Overview of the Biopsychosocial Effects of E-Learning and its Impact on The Academic Performance Among University Students

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ABSTRACT

Because of the COVID-19 pandemic, the world has to be under securitization of daily life in an effort to control the spread. The universities had to find alternative modes of learning to replace the traditional learning such as online learning (e-learning) which is facing a debate regarding its acceptance or refusal and its impact on the students and the learners' life. So, the current research aimed to review the physical, psychological and social effects of digital learning and its impact on the students' university performance. This is a narrative review article in which researches were reviewed and appraised regarding the type of the study, sample size, methodology of research, the country of origin, results obtained, limitation for each study, outcome and conclusion. Multiple scientific search engines including NCBI, Elsevier, JAMA Network, PubMed, Science Direct, ERIC (Education Resources Information Center), and Google Scholar. It was concluded that the effects of online learning on the learners and educators are not fully studied and still need more detailed research to understand these effects and how to avoid them. However, the most common effects include Musculoskeletal disorders (MSDs), computer-vision syndrome (CVS) and burnout syndrome. It is also found that a lack of computer skills has been identified as the main source of stress and anxiety among online learners. The relation or interaction between students with peers and/or educators is dependent on the own student's preferences either to feel constrained or prefer limited contact. Flexibility of time during e-learning can be preferred by some students but it still challenges the students' commitment to classes. The determinant factors of academic performance among online students are the academic program nature, self-learning skills of the students and the role of educators.

Introduction

With the power of internet, knowledge became on finger tips, just a click away without the need to travel to learn more things as in the past, all needed is a set of computer, hard drive and mobile network, everything is ready and the cost is less (Islam et al., 2011). Same as in all aspects of life, technology became important in the education world evoking the term of e-learning. E-learning is the use of internet technologies to enhance knowledge and performance (Ruiz et al., 2006). Online learning was initially created to give chance to those who are unable to be a full-time student. This group of students include those who work and wish to study at the same time. Today, the function of e-learning is broadened to include all form students, full time students or distance learners (Azhari and Ming, 2015).

Currently, the world is facing an existential threat which is the COVID-19 which has a capricious effects on life as it affects every aspect of livelihoods including education because of the securitization practiced to control the spread of the disease that included also securitizing face-to-face schooling to limit the virus social dissemination (Murphy, 2020). COVID-19 has a lower incidence rate but with severe symptoms as mortality is estimated lower when compared to SARS and MERS (Guarner, 2020) but the possibility for asymptomatic transmission (Li et al., 2020) and the lower rate of youth presentation of symptoms increase this threat. Thus, social distancing became a necessary practice through

securitization by the government which include securitising face-to-face schooling which is shutting down of education at university, colleges and school in hopes that it could help to reduce total fatalities due to COVID-19 and flatten the infection curve (Murphy, 2020).

Therefore, it is important to know the effect of e-learning among university students .The effect is mostly positive such as it provides flexibility, access to the global world, help students to be actively engaged, tutor response faster, tutor feedback useful ,enhance students learning, making education easier and assignment marked prompt (Salamat et al., 2018). There are also drawbacks such as musculoskeletal disorder (Sirajudeen et al, 2018), computer vision syndrome (Reddy et al., 2013), social isolation (Beccaria, 2013), loss of family interaction (Lee and Martin, 2017 and Beccaria, 2013), burnout syndrome (Pavlakis and Kaitelidou, 2012) and poor academic performance (Jaggars and Xu (2016). So, this research aims to review the effects of e-learning on university students including biological, psychological and social as well as the impact of online learning on academic performance.

Methodology

This research is a review for the different effect of online learning on university students, that was implemented by searching the scientific search engines including NCBI, Elsevier, JAMA Network, PubMed, Science Direct, ERIC (Education Resources Information Center), and Google

Scholar in English terms using keywords including e-(or e) learning, web-based learning, online learning, virtual learning, mobile learning, tertiary education, university, psychological, biological, social, academic achievement. The articles included in the research were published in Scopus journals within 20 years late, including university students, from different countries (North America, South America, Asia, Australia, Africa) and researches about online programs evaluation. The chosen articles were appraised regarding the type of the study, sample size, methodology of research, the country of origin, results obtained, limitation for each study, outcome and conclusion to reach a conclusion regarding effects of e-learning from various aspects.

Computer Vision Syndrome (Cvs):

CVS is a group of visual symptoms related to using the computer. According to the American Optometric Association, these symptoms may be caused by inadequate lighting, glare on a display screen, improper viewing distances, bad sitting posture, uncorrected vision problems, a mixture of these causes (Kandola, 2020). In Malaysia, 90% of university students among five universities (International Medical University, University Putra Malaysia, Multimedia University, Melaka Campus, Melaka Manipal Medical College, Penang Medical College) experienced one or more symptoms of CVS symptoms (Reddy et al., 2013). In Egypt, 86% of the students among the Medical Students in Sohag University Hospital were accustomed to using their digital screens 3 hours or more daily which made them very liable to suffer from one or more CVS manifestations (Iqbal et al., 2018). In Pakistan, 67.2% of medical students of Bahria University Medical and Dental, Karachi, claimed that they have experienced at least (headache, eye fatigue, burning sensation, eye irritation, neck shoulder pain) related to CVS (Noreen et al.,2016). In Saudi Arabia, 95% of undergraduate medical students at King Abdulaziz University, Jeddah reported at least one symptom during studying using computers. The most frequently reported symptoms were excessive tearing and neck, shoulder, or back pain (Abudawood et al.,2020).

Even with exclusion of students using drugs that affected visual health, diagnosed with underlying systemic diseases such as diabetes, hypertension, or pre-existing eye diseases, symptoms of CVS are confirmed to occur during online learning (Noreen et al., 2016).

The relationship between experiencing CVS and refractive errors has been studied but the conclusions are variable. It was observed that Students wearing spectacles experienced CVS symptoms much more often than those who were not wearing spectacles (Reddy et al, 2013) while another study showed the use of spectacles or contact lenses showed no association with CVS (Abudawood et al., 2020). However, Reddy et al. (2013) concluded that CVS has no association with refractive error such as myope or hyper myope while, Abudawood et al. (2020) concluded that dry eye disease and astigmatism are closely related to CVS. So, it can be concluded that multiple factors can contribute to CVS development such as having underlying eye problems that will be more likely to develop CVS. Future research is suggested to compare refractive error populations and

students with those with no eye problems or risk factors that cause CVS.

Symptoms of CVS worsen with less frequent breaks (Noreen et al., 2016). Those who did not take breaks during studying had a higher chance of tearing, double vision, change in visualizing colors, and neck, shoulder, or back pain (Abudawood et al., 2020).

To avoid or overcome CVS, some studies advised like to see distant objects in between work, eye massage (Reddy et al., 2013) and topical eye drops were used among the Medical Students at Sohag University Hospital, Egypt to treat the dry eye (Iqbal et al., 2018). The 20-20-20 rule is a technique to prevent CVS through breaking every 20 minutes by taking 20 seconds looking at something 20 feet away during the long sessions of using the computer (AOA, 2016). This technique was recommended by the American Optometry Association (AOA, 2016) and supported by different studies (Abudawood et al., 2020 and Noreen et al., 2016) to be used as a preventive measure for CVS. Also, the use of radiation reducing filters on the monitor has been studied with CVS but unfortunately did not help to ease the symptoms (Reddy et al., 2013). Still studies are needed to test effective interventions to prevent or alleviate symptoms of CVS

Musculoskeletal Disorders (Msds)

On studying the physical effects that may be suffered because of long use of electronic devices during e learning, it was reported that more than half of university students in Majmaah region - Saudi Arabia had suffered either musculoskeletal disorders, visual symptoms, or sleep disorders. Females were more common to complain neck and shoulder pain (Sirajudeen et al., 2018) that was explained by possible biological gender differences in metabolism, physical structures, or hormonal variations, affecting transmission, sensitivity, and perception of pain (Tittiranonda et al,1999). By reviewing the related articles, it is recommended to have further cohort studies to cover other risk factors like age, race and Body Mass Index.

The risk factor contributing to the development of MSDs of shoulder, elbow, and wrist/hand is prolonged use of computers without insufficient break interval (Sirajudeen et al.,2018). However, the Health Science undergraduates in UniversitiKebangsaan Malaysia (UKM) showed that gender, body mass index, and hours spent in sports and physical activity were not associated with low back pain (Nordin et al.,2014). Hence, the lower back pain could be multifactorial.

Overall, the MSDs should not be underlooked as many students do buy over the counter medication to relieve the symptoms of muscle and skeletal problems, headaches, stress and cardiovascular problems (Pavlakis et al.,2011). Recommendations were given to minimize low back pain such as improving physical fitness, practicing frequent breaks and stretching during sitting (Nordin et al.,2014).

The participants who did not use an external mouse while using laptops were more likely to develop MSDs of the upper limb and spine (Sirajudeen et al.,2018). Carpal tunnel syndrome is more common in working people, students with intensive use of mouse and Gamers spend 6-8 hours a day playing computer games. Frequent mouse-clicking, using

wheel scrolling and dragging the mouse could lead to carpal tunnel syndrome (Maiberg, 2015).

The limitation of the above studies is that the population studied was carried out without any information about their medical condition and no physical examination was carried out on the population studied. Despite this, these studies show that there was a high prevalence of computer-related syndrome which should not be neglected.

Beside there are more side effects has been detected in association with the use of cell phone especially with using more than one cell phone (79%), sinceabout 5 – 10 years (41.9%), for more than 5 hours daily (65.7%), for entertainment (34.3%), andmaking about 1-5 calls daily (41%), with average call duration 1 – 30 min (56.2%), start using cell phone at age 7 – 12 years old (66.7%), mostly handheld (61%), at right side (40%),at all times of the day (64.8%). Most common side effects associated with cell phone usageinclude ear pain (52.4%), headache (79.5%), fatigue, anxiety or insomnia (57.8%), tremors and eye painbeside statistically significant (P<0.05) complain of dry mouth (56.6%) and/or bad odour mouth (46.4%). It is concluded that there is a specific pattern associated with occurrence of side effects due to cell phone use (Attalla et al., 2020(a)).

Psychosocial Effects

What students think and feel during class are as important as their physical health because it can also affect their learning process and academic achievements. Recently, education has undergone a drastic change where students are forced to study online due to a Covid-19 pandemic. So, it is important to study how online learning can affect student's psychological well-being.

Motivation to learn is very important to students because it is like a source of energy that makes the students move forward. Highly motivated learners mean that they have passion, more efforts, and encouragement to learn than the less motivated learners. These include internal and external motivators (Widjaja and Chen, 2017). In the Urban Public University in the Southwest of the United States, 85.88 per cent of students participating in an online course stated that they were more driven by external factors, such as gaining participation points and completing the course. However, only some students were intrinsically motivated because they wanted to expand their knowledge and want to learn something new (Lee and Martin, 2017). On the other hand, a research in Midwestern University studied how the engagement of students in online discussions contributed to intrinsic motivation. The results showed that students are engaged in online discussion if they feel that the class is enjoyable, interesting and valuable (Xie et al.,2006) while, (El-Seoud et al., 2014) pointed out that self-motivation is one of the crucial factors for students' success in online learning.

As long as intrinsic and extrinsic motivators affect the ability of students to stay engaged in the online learning process, it should be taken in account to observe how online classrooms influence the motivation of the students.

A study of the impact of online education on students at the Virtual University of Pakistan revealed that online learning enhanced students' motivation. Out of 90 students, 49%

voted that e-learning is better than traditional classroom, may be because they find it more flexible (Akhter and Mahmood 2019) which indicates thatonline learning enables students to learn in a way that genuinely interests them instead of being forced to learn in a certain way.

Teachers play an important role to sustain students' motivation. The students were found to be more encouraged to participate in online discussion when the teachers appreciated their hard work (Xie et al., 2006). So, teachers need to change their method of teaching to suit the online environment in order to motivate students in online learning (El-Seoud et al., 2014).

The user friendly and well-structured websites enhance the students' interest in participating in online discussions easily and facilitate other functions such as quoting and voting that (Xie et al., 2006).

It can be concluded that students are more likely to be enthusiastic about learning if their works are valued and recognized. Besides, teachers must use a platform that is accessible by all students for instance Google Classrooms, Zoom meetings or other websites where teachers can share the learning materials and be able to communicate with students through chat rooms or online meetings.

Stressis another effect that is associated with e-learning in some researches. Ninety percent of the first year's students at a distance learning program in Open University of Crypus had stress and feeling anxious mainly regarding the fulfillment of course requirements and time pressure (Pavlakis and Kaitelidou, 2012). Most of the distance education students in University of Cape, Ghana. were stressed due to high academic workload, frequent number of examinations, financial and family problems. Praying or meditation was the most effective method that helped them to overcome their stress, followed by self-distracting such as watching television or listening to the music and emotional support (Kwaah and Essilfie, 2017). It can be noticed that in the previous two studies, respondents are adult learners that are employed and married that means having more commitments therefore likely to have a higher stress level compared to younger learners, so more research is needed to explore the level of stress at different ages.

Anxiety: Data collected from 96 students that participate in online class revealed that they have computer anxiety, internet anxiety, talking in virtual groups and online test anxiety. They were anxious because of technical aspects of computers (26 students), being the centre of attention (19 students), feeling embarrassed for not understanding the language (8 students), and 10 students stated that they had symptoms of anxiety such as sweaty hands and tremors before an online test (Nazime and Huseyin, 2010). Distance learning students in Allama Iqbal Open University reported that ineffective communication between students and tutors, lack of guidance from the tutors and lack of interaction between students and faculty management causing anxiety (Ajmal and Ahmad, 2019).Generally , online learners had a higher level of anxiety than on-campus students. Their anxiety is mainly related to technology, course requirements, and personal problems (Devaney, 2010). In addition, emotional changes were observed among adult learners enrolled in an online educational programme in a higher education institute in Malaysia throughout one academic semester. It is reported that they felt negative

emotions while using technology during learning. Due to lack of technology skills, they were worried and uncertain where their submitted assignments went after they pressed the 'submit' button (Ch'ng, 2019). Hence it is recommended that students should have the necessary computer skills to overcome these challenges before joining the online class (El-Seoud et al., 2014).

Burnout syndrome is an individual's mental and physical exhaustion due to excessive and prolonged stress. People experiencing burnout syndrome often have negative emotions and poor self-esteem. Over one third of the students experienced a high burnout level, 35.6% of them had high emotional fatigue, 25.5% had high depersonalization level and 45.1% had a lack of personal achievements (Pavlakis and Kaitelidou, 2012).

The social interaction of students with their peers and educators is challenged during e-learning as they will only interact through asynchronous written communication and not by the traditional face-to-face. Poor social and physical links of students with their friends and educators will lead them to have difficulties with their studies as well as generate confusion on how they were going and they may experience loneliness due to lack of social connectedness (Beccaria, 2013). Besides, e-learning puts students in isolation, distance and lack of contact with their educators leading the students to not have the opportunity to enjoy their student's campus life (Narayanan and Selvanathan, 2016). The affable attitude, dependability, promptness and immediacy of the educators are key elements which help to create a sense of community in e-learning courses. Some students feel less need to interact with their friends. They do not really take initiative to interact between each other even though they agree that discussing with their fellow peers contributes to finding answers to queries and to alleviate negative emotions (Angelaki and Mavroidis, 2013).

Most of the students said that limited interactions with their peers caused them to have a stressful learning experience (Alibak et al., 2019). While others consider e-learning alleviates constraints of academic interactions as they communicate through asynchronous written correspondence. Thus, students are likely to experience less interference from their instructors, and less pressure to answer questions from them (Bettinger et al., 2017) and feel that e-learning is a good option to avoid their educators' contact (Alshahrani et al., 2017). Marketing students in a large Australian university ensured that the loss of face-to-face interaction between educators and students is not an issue for e-learning. However, some students did mention that e-learning caused them to have loss of motivation, feeling bored and having difficulties in teamwork which may be due to lack of links with their classmates (Loh et al., 2016). It should be noticed that the data from this study has been collected from marketing students and from only one institution, also the sample size was relatively small that makes the results difficult to be generalized among all students.

Conclusively the relation between students with peers and/or educators is dependent on the own student's preferences either to feel constrained or prefer limited contact.

Flexibility and convenience can be considered by some students as an advantage of e-learning especially for older students with family and work responsibilities. Thus, e-learning benefits them as they can still pursue a degree without having to attend classes at the campus (Lee and Martin, 2017). Also, students may participate in classes from anywhere at any time of the day and this flexibility could help students to better distribute time and energy (Bettinger et al., 2017). Moreover, presenting or discussing clinical cases in the radiology department between students and educators was done easily with both parties being at different locations and only by using electronic devices (Pinto et al., 2011).

Despite having flexibility of time, some students faced challenges in trying to manage their study time with family time, which impact negatively on their academic performance and may lead them to discontinue their studies (Lee and Martin, 2017 and Beccaria, 2013). Students with undisciplined behaviour as they might forget their schedules (Bettinger et al., 2017). So, academic staff should be more cognisant of students' time constraints and greater consideration should be considered for those with family or work commitments (Beccaria, 2013).

Impact Of E-Learning On Academic Performance

Academic performance is measured by students' GPA/CGPA as it provides good insight in the level of performance of individuals (Masrom,2015). Online learning makes use of telecommunications technology and provides students with the ability to learn online and facilitates their learning, thereby enhancing their academic performance.

Academic programis a major determinant factor for academic performance during e-learning (Cavanaugh and Jacquemin, 2015). An American study had concluded that some disciplines may not be well suited to online delivery like Finance, Human Resources Management and Accounting as they have low completion rates, which means they have high failure rate if they are taking the course in online delivery method, but as for Reading, Health and Special Education have the highest completion rates and can obtained a good grade by just using online delivery method (Atchley et al., 2013). American students atface-to-face Environmental Science class achieved highest percentage of A's (63.60%) as compared to online class (36.40%) (Paul and Jefferson, 2019) that can be related to the nature of the environmental science that is concerned about the interrelationships between human activities and the environment. Thus, face to face interactions is the suitable delivery method for them to gain as much as learning experiences and achieve good grades.

Subjects that are not suitable for e-learning include those require calculation as the students will face difficulty trying to understand these subjects when their educators use pure e-learning as a tool for teaching (Narayanan and Selvanathan, 2016)and those require hands on procedural involvement e.g., radiology(Pinto et al., 2011).

So, future researches are suggested to have a more comprehensive study design so that students' academic performance can be assessed carefully in a particular time and also in different courses.

The second factor that impacts academic performance among online students is the self-learning skill. The more

skill the student has, the more benefit to get from e-learning. Self-directed e-learning can promote the student's independent efforts instead of relying on their teachers and also can trigger their critical thinking process as they will find multiple answers or information with their own efforts (Zare et al, 2016).The factors affecting the students' intention to practice M-learning include the students' attitude, perceived usefulness, perceived ease of use, and availability of resources(Attalla et al., 2012 &Attalla et al., 2020(b)). 40% of students preferred e-learning in comparison face to face learning (Nur Nabila and Jalal, 2017).

It is proved that practice of m-learning is affecting the future practice of m-medicine (Abdel-Wahab et al., 2008). Higher education students from United Kingdom, Saudi Arabia and Kenya from various academic discipline became more self-reliant and more confident when searching for information online as they agree that the internet offers them the option to prepare before class begins and confirms that they need fewer explanation of the information provided by their educators (Alshahrani et al., 2017).

Another factor that affects academic performance during e-learning is the degree of student's interaction. Low interactions during online classes may make it more difficult for the students to identify peers, gain support, discuss, explain, and work with other students that may lead to a low academic performance (Jaggars and Xu, 2016, and Broadbent, 2017). Students with interaction rating of 2 out of 4 had an estimated course grade of 2.27, or a C− and it was suggested that if the same student took a course with an interaction rating of 3, his or her estimated course grade would have risen to 2.67, or a C+ (Jaggars and Xu (2016). Hence, interaction among them is important as it can build a support system and also gain confidence among the students to participate and give opinions in their learning, hence they will develop a positive attitude towards their learning (Jasper et al, 2012). Similarly, many online students have failed compared to traditional students and the students expressed frustrations about non-responsive group members in the group project setting, which may contribute to lower grade (Ni, 2013).

Students need to develop good interactive skills with their lecturers because it impacts student self-assessment of learning regardless of quality of the online course design (Castle and McGuire, 2010). Therefore, the role of lecturers is an important factor in the online students' academic performance. Lecturers must be proactive by giving adequate teaching material that is essential for students' satisfaction. Lecturers need to always actively invite student questions through a variety of modalities, respond quickly to student queries, ask for and incorporate student feedback, and show a sense of "caring" environment that encouraged online students to commit to the course and perform at a higher academic level (Jaggars and Xu, 2016).

An analytical study done in the United States showed the students form various disciplines ranked online delivery of education more than traditional methods/ onsite learning (Castle and McGuire, 2010 and Cavanaugh and Jacquemin, 2015). This is probably because the students showed more interest in advanced technology intervention such as animations or fun illustration. Besides, online video calls can be similar to face to face discussion/learning that ensure

a strong interaction (Castle and McGuire, 2010).So, the lecturers should be creative in preparing the learning materials, conducting the class in a unique way to attract students ' interest, and often interacting with students to ensure that their performance can be carefully assessed and upgraded so that the learning objective can be targeted.

Conclusions

Throughout this review study, it is found that e-learning can have positive or negative effects on the students. Physically, e-learning can be associated with Musculoskeletal disorders (MSDs), computer-vision syndrome (CVS) and burnout syndrome. Vulnerable students include female, those with underlying eyesight problems and prolonged computer use without adequate rest.

From a psychological point of view, students are required to have a high degree of self-motivation to maintain their engagement in online learning. Stress has become part of students' life. However, chronic stress can affect students physically, mentally and emotionally (burnout syndrome). However, with proper time management, self-motivation, and guidance from tutors, all of the problems may be overcomed. The interaction between students with peers and educators is dependent on the own student's preferences either to feel constrained or prefer limited contact. Flexibility of time during e-learning can be preferred by some students but it still challenges the students' commitment to classes.

The relationship between e-learning and academic performance is inconsistent as being multifactorial depending on academic programmes, students' self learning skills and the role of educators.

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