysis of technology use in education and sociology and culture of technology.

Mustafa Koc
Ph.D Candidate of Instructional Technology
University of Illinois at Urbana-Champaign
2108 S. Orchard Street #203

Urbana, IL 61801 - USA
Phone: (217) 384-2986
E-mail: mkoc@uiuc.edu

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