The Design of Web-based Learning Environment to Actively Connect Human Brain and Goble Brain

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Abstract

The main goal of this study is to identify factors that might influence learners to learn online actively based on the theories of human brain, constructivism, rational behavior, innovation diffusion. There are 2,083 interviewers data collected from high schools in Taipei and Hualien. The “Active Online Learning” Model has been constructed based on survey results by using structural equation modeling. The results of the analysis indicate that the perceive usefulness is the critical factor to promote satisfaction to the web-based learning environment. A content-rich online learning environment can connect each individual's prior academic experiences and encourage active online learning.

1. Introduction

For the purpose of surviving in the highly competitive globalization environment, it is critical to apply advance computer and Internet technology to provide flexible, multiple, dynamic multimedia teaching environment to grasp the rapid changes of knowledge and accumulate intellectual capital in the era of knowledge-based economy. The virtual classroom is very different from the traditional physical classroom in terms of disciplines. The role of self-regulated learners is relatively more important under the much less regulated web-based learning environment. A learner without reasonable motivation is quite difficult to learn online actively. To attract learners continuing to learn online, in addition to learner’s motivation, the design of the web-based learning environment is critical to enhance users’ intention. In this study, a set of key concepts including perceived ease of use, perceived usefulness and multiple adaptations have been adopted to integrate with the theories of innovation diffusion, technology

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acceptance, cognition, construction and human brain to explore factors that might influence learners’ satisfactions and intentions to participate in the web-based learning environment.

2. Theoretical Background

This study focuses on the integration of human brain theory with educational theories and the influences on the development of the learning environment. Also, the concepts of planning behaviors, reasoned action and technology acceptance model have been used to evaluate and estimate the effectiveness of the online learning web site. The related theories and concepts are specified as follows:

2.1 Cognitivism

Cognitivism had been developed since early 1960s, and it is viewed as mental constructions in the minds of individuals. Learning was regarded as information processing of input, storage and retrieval. Cognitivism emphasized on the internal mental processing on the part of the learners. It was based on the thought process behind the behaviors. However, knowledge was still viewed as given and as absolute, as in behaviorism (Skinner, 1938, 1953).

2.2 Constructivism

Constructivism started to be developed in the late 1980s. The concept was derived from collaborativism and cognitive information processing. Constructivism went beyond the ideas of cognitivism to understand the way in which the brain store and retrieve information. This theory also examined the way in which learners made meaning from experiences. The key concept of constructivism was that people learned best by actively constructing their own understanding. Knowledge could not be transmitted from one person to the other, it needed to be constructed by each individual. Jacqueline and Martin Brooks (1993) suggested that students constructed understanding that was meaningful to them. In other words, knowledge was constructed in the mind of the learners. Generally speaking, there are two different views of constructivism:

2.2.1 Cognitive Constructivism

Cognitive Constructivism was based on the work of Swiss developmental psychologist Jean Piaget (1977). There were two key principles for teaching and learning from Piaget's point of view. The first principle was that learning was an active process. The second was that learning should be whole, authentic and real. In a Piagetian classroom, students must be given opportunities to construct knowledge through their own experiences. Teachers provided a rich learning environment that assisted in expanding the conceptual and experiential background of the learners. Technology supplied a variety of tools to accomplish the goals of a constructivist classroom. In short, cognitive constructivism approached learning and thinking from the perspective of the individual.

2.2.2 Social Constructivism

Social constructivism was pioneered by Vygotsky (1978). Social constructivism defined learning as a social construct that was mediated by language via social discourse. From the viewpoint of social constructivism, learning does not occur in isolation. Learners interact with the knowledge, the learning environment and other learners (Dershem, 1996). Knowledge cannot be independent from the historical and cultural background of students (O'Loughlin, 1992). Meaningful learning is rooted in the historical and cultural background of each individual. Learning is not only based on an individual’s past academic experiences, but also on the collective experiences of the persons in the learning environment. People learn and work collaboratively, not individually, throughout most of their lives (Resnick, 1988, cited by Brown et al., 1989). The offspring of social constructivism was cooperative and collaborative learning. The major goal of cooperative learning was the construction of shared understanding through interaction with other students. The more the knowledge was shared, the more was learned (Leidner & Jarvenpaa, 1995). Basically, cognitive constructivism described the mind in terms of the individual and confined it to the individual’s head, while social constructivism described the mind as a distributed entity beyond the boundary of the individual's body.

2.3 The Human Brain

Thinking takes place through the aggregate action of billions of neurons. Learning in a biological system involves adjustments to the synaptic connections that exist between the neurons. Neuron interconnections are not fixed, they change all the time, mostly in response to learning. The nervous system transmits, stores and processes information instantaneously. The perceived information needs to be compared with the information that is stored in the nervous system. An interpretation is mostly related to our past academic experiences. The brain is designed to seek meaning in
the content. Meaning is complex and involves the need for relevance, emotional connections, transfer and pattern making (Nelson, 2001; Jensen, 1998, 2000):

2.3.1 Relevance

Relevance is a function of the brain's making connections between existing neural sites (Greenough & Juraska, 1986). Our brains grow in a social environment because we forge meaning through socializing. Group discussions and the sharing of personal academic experiences among students can help them to associate and connect their learning with meaning. Social cognition theory believes that culture is a determinant of individual development. Culture teaches children both what to think and how to think (Vygotsky, 1978).

2.3.2 Emotion

Emotion and meaning are linked. Emotions engage meaning and predict future learning because they involve our goals, beliefs, biases, and expectations. Research in brain theory suggests that emotional health is fundamental to effective learning. The key ingredients of Emotional Intelligence are confidence, curiosity, and capacity to communicate. Emotional Intelligence has proven to be a better predictor of future success than have traditional methods like standardized test scores (Goleman, 1997).

2.3.3 Pattern Making

“Patterns are the key to intelligence. Patterning information means really organizing and associating new information with previously developed mental hooks.” (Mehler & Dupoux, 1994, p49) To improve learning, it is important for a school to provide an online learning environment based on brain theory that encourages students to make their own meaning out of things. Brain theory fits well with the practice of contextual learning and constructivism (Parnell, 1996). Learning and memory are interlocked. It is important to realize that without memory we are unable to learn from prior knowledge and experience. Our memory works by association. It is difficult to remember information if there is no obvious association between things. In other words, the success of the retrieval is highly dependent on state, time and context. Associations, similarities or contrasts trigger recalls. Students can better recall their learning by using the right system in the right way.

2.4. Behavior Theories

There are three popular models of users' behavior theory including reasoned action theory, technology acceptance model and Innovation Diffusion Theory, which are used to predict students' participations in the web-based learning environment actively.

2.4.1. Theory of Reasoned Action

The theory of reasoned action (TRA) was developed by Martin Fishbein and Icek Ajzen (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). TRA is often used to predict and explain individual’s behavior in the process of decision-making. TRA suggests that a person's behavior is determined by one’s intention, and intention is influenced by his/her attitude and subjective norm directly or indirectly. Attitude toward the behavior is refers to the individual's positive or negative feelings about performing a behavior. Subjective norm refers to the individual’s subjective judgment regarding others’ preference and support for a behavior (Werner 2004).

2.4.2 Technology Acceptance Model

Technology Acceptance Model (TAM) was first introduced in 1989 (Davis, Bagozzi, Warshaw). TAM is an adaptation of the TRA to the field of Information Systems. TAM stresses on two critical factors to impact the intention of individual that are perceived usefulness and perceived ease of use. (Davis, 1989; Mathieson, 1991; Szajna, 1996; Taylor and Todd, 1995a Chau, 1996) Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). Perceived ease of use influences an individual’s attitude significantly through self-efficacy and instrumentality. In other words, when a person’s self-efficacy of using of the computer technology is different, it will enhance or weaken individual’s intention of using a specific computer technology (Davis, 1989; Mathieson, 1991; Szajna, 1996; Taylor and Todd, 1995a; Chau, 1996). In short, the more familiar with the system, the less anxiety the user will experience (Brown, 2004). Also, if users can obtain resources of information system in time to complete their academic assignments as a result their academic performance can be improved. This will trigger their positive attitude toward the system, the intention of using
the system can be enhanced. Moreover, the decision to adopt the system will be speeded up. (Alavi, 2002; Oliver and Herrington, 2003)

In addition to extrinsic motivations which are perceived usefulness and perceived ease of use, some of the researchers in TAM proposed perceived enjoyment as an intrinsic motivation to promote the intention and willingness of individual to accept information system (Agarwal et al, 1998). Van der Heijden’s theory uses TAM as foundation to evaluate the system by using enjoyment instead of efficiency of the system as a major consideration. In addition to usefulness and ease of use of system, Heijden suggests design a web site should also consider the aesthetics of the interface and the interesting of the content to inspire the positive feeling of the users. Positive emotions can promote the ability to store and retrieval information from brain. The study of Atkinson and Kydd (1997) indicates the perceived enjoyment will impact users' behavior to access the Internet Moon and Kim (2001) use perceived enjoyment as a factor to explain the acceptance of the system.

2.4.3 Innovation Diffusion Theory (IDT)

IDT Theory is concerned with the manner in which a new technological idea, artifact or technique, or a new use of an old one, migrates from creation to use. According to IDT theory, technological innovation is communicated through particular channels, over time, among the members of a social system. In 1962, Rogers presented IDT, the theory migrate the technological innovative idea, artifact or technique to an individual and an organization in the social system. The Diffusion processes consist of four key elements: innovation, communication channel, time and the social system (Rogers, 1962; 1995). Rogers proposed revised adoption model which is known as innovation decision processes based on the processes of an individual or an organization to accept innovative artifacts over a period of time. Innovation decision process can be divided into five stages: knowledge, persuasion, decision, implementation, confirmation. In recent years, many empirical studies’ researchers integrated five stages of innovation diffusion theory into three stages: knowledge, attitude and practice, it also known as KAP (Hubbard, et al., 2003).

Rogers (1983) presented the three key factors that affect individual to decide whether to accept a specific innovative object, which include: relative advantage, complexity and compatibility (Rogers, 1983). Relative advantage and complexity is similar to the perceived usefulness and perceived ease of use in TAM. Compatibility refers to the degree of compatible among individuals’ past academic experiences and current needs. The higher compatibility, the better the possibility of the use of innovative artifacts is.

3. Proposed Model and Hypotheses

This study proposes Active Online Learning (AOL) Model on the basis of the theories of behavior including TRA, TAM, IDT. AOL model adopts three stages (knowledge, attitude and practice) in IDT to predict whether an individual will participate in the web-based learning environment actively. The three stages are described as follows:

3.1 Knowledge

In the stage of knowledge, it adopts the perceived usefulness, ease of use and multiple adaptations to evaluate the usefulness, easiness and adaptation of the web-based learning environment.

3.1.1 Perceived ease of use (PEOU)

In addition to the computer skills is used to evaluate the ability of a user to operate the web-based learning environment, the accessibility of Internet-enabled computer devices is also used to evaluate the easiness getting online. Two facets of PEOU are provided as follows:

- Technique: Subscale of technique is calculated by 3 questions in the questionnaire that is used to evaluate users’ computer skills. These questions include total years of accessing the Internet (Q6), taking any Internet or computer classes (Q87) and having any computer skills (Q87). The higher the score that a user get, the better the computer technique that a user possess.

- Accessibility: There are five questions used to evaluate the accessibility of Internet-enabled computer devices. These questions include having a computer or computers at home (Q1), having Internet connection from home (Q2), type of the Internet connection (Q3), using mobile phone to get online (Q5) and places of getting online (Q11). The higher the score that a user get, the better the accessibility to a computer and the Internet that a user have.

Three hypotheses derived from PEOU are provided as follows:

H1: The better skills that a user has, the easier of web-based learning environment can be operated.
H2: The easier a user can access the Internet-enabled computer devices, the faster a user can learn online.

H3: The easier a user can operate and access the web-based learning environment, the more chances a user can experience the advantages and effectiveness of the learning web site.

3.1.2 Multiple Adaptations (MA):

The online learning environment provides a variety of materials, functions and interface designs that can attract users to explore and experience the advantages of the web-based learning environment. This study stresses the concept of “relevance” in the theory of human brain and cognitive constructivism, “interactive” in the theory of social constructivism and positive emotion “enjoyment” in the theory of human brain. Relevance, interaction and enjoyment are three facets of multiple adaptations which are used to evaluate the adaptations between learner and learning environment. Three facets of MA are provided as follows:

- **Relevance**: There are four items in a question used to evaluate the relevance of the content of a learning web site to the course and connection between a learner and a learning web site. The question is to identify the factors that influence the learning results online (Q73). The answer of each item has adopted 5-point Likert scales, in which 1 indicates extremely unimportant and 5 is extremely important. Four items include the information on the page current (Q73.1), the information relating to the course (Q73.2), the information meeting users’ needs (Q73.4) and the page linking users to other relevant web sites (Q73.5). The score of four items are cumulative, the higher the score, the higher relevance of the online learning environment is.

- **Interaction**: The web-based learning environment provides communication channels among teachers, students and learning environment that can promote learning and thinking through collaboration among users in the learning community. (Dershem, 1996) There are five items in the question of the factors that influence the learning results online (Q73) related to the subscale of interaction. Five items include the interaction with teacher online (Q73.10), interaction with other classmate online (Q73.11), providing an objective academic evaluation online (Q73.13), equipping with a discuss panel or a message board online (Q73.14), giving quizzes and solutions of related materials to assist students better understanding the course subjects (Q73.15). Also, a question of whether a student allows sharing and constructing the teaching materials collaboratively online (Q68) are all cumulative. The higher the score, the higher interactions in the online learning environment is.

- **Enjoyment**: Learning in a multimedia web-based virtual classroom is much more effective than blackboard and chalk in the traditional physical classroom. Multimedia can improve students’ motivation and enhance learning outcomes. An online virtual classroom applies advanced computer technologies, integrates multimedia of sounds, images, databases, graphics, slides and animation effects to promote learning both in lively and depth of teaching materials that can stimulate and initiate all related memory regions and inspire the positive emotion of learners. There are 2 questions with 5-point Likert scales used to evaluate enjoyment aroused by web-based learning environment. The question of the factors that influence the learning results according to past experiences on interaction with the Internet (Q73). It includes two items that are whether the web pages contain multimedia (Q73.3) and whether interface design of web-based learning environment attracts users (Q73.6). Another question is the reason for users to access the web-based learning environment (Q74), the item in the question is the vivid and lively multimedia interface design (Q74.2). The scales of each item are summed. The higher the score, the more enjoyment will be yielded.

Four hypotheses derived from MA are provided as follows:

H4: The more needs and requirements of the learners can be achieved by the web-based learning environment, the more adaptation between a learner and an environment can be fit.

H5: The more interaction among members and teachers in the online learning environment through the sharing and communication tools, the more learning paths and portfolio of learners will be retained in the online learning's environment. As a result, the online learning environment is able to provide teaching materials according to users’ needs. In other words, the adaptations between learners and learning environment are higher.

H6: The more interesting of teaching web site, the more positive emotions of learner will be inspired. The more learners are recognized the teaching web site and the more adaptation between a web site and learners will be made.

H7: The adaptation between a web site and learners is higher, the learners are more willing to explore teaching web site and thus web site will exert more achievements.
3.1.3 Perceived Usefulness (PU):

Task, convenience and knowledge are used to evaluate the effectiveness and usefulness of online learning environment.

- **Task:** Four items in a question of the main purposes of going online (Q75) are assisting doing homework, searching curriculum materials, downloading curriculum materials and browsing entrance examination materials. There is one item “improve academic performance” in a question of the reason for users to access the web-based learning environment (Q74) and a question of using Internet to search information for writing an assignment, a report, or doing research for school (Q86) respectively. All the items in Q74 involved five-point Likert scales ranging from 1-‘extremely unimportant’ to 5-‘extremely important’. The item in Q75 and Q86 are 2-‘yes’ and 1-‘no’. All the items for subscale “Task” are accumulate. The higher the score, the more the task has been accomplished.

- **Convenience:** To experience conveniences of the online learning environment, there are six items in the questions of the reason for users to access the web-based learning environment (Q74). The items of removing the barriers of space and schedule (Q74_1), sharing faculties, resources and information among schools (Q74_4), eliminating the differences between urban and rural (Q74_6), arranging more flexible course schedule (Q74_7), fitting personal schedule (Q74_9) and saving traffic time (Q74_10) are used to evaluate the convenience of the web-based environment. The answer of each item is 5-point Likert scales, and 1 indicates ‘extremely unimportant’ and 5 is ‘extremely important’. All the items for subscale “Convenience” are accumulate. The higher the score, the more convenience the online web site can offer.

- **Knowledge:** To participate in online learning environment, learner can increase his/her knowledge, link majority of knowledge base, access information better, and shorten the distance with the global knowledge. There are four items in the questions of the reason for users to access the web-based learning environment (Q74). The items of obtaining information easier and faster (Q74_8), connecting with information and knowledge base (Q74_5), bridging the distance to the globe and knowledge (Q74_3) and gaining information, knowledge, skill, ability (Q74_12) to evaluate the knowledge that web site can offer. The answer of each item is 5-point Likert scales, and 1 indicates ‘extremely unimportant’ and 5 is ‘extremely important’. All the items for subscale “Knowledge” are accumulate. The higher the score, the more knowledge can be delivery.

There are four hypotheses about the usefulness of the web-based learning environment are provided as follows:

**H8:** The more short-term learning goals and tasks can be achieved, the more useful of an online learning site is.

**H9:** The more knowledge and ability of learner can be enhanced, the more useful of the online learning web site is.

**H10:** The more facilitates of the web site can bring to learners, the more useful of the teaching web site is.

**H11:** The more compatible of the teaching web site and users’ needs, the easier of the teaching web site can be accessed and used, the higher satisfaction of the teaching web site will get

3.2 Attitude:

In the second stage of “attitude” reflects the satisfaction of the users to the online learning environment in term of ease, usefulness and flexibility. When users are more satisfied with the teaching web site, the higher the willingness is to participate in online learning. In this model, the observed variable of satisfied attitude (SAT) is a mediating variable to determine whether the learner will continue to participate in an online learning web site actively. The hypotheses related to the variable of satisfied attitude are provided as follows:

**H12:** The more satisfaction of a learner to the web-based environment, the more likely a user will access the web-based environment actively.

3.3 Practice:

In the third stage, "practice" is emphasized on the intention of users to participate in web-based learning environment actively. The question of the willingness of future participation (Q91) is used to evaluate a user’s intention to engage in online learning. This study attempts to construct a model that is based on the existing literature to evaluate the learners’ preferences to the learning environment in terms of three dimensions (ease of use, adaptation, usefulness) and perceptions of their impact on the effectiveness of e-learning which are directly or indirectly influencing learners’ satisfaction and intentions to learn online actively.
4. Methodology

4.1 Research Design

This study constructs “Active Online Learning” (AOL) model based on the theories of behavior (TAM, TRA and IDT), education and human brain. For the purpose of identify the factors that will impact learners to learn online actively. This study conducted a survey in Taipei and Hualien during March in 2011. Total of 2083 data were collected from both regular and vocational high schools. Among them, there are 1249 (61.1%) male and 796 (38.9%) female.

4.2 Data Analysis

In this study, structural equation mode (SEM) is adopted to explore the causal relationship of variables in AOL model by estimating multiple regressions simultaneously. There are 15 questions and 49 items used to compose three exogenous latent constructs (perceived ease of use, multiple adaptation and perceived usefulness), ten observed variables (technique, accessibility, relevant, interactive, enjoyment, task, knowledge convenience, satisfaction, and active online learning) in this study. This study uses a measurement model and a structural model two-step approach to SEM (Hair, et al. 1998). A measurement model is estimated followed by an estimation of structural model. The measurement model involves in conducting a confirmatory factor analysis (CFA) for assessing the contribution of each indicator variable and for measuring the adequacy of the measurement model.

The data collected for this study is normally distributed because the skew index ranges from -1.63 to .365 and kurtosis index ranges from -1.33 to 3.67 that are not exceed an absolute value of 3 and 10 respectively (Kline, 2005). The maximum likelihood estimation (MLE) was chosen to conduct SEM analysis. The use of MLE is to estimate the mean of a normally distributed random variable. In order to get reliable results in SEM, researchers recommend that a sample size of 100 to 400 cases is appropriate (e.g. Hair, Black, Babin, Anderson, & Tatham, 2006; Kline, 2005; Ding, Velicer, and Harlow, 1995) because if the sample size is less than 100, the procedure may fail to converge on estimates of the coefficients. On the other hand, if the sample size greater than 400, MLE will become too sensitive. Even though the sample size of this study is 2083, MLE is still chosen because MLE is a better option over other estimation methods based on past several studies (Tabachnick & Fidell, 2007; Hair, et al., 2006). This study uses CFA and MLE to conduct measurement model analysis and assessment.

4.2.1 Measurement Model Analysis

A meaningful latent variable should be composed by a set of observed variables that can accurately represent a construct (Hair et al., 1998). In other words, a set of observed variables in the latent variable should be reliable and valid in order to ensure the quality of the measurement (Bollen, 1989). To verify the reliability and validity of the latent variables in the model, individual item reliability measure, composite reliability measures and variance extracted measures were calculated.

- Individual Item Reliability

  The individual items in measurement model are critical to ensure the stable and reliable of the latent variables (Hair, 2006). In general, the acceptable factor loadings is greater at 0.7 (Bagozzi & Yi, 1988; Hair, et al, 2006). However, in the social sciences, the scope of the study is wider, the constructs is more difficult to define, the impact of external interferences and measurement errors are greater, as a result the factor loadings are not high. An item is considered to be reliable if the standardized loading value is greater than 0.5 and above (Johnson, et al. 2001). In this study, the individual item’ factor loading of the subscales is 0.64 for Technique, 0.54 for Accessibility, 0.95 for Relevance, 0.88 for Interaction, 0.89 for Enjoyment, 0.5 for Task, 0.75 for Knowledge, 0.74 for Convenience. The result showed that all the values of individual item reliability of each observed items are above 0.5, shows a good representation underlying latent variables (Anderson & Gerbing, 1988).

- Composite reliability measures

  Factor loadings can assess convergent validity that measures the extent to which the items truly represent the intended latent construct (Hair et al., 1998). In addition to factor loading, convergent validity can also be estimated by composite reliability (CR) measures (Hair et al, 1998). CR is computed for each latent variable included in the model, CR reflects the internal consistency of the observed variables measuring a particular latent variable. CR of latent variables PU, PEOU and in the model “AOL” are 0.65, 0.62 and 0.92 respectively. All three CR above the minimum acceptable level 0.6 (Fornell and Larcker, 1981), it shows that the measures are reliability (Fornell and Larcker 1981; Gerbing and Anderson 1988).
Discriminant validity measures the extent to which the conceptually similar constructs are distinct. Discriminant validity is examined by comparing the correlation between the construct and the square root of AVE. In the model, three AVE are 0.36, 0.36 and 0.74 respectively. There are two AVE below suggested value, however, the standardized factor loadings for all observed variables are above 0.5 and significant ($p<0.05$). This indicated that all of the items have an acceptable convergent validity in explaining the theoretical constructs (Hair et al., 2006).

4.2.2 Structural Model Analysis

Structural model was evaluated using AMOS 5.0 using maximum likelihood estimates. The measures used in this study to assess the model’s overall goodness of fit include the likelihood ratio chi-square ($\chi^2$), the ratio of $\chi^2$ to degrees of freedom ($\chi^2$/df), RMR(root mean square residual), the root mean square error of approximation (RMSEA), the goodness-of-fit index (GFI) and the adjusted GFI (AGFI). In practice, chi-square is not a very good fit index because it is affected by sample size. Larger samples like 2083 in this study might produce larger chi-squares that are more likely to be significant. However, both chi-square (4.627) and p value (0.099) are not significant in the study. In contrast to traditional significance testing, a nonsignificant chi-square is preferable that indicates the predicted model is congruent with the observed data. The ratio of $\chi^2$ to degrees of freedom is less than 3 ($4.627/2=2.314$) that indicates acceptable fit between the hypothetical model the sample data (Carennines & McIver,1981). RMR is 0.028 at acceptable level (<0.05). RMSEA measures the mean discrepancy between the population estimates from the model and the observed sample values. RMSEA is 0.025 which is less than 0.1 indicates good model fit (Browne, et al. 1993; Hair, et al. 1998). The GFI is developed to overcome the limitations of the sample size (Joreskog, et al. 1993). Extension of the GFI is AGFI, adjusted by the ratio of degrees of freedom for the proposed model to the degrees of freedom for the null model. Both GFI and AGFI value are 1 and 0.988 which higher than 0.9 is recommended as a guideline for a good fit (Segars, et al. 1993). In this research model, there are 11 out of 12 factor loadings of items are greater than 0.5. And all the factor loadings for the indicators were greater than twice of their standard errors, the parameter estimates demonstrated convergent validity. Also, all t-values greater than 2.58 are significant. Accordingly, all factors in the measurement model are adequate reliability and convergent validity (Anderson & Gerbing, 1988). An examination of the unstandardized parameter estimates revealed all estimates to be both reasonable and statistically significant at the 0.05 level. That is, all of the parameter estimates were $>1.96$, indicating that all the parameters were important to the hypothesized model (Hair et al. 2006; Holmes-Smith 2000).

5. Implications of the research

AOL model adopts three stages of knowledge, attitudes and practice in the theory of innovation diffusion to assess whether an individual will continue to participate in web-based learning environment. In the first stage, the usefulness of learning web site PU is directly determined by PEOU (0.60) and MA (0.69), the MA has greater impact on PU. Latent variable of PU, PEOU and MU in the first stage are all used to evaluate the ease, usefulness, and flexibility of learning web site that influences the attitude of the users in the second stage. The attitude of SAT affects directly from PU (0.38), indirectly from both PEOU (0.23) and MA (0.26). The usefulness PU of the web site play greater role to enhance users’ satisfaction SAT than MA and PEOU. The final stage, the intention of active learning online AOL is directly linked to users’ attitude SAT (0.63), indirectly impacted by PU (0.24), MA (0.24) and PEOU (0.145). PU plays 0.38 direct effects, MA 0.26 and PEOU 0.23 indirect effects on SAT. The model explains ($R^2$) 84% of the variance in active online learning AOL. The path significance of each relationship and $R^2$ value by each path in the model are shown in Figure 1.

![Figure 1. The path significance of each relationship and $R^2$ value in the model](image-url)
6. Conclusions

According to the findings, both perceived ease of use (PEOU; 0.60) and multiple adaptations (MA; 0.69) play critical influences on perceived usefulness (PU). The ability to operate computer and the Internet as well as the accessibility of computer and the Internet are reflecting the easiness of using the web-based learning environment for learners. These two factors determine whether the learners have the extra energy and time to explore and experience the learning web site that can achieve better academic performance. A multiple adapter web-based learning environment integrates the theories of human brain and education (cognitive construction of social structures) which provide readily available communication tools to teachers and students to construct a shared cognitive map that allows learners to direct their own learning and improve their intention to learn online actively.

The multiple adaptations (MA) emphasize on providing a web-based learning environment that includes diverse learning goals and experiences compatible with learners' prior academic experiences. The web-based learning environment embedded learners' learning paths that can motivate students to initiate exploring and constructing their own knowledge. Also, multimedia learning environment can improve learners' motivations and stimulate learners' positive emotions. Consequently, human related memory regions will be initiated and triggered that greatly influences the brain's activities and learning processes.

It is difficult to learn actively without motivation. A content-rich online learning environment can meet the users’ needs that allow user to associate with their prior learning experiences by interaction with learning environment. The study of Kinzie and Berdel (1990) indicates that interaction is leading the process of learning to improve academic achievement and promote learners' motivation. At same time, interaction can improve learning efficiency and develop learning strategies by controlling the learning content and preceding orders of the web-based environment. When learners actively participate in learning, they will pay attention to their own learning process, and can more easily perceived accomplishment and satisfaction. (Salomon, Perkins and Globerson, 1991)

References

Hu, L. T., & Bentler, P. M. (1999) Citpff croteroa fpr fot omdexes om cnpvaroamce Strictira; Eqiatopm <pde;omg. 6(1), 1-55.