

Review

Individual differences in online personalized learning environment

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The need has arise for the consideration of individual differences, to include their learning styles, learning orientations, preferences and needs in learning to allow learners engage and be responsible for their own learning, retain information longer, apply the knowledge more effectively, have positive attitudes towards the subject, have more interest in learning materials, have higher scores and high intrinsic motivation level. As regard the importance of individual differences, “intentional learning theory” was found to cover individual aspects of cognitive, intention, social and emotion. Learning orientations model proposed by this theory is focused on the whole-person perspective and can be used as a framework to examine the dynamic flow between deep-seated psychological factors, past and future learning experiences, subsequent choices about cognitive learning preferences, styles, strategies and skills, responses to treatment, and lastly, learning and performance outcome. Based on the review of previous research, online personalized learning environment is the best learning medium for individual difference approach, in that it has impacts on students’ achievements and satisfaction in learning. However, learning environment needs to provide new information, contexts for learning and practice, feedback, transfer, organizers and attention devices. Therefore, interactivity is a must in the online personalized learning environment.

Key words: Individual difference, personalized learning, intentional learning orientation model, online learning, interaction.

INTRODUCTION

The rapid growth of the individual difference research since the early 19th centuries has brought improvements and solutions in the education field. In order to ensure that learners engage and take responsibility for their own learning, many researchers (Aviram et al., 2008; Gagné et al., 2005; Jung and Graf, 2008; Kim, 2009; Retalis et al., 2004; Trinidad, 2003; Weber et al., 2005) suggested that the differences and distinctiveness of each learners must be taken into account in preparing the learning procedures. The differences of learners include their learning styles, learning orientations, learning rates,

cognitive styles, multiple intelligence, talents and many more. All learners will be provided with the necessary challenges and opportunities for self-development and learning if these differences are taken into account (Aviram et al., 2008; Jung and Graf, 2008). In addition, according to Weber et al. (2005), learning is a constructive process. This is supported by the research of Chapman (2006), which found that learning occurs best when learners understand the relevance and meaningfulness of learning to them, and also when learners are actively engaged in creating their own idea or knowledge and are able to connect what they learnt with their prior knowledge and experience. Besides, the consideration of individual differences in learning allow learners to engage in learning and be responsible for their own learning, retain information longer, apply the

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knowledge more effectively, have positive attitudes towards the subject, have more interest in learning materials, have higher scores and high intrinsic motivation level (Aviram et al., 2008; Jung and Graf, 2008; Kim, 2009; Lim et al., 2006; Retalis et al., 2004; Schiefele, 1991; Thompson, 2008; Weber et al., 2005). Weber et al. (2005) found that necessary challenges and opportunities for learning and self-development will be provided if learners' differences are considered in learning. Moreover, the emphasis of individual difference in learning increase learners' satisfactions and then increase their motivation towards learning, followed by better grade in the subject (Aviram et al., 2008; Lim et al., 2006). As a result of that, lots of approaches have blossomed over the last decade and most of them have primarily, cognitive perspectives. For example, learning style known as cognitive learning style has many dimensions of theories, such as Felder-Silvermann Learning Style Theory, Field Independence or Dependence, Honey and Mumford Learning Style, Kolb's Learning Style Model, Myers-Brigs Type Indicator and so on. Although Klasnja-Milicevic et al. (2010) defined learning style as the characteristic cognitive, affective and psychological behaviours that indicate how learners interact with and respond to the learning environment, Martinez (1999) realized that the approach mostly focused on cognitive aspect and demote other factors to secondary or no role. Therefore, some contemporary researchers (Bentley, 2000; Chapman, 2006; Martinez, 1999, 2001a; Martinez and Bunderson, 2001; Tasir et al., 2008; Unfred, 2003) included conative or intention and affective or emotions constructs that have influence in students' learning in their study.

As a matter of fact, intentional learning theory is one of the theories that consider individual differences in learning. This theory hypothesizes that the fundamental of understanding how an individual learns, interact with an environment, performs, engages in learning, experiences learning, and assimilate and accommodate the new knowledge is by the awareness of the individual's fundamental emotions and intentions about how to use learning, why it is important, when is the suitable time, and how it can accomplish personal goals and change events (Martinez and Bunderson, 2001). More so, this theory did not focus primarily on cognitive constructs, but is concerned more on conative, affective and social aspects of how individuals learn and manage their own learning construct (Martinez, 1999; Martinez and Bunderson, 2001). According to Unfred (2003), the intent of this theory is to focus on emotions and intentions of an individual regarding why, when and how learning goals are organized, processed and achieved. Learning orientations, which is a term introduced by this theory, describe the disposition of individuals in approaching, managing and achieving their learning intentionally and differently from others.

Other than that, according to Martinez (1999), learning orientations focused on the whole-person perspective and can be used as a framework to examine the dynamic flow between deep-seated psychological factors, past and future learning experiences, subsequent choices about cognitive learning preferences, styles, strategies and skills, responses to treatment, and lastly, learning and performance outcome. Learning orientations are used to construct three key attributes of learners: (1) focus on emotions and intentions of learning focus, (2) committed strategic planning and learning effort, and (3) learning independence or autonomy (Martinez, 1999). These attributes refer to the degree of learners' plan, engagement and effort to accomplish learning. These attributes can also be referred to the individual's desire and ability to take responsibility, make choices, self-motivate, manage and improve their learning (Martinez, 2001a).

The research done by Martinez (1999, 2001) summarized the attributes of transforming learners (transformances), performing learners (performances), conforming learners (conformances) and resistance learners (resistances) as follows:

(a) Transforming learners (Transformances) are found to be assertive, expert and highly self-motivated learners. Also, they use holistic thinking and prefer exploratory learning. In planning, they set and accomplish personal long- and short-term challenging goals, and maximize efforts to reach their goals. In addition, they are responsible for their own learning, managing their goals, learning, progress and outcome themselves and easily frustrated if given little learning autonomy.

(b) Performing learners (Performances) are found to be self-motivated and focused learners situationally. Also, they only meet above-average group standards if there is a benefit. In planning, they set and accomplish short-term and task-oriented goals, and minimize their efforts. However, they prefer coaching and interaction to reach their goals. In addition, they may be responsible for their own learning if it is in areas of interest, but may give up control in less interest areas.

(c) Conforming learners (Conformances) are found to be low-risk and extrinsically motivated learners. Also, they use learning to easily achieve group standards. In planning, they follow and try to accomplish simple task-oriented goals set and conducted by others, and maximize their efforts in supportive environments. In addition, they are less responsible for their own learning, and thus want continual guidance to achieve short-term goals.

(d) Resistance learners (Resistances) are found to be active or passive resistant learners. Also, they avoid using learning to achieve academic goals set by others.

In planning, they consider lower standards and fewer

Table 1. Design guidelines (Martinez, 1999, 2001a).

Category of design	Transforming learners	Performing learners	Conforming learners
Problem solving	Prefer complex and whole-to-part problem solving.	Prefer part-to-whole problem solving.	Prefer scaffolded and simple problem solving.
General environment	Loose structure of the mentoring environment.	Semi-complex structure of the coaching environment.	Simple structure of the guiding environment.
User interface	Open learning interface.	Hands-on learning interface.	Consistent and simple learning interface.
Feedback	Inferential feedback.	Concise feedback.	Precise feedback.
Learning module	Short, compact, big picture with links to more detail.	Medium, brief overview, focus on application.	Long, guided, step-by-step learning.
Examples	One good and one bad example.	A few good and bad examples.	Multiple good and bad examples.
Sequencing methods	Hypertext, meta-tags, specific access.	Semi-linear, branching, access by subtopic.	Linear, page-turner representation, general access.

goals, and maximize their efforts to resist expected goals. In addition, they are responsible for not meeting goals assigned by others, and set personal goals that avoid meeting formal learning requirements. However, situational performance or resistance may situationally improve, perform or resist the response to positive or negative learning situations.

Therefore, learning orientations questionnaire constructed by Martinez (1999) is used in categorizing students into four profiles which are: transforming learner, performing learner, conforming learner and resistant learner (Martinez, 1999). According to Bentley (2000), learning orientations questionnaire can help in finding new ways to assess and explore the differences in individual learning. The questionnaire also helps Martinez (1999, 2001) in determining and identifying the learning design guidelines for each learner (Table 1). In summary, a transforming learner prefers a discovery-oriented, non-linear and mentoring environment; a performing learner prefers a task- or project-oriented, competitive and interactive or hands-on environment; and a conforming learner prefers a simple, scaffolded, structured, facilitated and low-risk environment.

PERSONALIZED LEARNING ENVIRONMENT

Lots of research (Capuano et al., 2009; Gilbert and Han, 2002; Kim, 2009; Klasnja-Milicevic et al., 2010; Liu, 2007; Martinez and Bunderson, 2001) have been done to investigate the most suitable learning environment, taking individual differences into consideration. For that reason,

personalized learning environment is found to be emphasized on individual differences and needs, using a student-centred approach (Capuano et al., 2009; Gilbert and Han, 2002; Kim, 2009; Liu, 2007; Martinez and Bunderson, 2001). In early years, personalization is defined as an adaptation of the learning process and content to individual characteristics and preferences of learners (Corno and Snow, 1986; Cronbach and Snow, 1977). Then, in the 21st century, personalization in instruction is defined as an instruction that tailored learners' learning styles, intelligences, interest preferences, and so forth (Gilbert and Han, 2002).

There are a few strategies of personalized approach that can be adapted in the learning environment, such as the whole-person, name-recognized, self-described and cognitive-based strategies. First, the whole-person strategy emphasizes the cognitive, emotion, intention and social aspects of learners. These aspects are major elements in learning, and they have their own importance in learners' learning progress. As an example, emotion has the ability to influence learners' attention, perception and memory (Carlile and Jordan, 2005; Gagné et al., 2005). This will encourage them to engage in their own learning. Secondly, the name-recognised strategy emphasizes the recognition of learners' names, which is valued by most people if it is being acknowledged as an individual. Thirdly, self-described strategy is the personalized approach that is based on answers provided by learners. Lastly, the cognitive-based strategy is an approach that only refers to the cognitive process, strategy and ability of learners. Out of these, the whole-person strategy is the most suitable approach of the

personalized learning environment for learners with different profiles of learning orientations, as explained previously.

As regard the importance of considering individual differences in learning, a number of personalized learning environment was developed, such as AEHA (Retalis et al., 2004), TANGOW (Carro et al., 1999), AHA! (De Bra et al., 2006) and SILPA (Martinez, 2001a). First, Adaptive Educational Hypermedia Applications (AEHA), a framework of Retalis et al. (2004), implemented Kolb's learning styles – divergers, assimilators, convergers and accomodators. This framework also includes four main design dimensions which are: content, navigation and interaction, activities and layout. Secondly, Carro et al. (1999) implemented Felder-Silverman learning style model, which comprised sensing, intuitive, sequential and global learners, in task-based adaptive learner guidance on the WWW (TANGOW). This system allows the update of the learning style model if the student's behaviour during the learning period is contrary with the expected behaviour. Thirdly, an educational system called Adaptive Hypermedia Architecture (AHA!) was developed by De Bra et al. (2006), and it implemented the field-dependent and field-independent styles of learning. Afterwards, De Bra collaborated with Romero, Ventura and Delgado in upgrading AHA! and the system's algorithm was then tested with 78 students of Eindhoven University of Technology in The Netherlands (Romero et al., 2007). These three learning environments are web-based but have not yet been tested on students' performance or satisfaction. Conversely, the fourth personalized learning environment, which is an interactive web-based learning called system for intentional learning and performance assessment (SILPA) was tested with seventy-one volunteer adults with a mean age of 22 for its influence on learners' satisfactions, performance, achievement and learning efficacy (Martinez, 2001b). SILPA implemented learning orientations model that presents four profiles of learning orientations that varied on how learners choose to learn, based on efforts, emotions and intuition, which are transforming, performing, conforming and resistant learners. Martinez (2001b) found that learners are more successful in the learning environments that matched their individual learning orientations. In addition, learners are more responsible to their learning environment and also improve their learning ability that may lead to higher learning orientations and higher performance standards. Therefore, based on the review of the research on personalized learning environment, the environment is best applied in an online medium, specifically a website. Moreover, website is found to be perfect for individualized learning, in that it offers personalization in learning (Martinez, 1999, 2001a, 2002), leads to innovations in education field (Liu, 2007) and increases students' satisfactions (Martinez, 2001a) that will in turn motivate them (Lim et al., 2006). In addition, with the use of

website, instructors can monitor students' progress easily (Martinez, 2002; Martinez and Bunderson, 2001), the learning content can be presented specifically to each learner (Martinez, 2002; Martinez and Bunderson, 2001), learners can be identified individually (Martinez, 2002; Martinez and Bunderson, 2001), and students can become independent or self-direct (Martinez and Bunderson, 2001). Also, website allows for immediate updates, and allows students to have link with other web sites and extend their knowledge about the topic (Gagné et al., 2005; Wang and Yang, 2005). Additionally, Tasir et al. (2008) found that learning orientations are considered useful and rational for online learning when considering the impact of emotions, intentions, effort to accomplish learning and success, and social factors on learning.

INTERACTIVITY IN ONLINE LEARNING

Online instructional design needs, used to provide the external conditions of learning to students, include: new information, contexts for learning and practice, feedback, transfer, organizers and attention devices (Gagné et al., 2005) that have been specified in the term "interactivity". There is a range of definition on interactivity since the research (Bannan-Ritland, 2002; Chou et al., 2010; Evans and Sabry, 2003; Muirhead and Juwah, 2004) was done on various sample with various approaches (Clayton, 2003). Evans and Sabry (2003) define interactivity as functions and operations that enable users to work with computer-mediated contents and receive feedback. Conversely, interactivity is defined by Bannan-Ritland (2002) as an active involvement of a learner in instructional activities and technologies, to include social interactions and network. On the other hand, interactivity refers to the function and impact of interactions in online process of teaching and learning (Muirhead and Juwah, 2004).

Therefore, there are three major terms of interactivity (Chou et al., 2010) that have to be integrated in online personalized learning environment. The first term is the interaction type, which includes the relation between the learner and himself, learner and interface, learner and content, learner and instructor, and learner and other learners. The second term is the interactivity dimension, which is the attribute of interaction type, to include ease of adding information, choice, non-sequential access of information, adaptability, monitoring of information use, responsiveness to the user, personal-choice helper, playfulness and facilitation of interpersonal communication. The third term is the interactive function, which is the technical operation corresponding to the interactivity dimension for each interaction type, such as note-taking functions and jokes.

Brief definitions of each interactivity dimension are as follow:

1. Ease of adding information: The learning environment facilitates learners to upload and disseminate information (Chou et al., 2010).
2. Choice: Learners can choose their preferred information and functions (Chou et al., 2010; Evans and Sabry, 2003).
3. Non-sequential access of information: Information can be accessed from various paths (Chou et al., 2010).
4. Adaptability: The learning environment provides adapted learning activities according to the profiles of learners' learning orientations (Chou et al., 2010; Evans and Sabry, 2003).
5. Monitoring of information use: The learning environment, in which data on the learner's choice and activities are collected, can be tracked by the learner for reflection (Chou et al., 2010; Evans and Sabry, 2003).
6. Responsiveness to the user: The learning environment responds to learners immediately (Chou et al., 2010; Evans and Sabry, 2003).
7. Personal-choice helper: The learning environment provides guidance for learners to choose preferred and suitable information (Chou et al., 2010; Evans and Sabry, 2003).
8. Playfulness: Interaction and fun elements to attract learners' attention (Chou et al., 2010; Evans and Sabry, 2003).
9. Facilitation of interpersonal communication: The learning environment provides synchronous and asynchronous communication channels for learners (Chou et al., 2010).

Brief descriptions and functions of each interaction type are as follow:

- a) Learner-self interaction: Learners monitor their activities in the learning environment and track their completed tasks for reflection purpose (Chou et al., 2010). Interactive functions for learner-self interaction are note-taking, online survey, calendar and schedule reminder, task-list, online quiz for self-evaluation, individualized record, individualized instruction, individualized test or quiz, login-status tracking, materials-viewed tracking, learning-completion tracking, grade-status tracking and learning dashboard.
- b) Learner-interface interaction: Learners access information and guidance in the learning environment (Chou et al., 2010; Peng et al., 2008). Interactive functions for learner-interface interaction are fixed-frame (menu) design, language choice, sitemap, keyword search, database search, software downloading, email to webmaster or instructor, comments on the system, online registration, login-status tracking, materials-viewed tracking, learning-completion tracking, grade-status tracking and learning dashboard.
- c) Learner-content interaction: Learners access learning contents in the learning environment (Chou et al., 2010).

Interactive functions for learner-content interaction are links to related educational systems, links to related learning materials, multimedia presentation, push media, online quiz for self-evaluation, online examination, online help with contents, individualized learning record, individualized instruction, individualized test or quiz, materials-viewed tracking, note-taking, educational games and jokes.

d) Learner-instructor interaction: Learners interact with the instructor by using communication channels provided in the learning environment (Chou et al., 2010). Interactive functions for learner-instructor interaction are: email to webmaster / instructor, bulletin board systems, synchronous communication, social tools, grouping, online examination, and comments on the course and instructors.

e) Learner-learner interaction: Learners interact with other learners by using communication channels provided in the learning environment (Chou et al., 2010). Interactive functions for learner-learner interaction are: email to other learners, bulletin board systems, synchronous communication, social tools, grouping and forum systems.

CONCLUSION

In order to develop a learning environment, individual differences need to be taken into consideration to ensure the impact on students' achievements and satisfactions. Therefore, the learning environment must be suitable for their differences, to include their learning styles, learning orientations, preferences and needs in learning. In addition, there is need for instructional design to provide external conditions of learning, such as: new information, contexts for learning and practice, feedback, transfer, organizers and attention devices. For this reason, the integration of interactivity functions in the learning environment could ensure that those external conditions of learning are provided to students.

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