In order to integrate the individuals’ differences in online learning, the concept of Personalized Learning Environment (PLE) has emerged as a concept in line with the Web 2.0 tools that serves to integrate essential learning outcomes such as lifelong learning and self-directed learning. This paper discusses a background of problem regarding this issue which is focusing on cognitive styles as the personalized aspect and the development of mental model as the impact of the learning process. The chemical bond subtopic is selected as a domain because this subject involves three levels of chemical representations which are macroscopic, microscopic and symbolic and this subject also emphasizes the modeling ability.

Keywords - personalized learning environment (PLE); individuals differences; cognitive styles; mental models; chemical bond.

1.0 Introduction
Technology is changing the way education is being delivered and perceived. Technology rich the learning environments and offer the potential to the learners to become active participants in constructing their own learning such as in web based learning environment. However, the web based learning environments are great educational tools only if they are designed well (Wijekumar, 2005). The critical selection of learning strategies to ensure the learning takes place and how students’ can reflect on their learning process is the examples of challenges for educators to design the web based learning (Trinidad, 2003). Hence, according to Johnson and Aragon (2003) the powerful online learning environment should consider all the seven aspect which are address individual differences, motivate the student, avoid information overload, create a real-life context, encourage social interaction, provide hands-on activities, and encourage student reflection.

2.0 Background of problems

2.1 Personalized and individual differences issues in online learning
Personalization technologies are defined as approaches to adapt educational content, presentation, navigation support, and educational services so that they match the unique and specific needs, characteristics, preferences of each learner (Magoulas, Chen, and Dimakopoulos, 2004). Alexander (2009) mentioned that the term PLE describe the tool, communities and services that constitute the individual educational platforms learners use to direct their own learning and pursue educational goal. Via PLEs, it can help learners to take control and manage their own learning (Jones, 2008). On the contrary to the conventional instruction system, at which students try to adapt themselves to the concept, personalized learning advocates that the concept has to be adapted to individual student (Karagiannidis, Sampson, and Cardinalli, 2001).

According to Attwell (2007), the idea of personalized learning environment (PLE) was raised up when people recognized that learning is continuing and seeks to provide tools to support learning. People also concerned about the role of individual in organizing their own learning. Furthermore, PLE concept also is based on the idea that learning will take place in different contexts and situations and will not be provided to a single type user. Since online learning has changed the ways in which education has been conducted, researchers and educators need to consider the factors contribute to the effectiveness of online instruction. One claims that online instruction lacks the ability to satisfy the diverse learning needs for online learners. An investigation of student learning preferences has shown that among the variables influence of the success learning and is considered as important are cognitive styles, learning styles and prior knowledge (Chen and Paul, 2003: Alomyan, 2004).

According to Federico (2000), students will be able to achieve their learning goals if the pedagogical procedures are adapted to their individual differences. Other than that, the design and the instruction of the online learning are also considered as important part in order to achieve the learning goals. However, the main problem in exploiting information in a web-based learning environment is to determine which attributes should be used and how to attend the diverse type of students (Brusilovsky, 2001). Hence, identifying
different types of learner variables and their impact on student learning have been a major area of study in online instruction (Saeed, Yang, and Sinnappan, 2009). Apart from that, online learning applications need to integrate the user interface design with instructional design and the development of the evaluation framework to improve the overall quality of web-based learning environments (Lekkas et al., 2009).

Many researchers claimed that the main problem with online learning environment is the lack of personalization aspect (Martinez, 2001; Cristea, 2004; Rumetshofer and Wob, 2003). Thus, one of the key issues concerning in today’s learning is individualized learning (Wang, 2004). According to Wang (2004), individualized learning is a learning model that places student (learner) in the center of the learning process. Students are active participants in their learning which mean they learn at their own pace and use their own strategies; they are more motivated and their learning is more standardized. Else, individual learners will take advantage of self-paced learning environments in which they have control over their pace of learning, information flow, selection of learning activities, and time management (Jung, 2001). This is also supported by Dron (2007) that stated the current studies are points the need to support and to encourage students to control the whole learning process.

2.2 Cognitive styles as one of the individuals’ differences

Searching for information sources in online setting is now a skill which most students have to be familiar. Previous research suggested that the skill of searching for information is in some respects related to cognitive style (Graft, 2003). Cognitive style also is one of the individual differences that taking into account in research study nowadays (Chen and Paul, 2003; Alomyan, 2004; Chen and Ford, 2000; Kim, 2001). Cognitive style as stated by researchers is a fundamental individual difference which is the preferred ways of organizing and processing information and experience (Chakraborty, Hu, and Cui, 2005; Peneheva and Papazova; 2006). Riding and Rayner (1998) defined the cognitive style as how individual preferred and habitual approach to organize and represent information. Riding (2002) also claimed that cognitive style affects the ways in which events and ideas are viewed, affects how person may respond to, how person think about, and also how person make a decision.

Cognitive styles are seen to have a significant effect on the learning process (Cakan, 2000; Kamaruddin, Abu Bakar, and Surif, 2004). It is because, students with high cognitive ability are assumed to be able to engage in a learning process. Cognitive styles also influence on students’ intellectual abilities, skill and personalities (Danili and Reid, 2006). In addition, knowledge of cognitive styles also can help educators to enhance students’ performance and productivity (Broeck, Vanderheyden, and Cools, 2003). Hence, cognitive development among students should be emphasized in order to develop a creative and innovative thinking style. Thus, it is the educators’ responsibility to consider the students’ cognitive differences in the teaching and learning process (Kamaruddin, Abu Bakar, and Surif, 2004).

In hypermedia system, it seems to be important to clarify the individuals’ difference such as cognitive style (Ruttun, 2009). Among other individuals’ differences, cognitive styles are vital because it refers to manner which information is perceived and processed. Researchers revealed that students possess different cognitive styles displayed different learning preferences and required different navigational support in hypermedia systems (Graft, 2003). Therefore, this becomes a challenge to educators to take account of this cognitive styles affect when integrating information and communication technologies in learning environment (Altun and Cakan, 2006).

2.3 Cognitive styles in learning chemistry subject

In chemistry subject, the learning process not only memorizing of facts but more towards the application of the facts in their daily life especially what have undergone by learners’ in their environment. The process of teaching and learning of chemistry subject should emphasize the students’ ability to think what had their learned about the chemical concepts and try to apply it in the real situation (Dewan Bahasa Dan Pustaka, 2001).

Sometimes, chemistry subject needs students to visualize things when it involved the use of model. It requires students to imagine and visualize the molecules. According to Madar and Buntat (2008), the visualization ability has close relation with cognitive styles. Thus, the cognitive styles must be considered by educators when they teach chemistry subtopics which need students to visualize images. Other than that, by using concept maps in chemistry subject is expected to result in higher achievement in chemistry (BouJaoude and Attieh, 2008). By using this technique it may help students to organize information, foster metacognition, and engage students in building their knowledge structures (BouJaoude and Attieh, 2008). BouJaoude and Attieh (2008), also found that field dependence and filed dependence students have different ability in constructing knowledge, mapping the concept and making a link between concepts.
Therefore, in order to enhance the chemistry learning process, the investigation about students’ cognitive style should be done (Kamaruddin, Abu Bakar, and Surif, 2004). It is because cognitive variables such as cognitive styles play an important role in one’s chemistry achievement (Gerald, 2002; Danili and Reid, 2004; Bassey, et al. 2007; Stamovlasisa, Tsitipsib, and Papageorgiou, 2010).

2.4 Difficulties in learning chemistry subject
In Malaysia, many students face difficulty in learning chemistry subject. Students regard that chemistry as a difficult subject because it involves many abstract concepts and difficult to imagine. Chemical subject is closely related to abstract concepts, and this also causes difficulties for students to learn (Sirhan, 2007). According to Taber (2002), students need an imagination and a higher order thinking to learn and master the chemical concept. Understand the chemical concept is not only known what happened, but students also must know how to apply it and also explain it clearly and easily. These are the difficulties faced by students when they learn chemistry (Sirhan, 2007).

In fact, chemical knowledge consists of three levels which called sub-microscopic, macroscopic and symbolic. These three levels are link with each other in Chemistry Triangle (Refer figure 1) (Sirhan, 2007; Johnstone, 1991; Harrison and Treaust, 2000). There are the interactions and distinctions exist between the three levels and it becomes an important characteristic of chemistry learning for mastering the chemical concept. However, students are live and imagine in the macroscopic of matter. Consequently, students cannot follow the shifts between the macroscopic and microscopic levels (Harrison and Treaust, 2000; Treaust, Chittleborough, and Mamiala, 2003; Robinson, 2003). Therefore, it is important for educators to determine and overcome these difficulties (Sirhan, 2007).

![Figure 1: Three Levels of Chemical Representation in Chemistry](image)

Many researchers reported that students generally understand the chemical phenomena at macroscopic level and able to interpret at the symbolic level. Conversely, it seems students are often unable to connect either of these levels to the microscopic level (Jansoon, Coll, and Somsook, 2009). In order to integrate the three levels of representation, students need to confront a variety of problems. First, fragment topics that do not fit well rather than the presented one (Gabel, 1999). Second, they need to learn how to connect the abstract concept (Wu, Krajcik, and Soloway, 2001), and third they need to be exposed to abstract phenomena that are difficult to interpret or visualize at the sub-microscopic and symbolic levels (Johnstone, 1991). If students are able to depict how the three levels are connected between each other, then students are able to generate understandable explanations (Treaust, Chittleborough, and Mamiala, 2003) and generate relational understanding (Treaust, Chittleborough, and Mamiala 2003; Mulford and Robinson 2002). These will help in reducing alternative conceptions among students.

According to Davidowitz and Chittleborough (2009), Gabel (1999) and Nahum et al. (2004), teacher should help students to make a link between the three levels. Robinson (2003) suggested that students must first deeply understand how to convert a symbol into meaningful information. Only then, they will able to move towards quantitative information. Teacher should provide physical examples and clear descriptions and depict the chemical diagram in color to help students to understand and make a connection between the three representations in chemistry subject (Davidowitz and Chittleborough, 2009). Therefore, it is important for teachers to think how to help students to see the differences between the macroscopic, microscopic and symbolic levels.
2.5 Models and mental models in learning chemistry

Models are a great importance in understanding chemistry (Nahum, et al. 2004; Coll, 2006). Models are also used in all science subject but they are particularly important in chemistry because this subject involves so many complex and abstract concepts (Coll, 2006). According to Gilbert et al. (2000), one of the chemistry education goals is to teach students how to interpret models, use it and understand the nature of model. Justi and Gilbert (2002) stated that by using models, the understanding of chemistry among students and also the ability to produce their own chemical models might be improved. Other than that, models also help students to make a link between the scientific theories to practice (Gilbert, 2005).

One of the subjects that involve the using of models is chemical bond. Many researches had been done to prove the students’ problem in this subtopic. The fact is, students cannot see how the atoms or elementary particles are held together and also how they interact and bond together to form a compound. This demonstrates that learners who want to understand chemistry need to understand models for chemical bonding first (Coll and Treagust, 2003). Coll and Treagust (2003) reported that students in secondary, undergraduate and postgraduate levels all prefer simple and realistic mental model for chemical bonding despite they were exposed to abstract mathematically complex images. Students’ misconceptions regarding these chemical bond concepts are based on the fact that they live and operate within macroscopic world of matter and do not easily follow shifts between macroscopic level and microscopic levels (Harrison and Treagust, 2000). As a result, they tend to build a non-scientific mental model (Taber, 2002).

![Figure 2: The interdependence of three levels of science concepts model (Detevak, 2005)](image)

Detevak (2005) developed a model called Interdependence of Three Levels of Science Concepts (ITLS) (refer to figure 2) to explain the connection between concrete and abstract level. In order to gain and build knowledge, students are encouraged to use mental models in order to see the connection between all the three levels in chemistry triangle (Devetak, 2005). According to Jansoon, Coll and Samsook (2009), mental model represents ideas in an individual’s mind when they use to describe and explain phenomena. It allows an individual to engage in description explanation and prediction. When students learn science subject, they gain knowledge of scientific mental model as a result of the teaching process such as exposure to the use of model (Harrison and Treagust, 2000). That means students create their own mental model and try to understand the scientific knowledge when they involve in the learning process (Chittleborough, et al., 2005).

2.6 Computer based learning to enhance learning chemistry

When concerning again about the three levels of representation in learning chemistry, a variety of instructional approaches such as instructional technology (Ardac and Akaygun, 2004; Tasker and Dalton, 2006), laboratory activities (Chittleborough and Treagust, 2007), mental models (Chittleborough and Treagust, 2007) and concrete models have been used to help students understand chemistry at these three levels. Many studies (Wu, Krajcik, and Soloway, 2001; Ardac and Akaygun, 2004; Tasker and Dalton, 2006) found that students gain benefits when their learn using computer-based visual models for the three types of representation. For instance, multimedia tools, which integrate the animation of molecular models, video clips of chemical equilibrium, or real-time graphics, provide students with opportunities to visualize chemical processes at the microscopic level.

Computer based molecular modeling is a useful and flexible tool which enables the students to view a representation or phenomena that are not visible to the naked eyes (Aksela and Lundell, 2008). According to Aksela and Lundell (2008), via computer, students have fast and easy way to make use of visual models which supported by verbal presentation. In addition, by integrating the innovative technology such as the use of computer models, it gives exposure of the micro and macro world in chemistry subject (Dori and Barak, 2000).
For chemical bond subtopic which involves the uses of models, Kozma and Russell (2007) suggested that molecular models, simulations, and animations could aid in studying chemistry especially in understanding the concept of bonding in these subtopic. It is agreed by Frailich, Kesner, and Hofstein (2009) saying that simulation and animation can demonstrate models at the macroscopic and microscopic levels. Ardac and Akaygun (2004) found that students who learned with the aid of dynamic computer-based models have better understanding and outperformed compared to their peers (who had no such experience) regarding molecular representations. Hence, the development of computer based model to learn the three level of representation in chemistry is seen to be important in order to improve students’ understanding in chemical bond subtopic. Thus, the web based learning with concern about the students' cognitive style as their personalized aspect will be developed. Otherwise, by this platform of learning it is hoped to help students to develop their mental model regarding the chemical bond subtopic.

3.0 Conclusion
This paper has discussed how the education world emphasizes in the issue of technological and then move towards from ICT to online learning and finally arise the personalized learning issues. This issue comes to the mind when the needs of the individual differences among students should be taken into account in the process of teaching and learning. In addition, studies have also shown that individual differences have a significant relationship with student achievement. This paper also describes how individual differences in cognitive styles, particularly related to the chemistry subject. Hence, educators need to develop an educational environment that will appeal to the individuals' differences among students. It is also vital that students to have an understanding of their own learning styles to improve their speed and quality of their learning. Perhaps, the personalized learning environment has the potential to provide an environment that allows students to experience learning in their context and these experiences will enrich their process in gaining new knowledge.

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