ISSN 2462-2052 *Journal of Science and Mathematics Letters*
DOI: https://doi.org/10.37134/jsml.vol11.1.12.2023 *Volume 11, Issue 1, 83-90, 2023*

RESEARCH ARTICLE

The Development of an Interactive Learning Module for Physics Subject in Post-Secondary Institution: A Need Analysis

Mazlina Mat Darus[1*], Hazimah Ashamuddin[2], Nurul Syafiqah Yap Abdullah[1]

[1]Department of Physics, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjong Malim, Perak, Malaysia
[2]Matriculation Division, Ministry of Education, Malaysia
*Corresponding author: mazlina.md@fsmt.upsi.edu.my

Received: 12 January 2023; **Accepted:** 20 March 2023; **Published:** 22 March 2023

ABSTRACT

New approach in teaching and learning (T&L) is essential to sustain the evolvement of knowledge towards a borderless frame. One way to achieve this is by utilizing technology, particularly in T&L with the aim to scaffold the process of knowledge transfer efficiently. In order to adapt to the changes, educators must keep their pace synchronized with the latest innovation in teaching tools, which is common in the field of e-learning. The lack of T & L tools, particularly in learning Physics subjects and the challenges in mastering the concepts are the motivation for a need analysis to be carried out for post-secondary students. This study is crucial to elucidate the actual needs among educators as well as students and to address the choice of topics and preferable methods. The respondent of this study consists of 38 Physics lecturers from eight matriculation colleges under the Ministry of Education, Malaysia, selected through random sampling. A survey form was developed and validated by four experts and data were collected by distributing the survey form randomly. Data were analysed based on the descriptive analysis method. There were four important outcomes regarding the common needs among the educators (1) A swift effort is required to develop an interactive module for T&L using a smartphone; (2) Electromagnetism is the most challenging topic among students; (3) The root cause of the problem arises is due to the inability to visualize the physics concepts; and (4) Simulation, videos, smart apps, and exercises are the aspects that need to be considered in developing the interactive module. Based on these findings, the development of an interactive module for the Electromagnetism topic using smartphone is inevitable with the aim to facilitate the T&L process and enhance students' understandings.

Keywords: need analysis, interactive module, smartphone, electromagnetism

1. INTRODUCTION

The education system is in urgent need to move rapidly corresponding to the evolvement of industrial revolution 4.0 (IR 4.0). The spread of Covid-19 pandemic has motivated teachers and educators around the world to have alternative experiences in the learning plan to achieve their teaching and learning objectives (Kumar et al., 2020). During the outbreak, online learning has become the only method to provide students with continuous education (Muhamad Nasri et al., 2020). The approach and methods used must be equipped with cyber-physical system technology. The idea of the Internet of things (IOT), which enables people to connect regardless of time and place, especially with the use of a device such as a computer, tablet, and smartphone, is beneficial particularly in education. The integration of technological tools and media in the learning process provides an equal opportunity for both educators and learners to experience sophisticated T&L activities. One way to achieve this is by using a smartphone for education purposes, which embeds with a specific application (Apps) that contains appropriate learning theories, methods, and activities especially in science education (Kalogiannakis et al., 2018; Papadakis & Kalogiannakis, 2017). Although there were vigorous debates on the effects of utilizing technology in T&L, well-designed learning materials can give positive impacts towards students' learning (Branch, 2009). The use of smartphones can facilitate towards engagement, attainment, and excitement in students' learning experience apart from convenience at all times (Clemente et al., 2017; Li et al., 2016). On top of that, it can also be strategically crafted into a meaningful learning plan (Aji et al., 2018; Morris et al., 2016; Papadakis & Kalogiannakis, 2017; Yildirim & Sensoy, 2018). Since the use of smartphones in daily life is common, particularly among youngsters, hence it is an advantage to engage students in learning via smartphone.

In order to cope with the current trend, the improvement in pedagogical tools and learning approaches is inevitable to ensure the education system is synchronized with technology advancement (Alias et al., 2020). A systematic approach in T&L must be designed to engage learners, specifically post-secondary or university students, in the learning process. Hence, a radical change in the pedagogical approach is essential. Generally, the traditional teaching method is still being adopted widely, for example, chalk and talk, slide presentation, exam oriented, drilling, and memorizing. This method, however, seems to be outdated and unable to engage and cultivate students' interest in learning, especially in the science subject (Cardinot & Fairfield, 2019). This may be one of the factors which contributes to the decreasing number of student's enrolment in the science stream (Karacop, 2017; Phang et al., 2014). It is an alarming scenario which results in a lesser number of students specialising in a career related to science and engineering. This situation is impeding the expectation of Ministry of Education towards the 60:40 policy and the requirement of human capital in facing the challenge of IR 4.0.

Physics subject is one of the most challenging subjects in the science stream. Many students experience difficulties in understanding the fundamentals of physics concepts (Mazlan, 2018; Saleh & Mazlan, 2019). This problem contributes towards a negative perception of the subject itself. Apart from that, there are also a few other issues which are related such as; (1) The use of traditional methods in teaching and learning Physics, (2) Lack of good resources, (3) Students' negative attitude, (4) Problems in using technology, (5) Readiness of Physics teachers, (6) Inaccurate assessment and (7) Topics are abstract and require 3D visualisation, (Cepni et al., 2006; Halim et al., 2014; Phang et al., 2014; Plotz & Hopf, 2016). Reports from previous studies stated that Electromagnetism is one of the most challenging topics (Karacop, 2017; Sağlam, 2010). This topic is compulsory for science stream students to learn from the secondary level up to tertiary level. It is a challenging topic since it involves with non-visualized concepts and many mathematical calculations and formulas (Cai et al., 2017; Karacop, 2017; Li & Singh, 2012; Mueanploy, 2016; Zajkov et al., 2017). In a study conducted by Barma & Daniel (2017), most students failed in the exam which involves the concept of this topic. In other countries, many studies have been conducted related to Electromagnetism and the methods used are vast including simulation, augmented reality, video game learning, and remote laboratories to increase students' understanding (Astra & Fitri, 2017; Chou, & Shyu, 2017; Hookway et at., 2013; Li et al., 2016; Potkonjak et al., 2016). For instance, among the challenges in learning this topic is the inability to visualize the concept of magnetic force between bar magnets by stating the net force on the middle bar magnet to be zero. Apart from that students also encountered difficulties in understanding the movement of a charged particle in a magnetic field, unable to distinguish interaction between parallel current carrying wires and static charges (Li & Singh, 2017). Through simulations and interactive features, the appearance of magnetic field, the change in the magnetic flux, and the direction of the induced current can be visualized and manipulated in different settings, which can help students to have a better understanding of this topic.

However, in Malaysia, not many findings can be referred to regarding this issue among post-secondary students, particularly in Matriculation Colleges (Kadir & Badlilshah, 2016; Othman et al., 2017). The root causes of this issue emerged during secondary school level and were carried up to post-secondary and tertiary level. Apart from Physics being a challenging subject and the lack of T&L tools to facilitate both educators and students, it is crucial to establish a systematic study and at the same time develop an effective method to overcome the difficulties in learning Physics exclusively for post-secondary students. In this study, a need analysis is conducted to assess the selection of the critical topics and methods engaged (Richey & Klein, 2014; Siraj et al., 2013). This study aims to identify the current requirements of post-secondary students in learning physics and to provide a solution. The objective of this study is to develop a learning tool via an interactive module using a smartphone for physics subjects among post-secondary students. The selection of the method and topic is based on the feedback from the educators. Several issues need to be addressed including, (1) is there any necessity to develop an interactive module as a learning tool?, (2) what is the most challenging topic?, (3) what are the factors that contribute to these challenges?, and (4) what are the elements to be included in the interactive module?.

Feedback from educators is vital in getting accurate information before embarking on design and system development (Muslimin et al., 2017). Since the use of a smartphone has become popular among students, it is an advantage to utilize the smartphone as a learning tool. Response from the feedback indicates that the development of an interactive module using a smartphone is necessary and the topic with the highest vote is electromagnetism as the most challenging topic.

2. METHODOLOGY

This study employs a descriptive analysis method. We have developed a set of survey questions and distributed through an online need analysis survey form. The survey form had been validated by four experts in the physics education field, with more than 15 years of teaching experience. The validity of the instrument is analyzed based on the Content Validation Index (CVI). The average value of CVI obtained is greater than 0.8, hence considered as an acceptable CVI coefficient value (Davis, 1992). This study uses the following CVI formula (Polit & Beck, 2006), as shown in Eq. 1 and Eq. 2 below:

$$\text{Item Content Validity Index (CVI)} = \frac{Total\ agreement\ of\ expert}{Total\ number\ of\ expert} \quad \text{----------- (Eq. 1)}$$

$$\text{Average Content Validity Index (CVI)} = \frac{Total\ CVI}{Number\ of\ items} \quad \text{----------- (Eq. 2)}$$

The item CVI value is calculated using Eq. 1, and the average CVI value is 0.96, which calculated using Eq. 2 formula (2) and the details are shown in Table 1. The obtained average CVI value is more than 0.8; thus, the value is accepted. The surveys were randomly distributed to the respondents, which consisted of 38 educators from post-secondary colleges. There are a total of 150 physics educators from all colleges and according to Gay et al. (1992) and Roscoe (1975), for a small population in a descriptive study; the minimum number of respondents is 20% of the population.

Table 1. Content Validity Index (CVI)

Expert	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5	ITEM 6	Proportion relevant
Expert 1	/	/	/	/	/	/	1.0
Expert 2	/	/	/	/	/	/	1.0
Expert 3	/	/	-	/	/	/	0.75
Expert 4	/	/	/	/	/	/	1.0
No. of agreement	4	4	3	4	4	4	
Item CVI	1.0	1.0	0.75	1.0	1.0	1.0	0.96

3. RESULTS AND DISCUSSION

The survey form consists of two parts. The first part is about the profile description of the respondents including gender and teaching experience as shown in Table 2. Most of the respondents are female, and the majority of them possess more than five years of teaching experience. Meanwhile, the second part comprises a set of survey questions, as depicted in Table 3. This section focuses on the feedback regarding the requirement of developing an interactive learning tool for the specified topics of concern.

Table 2. Respondents' profiles

Respondents' Profiles	Description	Numbers of respondent
Gender	Females	30
	Males	8
Teaching Experience (years)	1-5	7
	6-10	10
	11-15	12
	16-20	5
	More than 20	4

Table 3. Analysed data from need analysis survey form

Question	Description	Percentage (%)
1. Is there any necessity to develop an interactive module using a smartphone?	Agree	86.8
	Perhaps	13.2
	Do not agree	0
2. Based on your experience, which topics do you think the students feel challenging and weary? (You can choose maximum three topics)	Thermodynamics	0
	Modern Physics	13.2
	Electric	36.8
	Electromagnetism	57.9
	Light	26.3
	Waves	42.1
	Heat	5.3
	Mechanics	10.5
3. In your opinion, what are the challenges that hinder students' interest? (You can choose more than one)	Unable to visualize the concepts	81.6
	Limited time and teaching techniques	5.3
	A lot of problem-solving	2.6
	A lot of definition and misconception	50
	Many concepts need to be acquired	13.2
	Others	0
4. If an interactive module is to be developed, what type of learning materials should be included?	Exercise	36.8
	Notes	2.6
	Video	71.1
	Experiment	13.2
	Mobile application	42.1
	Simulation	73.7
	Others	0

3.1. Development of interactive modules

From this need analysis study, almost all respondents agreed that an interactive module is required to be developed in helping students to have better understandings in learning physics. As can be seen from Table 3, 86.8% of the respondents agreed that there is a necessity to develop an interactive module, while 13.2% were not sure of the need to have a learning tool. None of them disagree. This clearly shows that there is a need to develop an interactive module to support the learning process.

3.2. Selection of critical topics

It is found that the most challenging topic is electromagnetism based on the feedback that we received. Results show that 57.9% of the respondents agreed that the most challenging topic is Electromagnetism, followed by Waves and Electric (42.1% and 36.8% respectively). It is also found that all respondents agreed that thermodynamics is not a critical topic at all. The feedback shows one-third of the respondents with more than fifteen years of teaching experience and most of them (55%) agreed that electromagnetism is the most challenging topic among students. It is an important indicator of the topics of concern and to address the challenges in teaching and learning the specified topics. Findings from previous studies conducted in other countries also found that Electromagnetism is one of the critical topics in learning Physics (Cai et al., 2017; Chou et al., 2017; Li & Singh, 2012; Singh, 2005; Zajkov et al., 2017). This topic is a major concern among students and causes them to have a negative perception in learning Physics (Abu & Eu, 2017). Our findings confirmed that the core challenge in learning Electromagnetism in post-secondary colleges in Malaysia is similar to other studies which reported on the inability of students to visualize the Physics concept (Alias et al., 2014; Singh, 2008; Wang et al., 2017). This is the major obstacle in acquiring cognitive skills which resulted in students memorizing the content and formula solely. A temporary solution would be focusing on solving the past year questions, which is commonly a practice (Osman et al., 2006). However this in turn caused students to be unable in applying physics concepts in reality (Kelley & Knowles, 2016; Li et al., 2016). The lack of ability in relating concepts to real-life situations leads to boredom among students in learning physics.

3.3. Challenges in learning Physics

Among all listed challenges, the majority of the respondents (81.6%) had reached a consensus that the difficulties in visualizing the related fundamental concepts are the major obstacles in learning physics. Apart from having misconceptions in acquiring the correct concepts as well as problem-solving skills which also hinder students ability in understanding the physics concepts. In a study by Bestiantono et al. (2019), most students have a misconception in identifying the influence of magnets on the charge and they hold an inaccurate concept on electricity and magnetism influence. Students also encountered difficulties in determining the influence of the loop by having a wrong interpretation in determining the brightest lamp on a closed-loop. The issues above can be rectified by showing students the effects of real time event via interactive simulations by varying and manipulating parameters related to the concepts.

3.4. Elements of the interactive module

One of the criteria to be considered is the type of learning materials to be included in the module. Respondents were asked to give their opinions and most of them selected for video and simulations (73.7% and 71.1% respectively) to be included in the interactive module. These are among the most important elements to be embedded in supporting T&L. Other than that, mobile application (42.1%) and exercises (36.8%) are also among the popular elements to be included as well. However, the top choices made by respondents with fifteen years of experience in teaching were video or simulation or both video and simulation.

Hence, the feedback clearly indicates the urgent need to have an interactive teaching module which consists of videos and simulations to support T&L. An advance approach must be implemented as an effort in adapting the rapid changes in technology to enhance students' knowledge and skills (Branch, 2009; Gagne, 1985). One of the major challenges in developing an interactive module is that the module development is time consuming and requires specific computer and software knowledge as well as graphic skills in which not many educators have the ability to do so. This condition may hinder the interest and progress among the educators in building their own module. They would eventually continue using the traditional method although it is less effective in T&L (Phang et al., 2014). Therefore, the development of an interactive module in electromagnetism is a great contribution to the society, specifically to educators and learners. In this study, the platform chosen for the development of the interactive module is via Modular Object-Oriented Dynamic Learning Environment (MOODLE), an open source system. The app can be downloaded on both desktop and mobile phones. The advantages of using this app include worldwide accessibility, flexible, no cost incurred, and having strong support for safety and administration.

4. CONCLUSION

This study provides the researchers with empirical data about the content of an interactive module to be developed and suggests an appropriate method to accommodate the requirement in 21st century learning strategies. The findings serve as a guide in designing and developing the module in the next following development phase. The choice of topic is electromagnetism due to the fact that it is one of the most challenging topics to be taught and learned and requires a strong ability to visualize the concepts. This can be achieved by embedding simulations, videos, and exercises in smart apps using smartphone. The use of the smartphone is relevant in the current context of borderless learning as students can engage in learning anytime, anywhere, and at their own pace.

Declaration of Interest
I declare that there is no conflict of interest.

Acknowledgement
The authors would like to thank the Ministry of Education (MoE), Malaysia, and Universiti Pendidikan Sultan Idris (UPSI) for the financial support provided to this work.

REFERENCES

Abu NEB, Eu LK. (2017). Hubungan antara sikap, minat, pengajaran guru dan pengaruh rakan sebaya terhadap pencapaian Matematik tingkatan 4. *JuKu: Jurnal Kurikulum & Pengajaran Asia Pasifik*, 2(1), 1-10.

Aji SD, Hudha MN, Huda C, Gufran G. (2018). Computer animation with adobe flash professional Cs6 in Newton's Law. *IOP Conference Series: Materials Science and Engineering*, 288(1), 012131.

Alias M, Iksan ZH, Karim AA, Nawawi AMHM, Nawawi SRM. (2020). A novel approach in problem-solving skills using flipped classroom technique. Creative Education.

Alias N, DeWitt D, Siraj S. (2014). An evaluation of gas law webquest based on active learning style in a secondary school in Malaysia. *Eurasia Journal of Mathematics, Science & Technology Education*, 10(3), 175-184.

Astra IM, Fitri UR. (2017). Integrated lecture tools to improve student competencies to develop physical learning media design. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, 3, 79-88.

Barma S, Daniel S. (2017). Designing enhanced learning environments in Physics: an interdisciplinary collaborative approach producing an instrument for school success in game-based learning across the lifespan. Springer.

Bestiantono DS, Sa'diyah EH, Rachmatya R, Mubarok H, Adam AS, Suprapto N. (2019). University students' misconception in electromagnetism. *Journal of Physics: Conference Series*, 1417.

Branch RM. (2009). Instructional Design: The ADDIE Approach. New York: Springer Science & Business Media.

Cai S, Chiang FK, Sun Y, Lin C, Lee JJ. (2017). Applications of augmented reality-based natural interactive learning in magnetic field instruction. *Interactive Learning Environments*, 25(6), 778-791.

Cardinot A, Fairfield JA. (2019). Game-based learning to engage students with physics and astronomy using a board game. *International Journal of Game-Based Learning*, 9(1), 42-57.

Cepni S, Tas E, Kose S. (2006). The effects of computer-assisted material on students' cognitive levels, misconceptions and attitudes towards science. *Computers & Education*, 46, 192-205.

Chou YH, Shyu HY. (2017). Virtual Laboratory of the Magnetic Field due to a Current Element. *In Society for Information Technology & Teacher Education International Conference*, Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/f/177431/

Clemente G, Jesus F, Martinez E, Wee F, Kang L. (2017). Deployment of physics simulation apps using Easy JavaScript Simulations. *IEEE Global Engineering Education Conference*, 1093-1096.

Davis LL. (1992). Instrument review: Getting the most from a panel of experts. Applied Nursing Research.

Gagne RM. (1985). The Conditions of Learning and Theory of Instruction (4th Ed.). New York: Holt, Rinehart and Winston.

Gay LR, Diehl PL. (1992). Research Methods for Business and Management New York: MacMillan Publishing Company.

Halim L, Yong TK, Meerah TSM. (2014). Overcoming Students' Misconceptions on Forces in Equilibrium: An Action Research Study. *Creative Education*, 5(11), 1032-1042.

Hookway G, Mehdi Q, Hartley T, Bassey N. (2013). Learning physics through computer games. In Proceedings of GAMES'2013, USA.

Kadir A, Badlilshah MN. (2016). Analisis Sikap Terhadap Pembelajaran Fizik Dan Hubungannya Dengan Pencapaian Dalam Kalangan Pelajar Pra Universiti Di Sebuah Kolej Matrikulasi. Universiti Pendidikan Sultan Idris.

Kalogiannakis M, Ampartzaki M, Papadakis S, Skaraki E. (2018). Teaching natural science concepts to young children with mobile devices and hands-on activities. A case study. *International Journal of Teaching and Case Studies*, 9(2), 171-183.

Karacop A. (2017). The Effects of Using Jigsaw Method Based on Cooperative Learning Model in the Undergraduate Science Laboratory Practices. *Universal Journal of Educational Research*, 5(3), 420-434.

Kelley TR, Knowles JG. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education*, 3(1), 11.

Kumar G, Singh G, Bhatnagar V, Gupta R, Upadhyay SK. (2020). Outcome of online teaching-learning over traditional education during covid-19 pandemic. *International Journal of Advanced Trends in Computer Science and Engineering*, 9(5), 7704-7711.

Li F, Bao Y, Wang D, Wang W, Niu L. (2016). Smartphones for sensing. *Science Bulletin*, 61(3), 190-201.

Li J, Singh C. (2012). Developing a magnetism conceptual survey and assessing gender differences in student understanding of magnetism. In AIP Conference Proceedings.

Li J, Singh C. (2017). Developing and validating a conceptual survey to assess introductory physics students' understanding of magnetism. *European Journal of Physics*, 38 025702.

Malaysian Communications and Multimedia Commission. (2017). Handphone Users Survey. Retrieved from https://www.skmm.gov.my/skmmgovmy/media/General/pdf/HPUS2017.pdf

Mazlan A. (2018). Pembangunan dan penilaian keberkesanan modul pendekatan pengajaran berasaskan otak dengan integrasi I-Think dan Brain Gym untuk meningkatkan kefahaman konseptual dan motivasi belajar Fizik pelajar Matrikulasi. Universiti Sains Malaysia.

Mohamad Nasri N, Husnin H, Mahmud SND, Halim L. (2020). Mitigating the Covid-19 pandemic: a snapshot from Malaysia into the coping strategies for pre-service teachers' education. *Journal of Education for Teaching*, 46(4), 546-553.

Morris NP, Lambe J, Ciccone J, Swinnerton B. (2016). Mobile technology: students perceived benefits of apps for learning neuroanatomy. *Journal of Computer Assisted Learning*, 32(5), 430-442.

Mueanploy W. (2016). A study: effect of students peer assisted learning on magnetic field achievement. In Journal of Physics: Conference Series. Vol. 710. IOP Publishing.

Muslimin MS, Nordin NM, Mansor AZ. (2017). The design and development of MobiEko: A Mobille Educational App for Microeconomics Module. *Malaysian Journal of Learning and Instruction: Special Issues*, 221-255.

Osman K, Halim L, Meerah SM. (2006). What Malaysian Science Teachers Need To Improve Their Science Instruction: A Comparison across Gender, School Location and Area of Specialization. *Eurasia Journal of Mathematics, Science & Technology Education*, 2(2), 58-81.

Othman AB, Talib OB, Ibrahim DAB. (2017). Analisis Dokumen Silibus Kimia Organik Matrikulasi Berdasarkan Taksonomi Bloom. *JuKu: Jurnal Kurikulum & Pengajaran Asia Pasifik*, 3(3), 1-11.

Papadakis S, Kalogiannakis M. (2017). Mobile educational applications for children: what educators and parents need to know. *International Journal of Mobile Learning and Organisation*, 11(3), 256-277.

Phang FA, Abu MS, Ali MB, Salleh S. (2014). Faktor penyumbang kepada kemerosotan penyertaan pelajar dalam aliran Sains: Satu analisis sorotan tesis. *Jurnal Sains Humanika*, 2(4), 63-71.

Plotz T, Hopf M. (2016). Students' misconceptions about invisible radiation. In Electronic Proceedings of the ESERA 2015 Conference, Science Education Research: Engaging learners for a sustainable future. pp. 95–100.

Polit DF, Beck CT. (2006). The content validity index: are you sure you know what's being reported? Critique and recommendations. *Research in Nursing and Health*, 29(5), 489-497.

Potkonjak V, Gardner M, Callaghan V, Mattila P, Guetl C, Petrović VM, Jovanovic K. (2016). Virtual laboratories for education in science, technology, and engineering: a review. *Computers and Education*, 95, 309-327.

Richey RC, Klein JD. (2014). Design and development research: Methods, strategies, and issues. London: Routledge.

Roscoe JT. (1975). Fundamental research statistics for the behavioural sciences (2nd Ed.). New York: Holt, Rinehart and Winston, Inc.

Saglam M. (2010). Students' performance awareness, motivational orientations and learning strategies in a problem-based electromagnetism course. In Asia-Pacific Forum on Science Learning and Teaching, Vol. 11.

Saleh S, Mazlan A. (2019). The effects of brain-based teaching with I-think maps and brain gym approach towards physics understanding. *Jurnal Pendidikan IPA Indonesia*, 8(1), 12-21.

Singh C. (2005). Student understanding of Symmetry and Gauss's law. *AIP Conf. Pro*c. 790, 65.

Singh C. (2008). Interactive learning tutorials on quantum mechanics. *American Journal of Physics*, 76(4), 400-405.

Siraj S, Alias N, DeWitt D, Hussin Z. (2013). Design and development research: emergent trends in educational research. Kuala Lumpur: Pearson Malaysia.

Wang JY, Wu HK, Hsu YS. (2017). Using mobile applications for learning: Effects of simulation design, visual-motor integration, and spatial ability on high school students' conceptual understanding. *Computers in Human Behavior*, 66, 103-113.

Yildirim HI, Sensoy O. (2018). Effect of science teaching enriched with technological practices on attitudes of secondary school 7th grade students towards Science course. *Universal Journal of Educational Research*, 6(5), 947-959.

Zajkov O, Gegovska-Zajkova S, Mitrevski B. (2017). Textbook-caused misconceptions, inconsistencies, and experimental safety risks of a Grade-8 Physics textbook. *International Journal of Science and Mathematics Education*, 15(5), 837-852.