MEANINGFUL DATA ANALYTICS LEARNING IN HIGHER EDUCATION: ENGAGEMENT IN ONLINE CLASSES

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ABSTRACT

The implementation of full online teaching learning in Higher Educational institutions invites tangible challenges to sustain students interest and engagement in the course, throughout the semester. Meaningful learning encourges students to develop concepts constructively in active learning that promote the integration of knowledge in daily life and potential career applications. Meaningful learning also applies a richer application capabilities in synchronous or asynchronous learning system. Visualization is a technic to support concept description and imagination and provide an additional affective layer for learning towards increased motivation. In this paper, a discussion of active involvement of students using visualization in online data analytics courses at tertiary level is presented. Based on functional context principles of visualised course content, recommendations to practitioners are discussed

1.   INTRODUCTION

Online learning takes place in digital education, during the period of much challenging time, such as pandemic outbreak. Practically, online learning replaces the traditional face to face learning without much preparation by the educators in the swift. The online learning requires educators to plan their lesson well as to how to engage students in the learning materials and encourage them to understand and apply the learned concepts.

In online learning, active learning tasks using constructive and collaborative activities. Active learning plays an important role to engage students, develop their interest, and encourage them to participate in the learning process. Nevertheless, providing platforms and opportunities to communicate and discuss in online learning environments do not ensure the process of collaboration and engagement by itself (Muszynska 2020). One way to create the pre-

conditions for students' engagement involves visualisation for them to explore the concepts and relate to their own experiences and current knowledge (Yilmaz & Argun 2018).

In online learning process, instructors play their part as facilitators to actively involved in the discussion process (Naujokaitiene et al. 2020). Instructors facilitate the learning by giving clarification to any misunderstanding of concept meaning and interpretation. Instructors also provides guidance in clear presentation and communication to focus on the topic and generate alive interactions.

Instructors encourage students to relate new concepts being learned to existing cognitive structures through concept modification and construction of new links(Vallori 2014). This meaningful learning strategy produces a longer memory than memorization, as well as allowing real learning to take place to facilitate the transfer and application of learned cncepts to the real world (Guimarães et al. 2018; Priniski et al. 2018)]. Meaningful learning also helps students improve holistic skills covering cognitive, psychomotor and affective aspects (Ismail & Groccia 2018).

In data analytics courses, the meaningful learning approach appears suitable to be applied because its effectiveness helps students build a deeper statistical understanding and be able to transfer what they learn in the next class or in the real world (Garfield & Ben-zvi 2009). Meaningful learning content is enriched with emebeded elements that apply active, authentic, constructive, cooperative and objective (Fan et al. 2015).

In this paper, a discussion of active involvement of students using visualization in online data analytics courses at tertiary level is presented. Based on functional context principles of visualised course content, recommendations to practitioners are discussed.

2.   MEANINGFUL LEARNING IN HIGHER EDUCATION

This section describes meaningful learning in the context of its importance at the tertiary level. Meaningful learning is the process of associating new information with existing concepts in the cognitive structure (David P Ausubel & Fitzgerald 1961). The association of new concepts with existing concepts results in longer retention of information than memorization. These connections bring about changes in an individual's cognitive structure by modifying original concepts and new links are created. The three factors that influence meaningful learning are the existing cognitive structure, the stability of knowledge and the clarity of the knowledge being learned.

In meaningful learning, prior knowledge is considered to be most important in the teaching and learning process (D. P. Ausubel et al. 1980). In this way, new information is combined with existing ones to change the cognitive structure, significance and attribution of meaning. Students do not memorize, but learn with logical and meaningful meaning through planned activities such as play activities involving comics that manipulate intellectual development to understand ideas, develop skills and play social roles (Guimarães et al. 2018).

Meaningful learning refers to the effort to relate new concepts being learned to existing cognitive structures through concept modification and the construction of new links (Vallori 2014). This approach produces memory longer than memorization, as well as allowing real learning to take place to facilitate the transfer and application of learned concepts to the real world. Learning means emphasizing the active involvement of students in rewarding and challenging experiences involving real world situations as well as the application of knowledge to new situations (Karki et al. 2018).

Meaningful learning is an active process that promotes broader and deeper understanding concepts. The results of interactions between new and previous knowledge result in long -term changes in knowledge and skills (Cadorin et al. 2016). Meaningful learning occurs when

complex ideas and information are combined with students' own experiences and knowledge to form their own understandings.

Meaningful learning can only be achieved when the learning material is appropriate to students' cognitive structure (David P Ausubel & Fitzgerald 1961). he cognitive structure in question is the facts, concepts and generalizations learned and remembered by students (David P Ausubel 1962). Therefore, the suitability of learning materials should be commensurate with the ability and relevance of students' cognitive structure. Meaningful learning occurs when students understand the relevance learned to other knowledge. Thus, the intellectual and emotional factors of students are involved and active in learning activities.

Accordingly, there are three benefits of meaningful learning i.e. information learned meaningfully is longer remembered, new information associated with previously relevant concepts can enhance previously learned concepts, information learned even long not practiced can still be remembered by students and practiced to future. In addition, learning means not only strengthening existing capabilities, but also encouraging the development of skilled, knowledgeable human capital and attitudes to achieve greater levels of responsibility in the future. With meaningful learning, students are trained to carefully choose to connect new knowledge with prior knowledge possessed in their long-term memory as well as integrate new knowledge into their real-world workflows; so as to be flexible, innovative, efficient, and creative with technology (Vallori 2014).

Meaningful learning is successfully implemented when the learning environment has elements of active, constructive, purposeful, collaborative, and confronted with authentic topics (D. H. Jonassen & Strobel 2006). To ensure that meaningful learning is implemented, the use of technology should be mobilized to facilitate learning events that blend meaningful learning features that are interrelated, interactive and dependent (D. Jonassen 2003). This is because

technology is able to bring about a learning environment that stimulates, motivates, challenges, and actively engages students and interacts with learning materials.

In Malaysia, meaningful learning is a transformation launched at various levels of education to provide a fun and stimulating learning environment that is ready to be used in various aspects of life (Shariffah Sebran Jamila et al. 2017). Meaningful learning is considered to coincide with 21st century learning to prepare students who are critical thinking and able to solve problems in daily life (Siti NorFarahana & Siti Mistima 2017).

The emphasis on meaningful learning on the explicit relevance of learning content to daily life prompted researchers to apply this approach in teaching and learning (Annamalai et al. 2018; Ashfahani et al. 2017; Sailin & Mahmor 2017). Instructors play an important role in realizing meaningful learning by choosing the structure and context of learning carefully (Raihanah 2014). Instructors are able to stimulate and guide activities that trigger thinking among students about what they are doing (Ashfahani et al. 2017). In addition, the integration of hybrid learning and web technology is manipulated to promote a meaningful learning environment (Hamdan et al. 2015).

Having discussed the learning approach in detail, this study further discusses meaningful learning in tertiary-level data analytics courses in the next sub-section. These include emphasizing the importance of meaningful learning to address challenges and problems in data analytics learning, elaborating constructivist learning theories in meaningful learning and refining how meaningful learning can enhance conceptual understanding in data analytics courses.

3.   MEANINGFUL ONLINE DATA ANALYTICS LEARNING

The main reason for applying and designing a meaningful learning experience in online data analytics learning is because its effectiveness to help students build a deeper understanding of data analytics (Garfield & Ben-zvi 2009). Further, these students are expected to be able to transfer what they learn in the next class or in the real world. Moreover, traditional teaching approaches face serious problems involving students rarely having the opportunity to develop a deep understanding of what they are learning, and quickly forget it once they complete the course (Wessa 2009).

In a meaningful learning approach, course instructors act as coaches, study partners, or facilitators, rather than as intermediaries of knowledge in an instructor-centred classroom (Zieffler et al. 2018). Among the main roles of course instructors is to provide motivational challenges, to formulate and provide the criteria, planning, timeline, resources and support needed to ensure student success. Instructors are better suited to function as facilitators who guide students to deal with difficulties and problems that arise, than as dictatorial teachers.

Data analysis should be the focus for meaningful data analytics learning where interesting data sets motivate students to engage in activities, especially conducting appropriate analyzes and discussing how data collection methods and types of analysis used can affect research quality (Franklin & Garfield 2006). Learning should also train students with statistical reasoning skills and research -based activities as well as encourage collaboration, interaction and discussion (Garfield 2002). Such activities not only enhance short -term mastery, but also bring a positive influence on long -term retention, or depth of understanding of course material; fostering critical thinking and creative problem solving; the formation of a positive attitude towards the subject being taught, and increasing the level of confidence.

With the help of technology tools, students can gain support to develop statistical understanding and thinking using communication technology devices, graphing calculators,

games and gamification, the Internet, statistical software, and so on. Such tools are not only useful for producing data analytics including graph presentation and data visualization, but also help students visualize concepts and develop an understanding of abstract ideas through simulation (Chance et al. 2007; Neumann et al. 2011).

The availability of various learning materials in online learning allows students to access and provide learning materials in an environment that is their priority (Hamdan et al. 2015). Learning means more widely accepted in online learning where communication technology platforms make learning more relaxed and more accessible to students. Meaningful learning should lead to increased interest in learning because interested students can learn more effectively (Heddy et al. 2017).

Reliable and consistent learning materials encourage students to produce tangible and practical outputs and eventually be able to share with others. By incorporating authentic learning in the lecture room, course instructors can make it easier for students to engage all the senses to produce meaningful and rewarding learning outputs. Authentic learning can involve real-life assignments, or simulation tasks that give students the opportunity to connect directly with the real world.

In contrast to conventional data analytics classes, meaningful learning requires classroom discourse through carefully selected and designed activities and technologies (Chiou 2009). Effective classroom discourse features involve statistical arguments and explanations of how organized data elicit an understanding of the phenomenon being investigated; while students engage in an ongoing exchange of opinions that focus on important data analytical ideas (Cobb & McClain 2004).

4.   ENGAGING STUDENTS IN MEANINGFUL ONLINE LEARNING MODEL

Student engagement gets among the most attention from online learning educators and research community nowadays. In online higher education learning, the integration of technology aims to support learning process by increasing student engagement (Naujokaitiene et al. 2020). More discussion on recent development and trends in learning techniques and tools report enhancement of instructor and student interactions. These interactions contribute to student engagement positively.

In higher education online learning environment, learning process are integrated in student centred learning atmosphere. In this setting, instructors create such a learning environment that promotes a more active students' engagement. The setting encourages students to develop critical thinking skills. Active learning can be defined as a cognitive activity that involves students in doing something and thinking about the things they are doing. Therefore, in an online data analytics learning, students are exposed in various tasks so as to be able to explain, question, consolidate, and adapt new knowledge (Tan & Hew 2016). This is because learning is based on the process of appreciating new concepts. Students have the ability to learn and adapt to the environment through exploration and manipulation of the environment using available tools and information.

Active learning processes may diverse from various forms of tasks and learning activities. Active learning entails participation from students to boost them to think, research, reflect, and explore more about the learned topics. In a way, active learning acts as external motivators to support students to engage into deeper learning.

Active learning may works based on constructivism theory. Students build knowledge on conceptual understanding through interaction with previous knowledge while building confidence and intuition (Tishkovskaya & Lancaster 2012). Students are trained to leverage

their knowledge to be used in new and different situations. Students' ability to actively participate in the process of making meaning so that the knowledge they build is not inert or wasted (Mensah 2015).

Learning should be active and not passive or purely memorized. Active learning is achieved if students have autonomy in their own learning, by making decisions about their learning outcomes and appreciating the assignments given (Ab Halim & Siti Muhibah 2015). Active learning occurs when the ideas and concepts learned are implemented and tested on their own with minimal help from the instructor. In active data analytics learning, among the activities involved is asking students to solve problems on their own using the concepts learned based on the examples given. In this way, students deepen the use of statistical concepts and appreciate the learning problems that arise and find solutions to overcome them.

Active learning is definitely one of the student-cantered strategies that can involve various forms of activities in and out of the classroom (Fan et al. 2015). Active learning can attract students to be better prepared to follow the learning process with interest. This ability to learn on one's own is the ultimate goal of active learning. In addition, multilateral communication also results from an active learning process.

In online learning, students develop knowledge in a constructive manner as opposed to spoon feeding. The open boundary invites students to play an active role to control their learning, Students are stimulated to exhibit their critical thinking capacity, relate their knowledge to the existing events, reflect on them and get more actively involved in discussions. Instructors facilitate the learning process to foster students' engagement in many ways. For example, instructors can remind students engagement in the course content after the topic is discussed in the class, or to discuss the topic in advance to stimulate students' interest and allows them to construct their own knowledge.

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Contextual learning takes place in online learning to stimulate students' ability to relate the learned concept for real life application. Instructors who keen to provoke internal motivating factors using different tasks prepare students with deep learning. The surrounding allows students to exhibit elements of critical thinking skills. In terms of practicality, students get exposure to explain the subject matter in an everyday circumstance. Flexible and non-compulsory assignments enrich students with options that require them to reflect their current performance and learning target to achieve. Therefore, these learning activities aim to stimulate students' cognitive and affective progress. In student centred learning environment, students appreciate self-regulated learning and establish a more dynamic engagement in their learning progression.

In online learning, constructive learning encourages students to build their own understanding and knowledge about nature through their experience (Hill 2005). Thus, students are responsible for seeking their own knowledge and learning new things that can be utilized in developing their potential and skills (Mensah 2015). Knowledge can only be built on an individual's own understanding and cannot be transferred from the thoughts of one individual to the thoughts of another individual.

Constructive-based learning can balance the roles of instructors and students. In student-centred learning, students interact with learning materials and environments to gain understanding (Fan et al. 2015). Thus the concepts and solutions to learning problems are constructed by the students themselves by using their experiences selectively. Instructors act as facilitators in helping students actively build knowledge and solve problems. In this process, students will adapt the received knowledge to existing knowledge to build new knowledge. In addition to the facilitator, the instructor also acts as a designer of teaching materials in addition to identifying the existing knowledge of students and planning teaching methods in accordance with the nature of the knowledge base.

Constructive learning also promotes students to construct their own knowledge through collaborative activities. Fruitful outcomes from the collaboration stimulate students' peculiar interest and original apprehension. By exchanging their thoughts and perspective on the subject matter, collaboration members explore conceptual understanding in an interesting communication. Collaborative activities allow students to ask, negotiate and communicate with peers, stimulate their social presence significantly.

Collaborative learning refers to an environment in which a group of students is involved in a learning task and requires each individual to contribute to the group and be responsible to each other (Ahmad & Bayat 2012). Therefore, collaboration to find understanding, meaning or solution is important for creating an effective learning environment.

Peer networks built in collaborative groups allow students to support each other socially and academically including assisting students in dealing with common difficulties such as stress and isolation (Gibbs & Gil 2017). This network serves as a solid foundation in effective peer learning because there is a strong motivation and cumulative energy that has the potential to solve learning problems effectively where students feel comfortable and willing to share knowledge and experiences, exchange ideas, and help each other (C. Li et al. 2013).

5. CONCLUSIONS

This paper discusses in details approaches to engage students in meaningful online learning. The case applies implementation strategies in the teaching and learning of data analytics at the tertiary level. Meaningful learning approach suits data analytics courses because its effectiveness helps students build a deeper understanding of statistics and encourages the application of concepts in everyday life. Learning means by associating new concepts that are being learned with existing cognitive structures stimulate students to revisit their learning materials and consider modification of concepts. The construction of learning links so as to

produce memories supports stronger structure that take longer period than memorization, as well as enabling actual learning to take place.

`The paper proposes model of engaging students in meaningful online learning. Although the context applies data analytics learning, the general principles of meaningful learning could be generalised to wider circumstances in higher education learning. The model requires further evaluation in its validation and further discussion of its application. Therefore, the study recommends for future work to execute the model using empirical data on higher education learning. More research is welcomed to identify the successful practices of meaningful learning to observe students' behaviour and engagement and to inform instructors on the presence needed in order to develop student–centred activities in online learning.

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