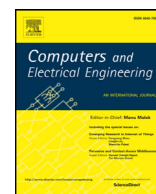




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Effects of visual map embedded approach on students learning performance using Briggs–Myers learning style in word puzzle gaming course[☆]

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ABSTRACT

Many researchers have indicated in their studies that there is a need to integrate knowledge construction tools to improve knowledge and enhance learning performance of students in life science courses. Due to improper integration of learning strategies, educational games effectiveness could be affected in comparison to conventional interactive systems. In present study, a visual map embedded matching based interactive word puzzle system was deployed to reduce student's cognitive load, enhance learning motivation skills to gain understanding on novel concepts, improve personality to foster interpersonal skills, improve learning achievements and compare them with conventional puzzle system in intelligent gaming courses. The efficacy of presented approach has been assessed by designing an experiment which involves mixed dimensions of Briggs–Myers learning style. The experimental results showed that the approach based on visual maps can improve overall students grooming and they could adopt gaming based educational technology with ease in contrast to traditional learning systems.

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1. Introduction

Multifarious researchers have pointed out that in today's scenario students are more involved in Digital Game Based Learning (DGBL) rather than instructor centered learning. Game based learning provides effective, interactive experiences that motivates and actively involves learners or students in the learning process. Coffey recommended DGBL as an interesting method that utilizes learning fundamentals and incorporates them into educational video gaming which enhances learner self-efficacy and their engagement towards learning courses [1]. Various researchers pointed out the need to integrate effective learning content and game based educational theories in enhancement of learning systems [2,3]. Legault and Green-Demers postulates that lack of integrity in motivational aspects of learning problems is biggest challenge among educational researcher's community [4]. Therefore, student learning motivational features and related aspects should be promoted to improve their learning achievement in Artificial Intelligence (AI) governed courses. In particular, learning contents with abstract knowledge representation and support is required for students to organize their knowledge effectively in the student-centered learning process. In existing school curriculum, students feel bored while understanding courses which in-

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volves AI features or related terminologies due to complex and uncertain learning content. Instructors are helpless to resolve queries or to identify weak areas where students are facing problems. So, there is a need for student to adopt gamification techniques which involve multimedia based visual map learning scenarios to develop interest in their learning.

Visual mapping is a learning approach which demonstrates path to learners in organizing the contents or knowledge what they have learnt through nodes and relationship between previous and new knowledge through links by connecting peer to peer nodes [5]. Researchers also pointed out that impact of distinguished learning style had serious and major role in digital game based learning content design and their usages in e-learning applications. Therefore, in present study, how the performance of students could be affected by influence of students' learning styles is explored. Depending on course requirements, mixed dimensions of Briggs learning styles, were taken into consideration in this study. Therefore, it was expected from results that learning facts would not only demonstrate employing strategy and effectiveness of matching word sequence visual maps but also provide students or learners to augment their personality, skills, motivations and achievements with the involvement of learning styles in digitized game based learning.

The entire paper has been structured as follows in which: Section 2 presents a related works on learning style and visual mapping. Section 3 presents development of an interactive word puzzle system using visual based approach. Section 4 presents the research design and experimental procedures to investigate impact of proposed approach on the learning behavior of students. Section 5 describes the results of investigation. Section 6 concludes the paper with a summary of the findings and potential research directions in current field of study.

2. Related works on learning style and visual mapping

Distinguished psychological experts defined learning styles as difference in understanding, evaluating and processing information based on learning processes [6]. According to Keefe's, learning style one is able to recognize how the individuals are able to understand different concepts and interacts with learning environment [7]. Learning process of individual would get disrupted if the learning content is delivered without knowing the skills, preferences and suitable learning style of learner. Due to this, varieties of learning styles have been proposed by educators to understand different behavior and features of individuals which classify them according to different learning aspects. In consideration with different learning instruments Kolbe introduced learning cycle theory which comprised of mainly four stages: Concrete Experience (CE), Reflective Observation (RO), Active Experimentation (AE) and Abstract Conceptualization (AC). Honey and Mumford developed a questionnaire which was based on Kolbes inventory and classified different individuals mainly into four categories as Activist, Theorist, Pragmatist and Reflector. To involve another aspect of learning dimensions like Active/Reflective, Visual/Verbal, Sensing/Intuitive and Sequential/Global model proposed by Felder–Silverman is incorporated into several learning studies [8]. Fleming proposed VARK driven learning style-based model which organizes learner mainly into four groups as Visual (V), Aural (A), Reading (R) and Kinesthetic (K). Later Myer and Briggs, introduced their questionnaire called Myers-Briggs Type Indicator (MBTI) which is effectively used for educational purposes [9]. MBTI uses four dimensional functions as: Extraversion/Introversion (E/I), Sensing/Intuition (S/N), Thinking/Feeling (T/F) and Judging/Perceiving (J/P). Due to strong validity of this model it has been widely recognized as most powerful tool among others to predict the behavior and learning style of an individual [10].

Although, in the past decades, several studies focused on considering Felder–Silverman learning style due to its effectiveness in developing impactful and personalized learning system. For example, Chen and Chiou have evaluated learning motivation of learners by considering active, reflective and sequential learning style into account [11]. Similarly, Hwang, G. J., Sung, H. Y., Hung, C. M., & Huang, I. developed an adaptive system for determining the learning achievements of learners by considering global and sequential learning style of Felder–Silverman index into account [12]. As of now, none of the researchers has considered MBTI learning style to determine the motivation level, cognitive level ability and learning achievements of individuals.

Therefore, among various learning styles mixed dimensions of two categories of MBTI was adopted in this study. The first category is ESTJ (Extraversion, Sensing, Thinking, Judging) and second category of learning style is INFP (Introversion, Intuition, Feeling, Perceiving) which was discussed earlier. Therefore, due to different style category it was predicted that combination of visual map embedded approach has different effects on students or learners with these two styles in comparison to conventional word puzzle system.

Visual mapping plays vital role in helping students through utilization of prior existing and newly gained knowledge by establishing visual links and relationships between the old and new knowledge, and motivate students towards meaningful and goal directed learning. The visual map technology has been used in different streams of natural science courses like plant breeding, defense based and arcade gaming which promotes learners or students and instructors to promote expertise thinking and enhance student knowledge structure with the usage of knowledge construction or learning tools. This tool also able to recognizes and manages the relationship between different concepts which help students to retain their gained knowledge. For example, in the research conducted by Khamparia and Pandey proposed visual mapping game-based learning environment to reduce student's anxiety and cognitive load, thereby enhancing their motivation level to learn a concept, overall personality to foster interpersonal skills and knowledge on life skills to encourage practical application of technology, in learning defense and military-based courses [13]. Similarly, Gwo-Jen Hwang, Han-Yu Sung & Hsuan Chang proposed concept map based interactive e-learning mode which improves the learning achievement and motivations of students [14]. Later, they found that method of concept enable mapping system did not improves the students' learning motivation. Liu

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