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The Relevance of Demographic Factors to the Use of Web 2.0 Applications among Science Teachers

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Abstract
This study aims to identify whether there are differences in teachers' evaluation of the effectiveness of Web 2.0 applications in teaching and learning (T&L) based on demographic factors. This quantitative study utilised a survey method. A total of 217 Science teachers were selected as respondents randomly. Data were collected using a questionnaire containing 21 question items. The data of this study were analysed descriptively and inferentially using SPSS version 26. Overall, the study's findings showed significant differences between teachers' evaluations of the effectiveness of the use of Web 2.0 applications in T&L based on age. However, there were no significant differences between teacher assessments based on gender, location, and teaching experience. The implications of this study provide input to school leaders of age factors influencing teachers’ evaluation of the effectiveness of the use of Web 2.0 applications. Therefore, teachers need to be given exposure such as courses or workshops on implementing Web 2.0 applications to be more confident in integrating teaching and learning. For further studies may want to explore how teacher can adopt the 21st century teaching learning methods.

Keywords: Web 2.0, Science, Teacher Assessment, Age

Introduction
In the 21st century, Malaysia faces various challenges in globalisation and the development of technology and information. Therefore, education plays a vital role in preparing competent and competitive students on the world stage to face the challenges of the Industrial Revolution 4.0 (IR 4.0). In line with time, the transformation of education needs to take place mainly in teaching and learning (T&L). Communication tools such as the internet and electronic tools such as computers are a combination of aids that teachers can use to enable students to access and find information in learning for this digital age. Thus, the student-centred teaching and learning (T&L) process need to lead towards a revolution in the use of digital technology in the classroom (Siong & Kamisah, 2018).

Along with time, technology-based communication is seen as an integral part of the currents of modernity. The ideal society is representative of a combination of time and space. Technological changes influencing new forms of interaction and interpersonal communication in the information age lead to observed changes in social life (Eraslan & Kukuoglu, 2019). With the development of internet technology, Web 2.0 applications stand
out with innovations that have completely changed the internet. Web 2.0 allows one to create content more easily on the internet. In addition, Web 2.0 applications have facilitated collaboration and social interaction in themselves. The area of use of Web 2.0 technology is increasing day by day. This is because technology makes interactions between users, applications and access to information very easy on the internet. Even these features are inevitable for use in the world of education (Darmaji et al., 2019). In conclusion, teachers as leaders and teachers of the future should be more complete, open to learning and follow innovation at all times.

**Web 2.0 Applications**

To date, teachers face challenges in terms of the use of Web 2.0 applications where there is no proper guidance to use Web 2.0 applications. This prevents the student from participating in Science learning activities more effectively (An et al., 2010). Furthermore, the level of use of Web 2.0 applications in T&L Science in the classroom is limited (Akgunduz & Akinoglu, 2016). This is because the method of learning science in school occurs by memorising facts, theories and laws of science alone (Poobalan et al., 2019). Now, with the rapid development of technology, students are more independent in acquiring knowledge. As a result, pupils begin to feel bored with teaching and learning sessions (T&L) that are only didactic and conventional (Lin et al., 2017). Thus, students need innovation in their learning. Therefore, to overcome this problem, blended learning methods were introduced. The blended learning method is a teaching and learning (T&L) method that combines face to face teaching in the classroom and online (Aida, 2018). This is an innovation in the field of education as an effort to diversify the methods of knowledge delivery as well as to produce competent and scientific people.

Moreover, the National Science Teacher Association (2011) concluded that 21st Century Skills encompasses technological skills (McComas, 2014). Thus, in a report (National Council of Teachers of Mathematics, 2015), effective teachers can optimise technology in developing students' understanding, stimulate their interest, and improve their mastery of learning in the classroom. Metcalf & Tinker (2004) state that although Science standards demand increased use of technology in the school, teachers are often less practising the use of technology in the classroom. Furthermore, Aslan & Zhu (2016) believe that teachers often use basic ICT skills. For example, teachers use PowerPoint slides and projectors in classroom presentations. Teachers rarely integrate technology in T&L Science. At the same time, teacher competencies are limited to basic Web 2.0 skills and are not interested in integrating Web 2.0 skills into their teaching practices. In addition, a report by the Malaysia Ministry of Education (2017) pointed out that only about 80% of teachers have spent less than an hour a week in integrating Web 2.0 applications in teaching. Thoroughly, the integration of Web 2.0 applications of teachers in the classroom is at a low level in using Web 2.0 applications as teaching tools.

Furthermore, in the TIMSS and PISA 2019 reports, teachers have reported a need to integrate technology into teaching and learning (T&L) while improving students' critical thinking skills. This is because about 70 per cent of teachers report that they need the integration of technology in the T&L process for future professional development of teachers in education (Martin et al., 2019). The justification is that Science teachers need technology integration skills in their T&L. This is because integrating technology in the T&L process can help improve students' mastery of Science subjects (Hu et al. 2018; and Fidan & Tuncel 2019). At the same time, teachers still use conventional methods in T&L because there are barriers
to the use of technology (Norfarahi et al., 2020). Among the obstacles is the lack of expertise in ICT, especially among teachers (Ambikapathy et al., 2020). Thus, skills factors have affected teachers' motivation in using Web 2.0 applications. Rationally, teachers have a high commitment to ensure that learning and facilitation (T&L) in the classroom can benefit students. Therefore, in-house training or workshops should be conducted from time to time. This is because Web 2.0 applications have evolved quickly, and teachers need to improve their skills in using Web 2.0 applications in the classroom. However, the knowledge and skills of Science teachers are still at a low level in the field of ICT because they are not from an ICT background (Mahfuzah et al., 2015).

In keeping with this current modernity, teachers' skills in integrating technology as the latest pedagogical tool in teaching are an excellent effort to apply ICT (Ghavifekr & Rosdy, 2015). Moreover, technology in education can assist teachers in providing teaching aids that suit students' needs, levels, and diversity (Lee, 2017). However, among the constraints identified, teachers' skills in using Web 2.0 applications in teaching and learning (T&L) limit the effective use of Web 2.0 applications (Nurulwahida et al., 2020). For example, teachers experience problems while using Toondoo software in English language learning where the software is complex. This is because teachers are unable to use the interface buttons effectively while creating content. This process has slowed down teachers in completing learning content in the classroom. Moreover, teachers do not have sufficient experience and cannot develop instructional content due to insufficient learning technology support. Therefore, teachers need to possess skills and knowledge in technology to determine the educational demands for the use of technology in education (Hursen, 2020).

As is known, teachers in schools still practice the teaching and learning (T&L) of Science subjects in a conventional manner. This conventional method is a method that requires face-to-face teaching. This traditional method starts with a talk accompanied by an explanation and then a division of tasks and exercises (Nair & Gopal, 2014). The teacher's activity is more towards explaining and the student listening or noting what the teacher is presenting. This learning creates a sense of boredom because students do not know the purpose of their knowledge and only accept the information given by the teacher. Pupils are not able to pay full attention to the teaching and learning process (T&L) that takes place in the classroom. Some diligent students work independently by re-reading notes given by the teacher outside of classroom time. However, this method is more memorising and ineffective, especially in learning Science subjects (Fadila & Chiew, 2010).

In a study, Krishnan (2005) argues that teachers find it difficult to regard Science learning as an exploratory process. Too often, Science learning is narrowed down to a typical routine mastery of conventional explanations and established Science techniques. The old pedagogy was criticised for only presenting content in a classroom format for students to memorise. Kreijins (2018) stated that interviews with teachers showed that students face difficulties understanding concepts and will spend more time in the parts they know less. This is because students' focus on T&L began to decrease after the first ten minutes (Cetin, 2018) due to learning sessions implemented in traditional methods. Che In & Ahmad (2018) stressed that students who have difficulty understanding learning would encourage them to be less interested in learning in the classroom. Even students find learning sessions no longer fun for them.

The study was conducted to answer some research questions as follows:
To what extent is the mean difference between teachers' evaluations of the effectiveness of the use of Web 2.0 applications in teaching and learning (T&L) based on demographic factors?

Hypothesis
This study has four hypotheses as follows:

- **Ho1**: There is no significant difference between the mean of teachers' evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by gender.
- **Ho2**: There is no significant difference between the mean of teachers' evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by location.
- **Ho3**: There is no significant difference between teachers' evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) based on teaching experience.
- **Ho4**: There is no significant difference between teachers' evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) based on age.

Methodology
This study uses a quantitative design by using a questionnaire as a research instrument. The results of the study were analysed descriptively and inferentially. The study population consists of Science teaching in a state of Malaysia, including primary and secondary schools. In contrast, the study sample consists of 217 Science teachers in the district. The study respondents were based on the sample size determination table of Krejcie and Morgan (1970). According to their respective districts, these Science Teachers will be selected at simple random based on the schools available in the Education Office.

This study uses a questionnaire instrument that contains 21 question items consisting of 11 items related to the respondents' background, 10 items related to aspects of Science teachers' evaluation of the effectiveness of the use of Web 2.0 applications in teaching and learning (T&L). The questionnaire used contained a five-point Likert scale of 5 (Strongly agree), 4 (Agree), 3 (Not sure), 2 (Disagree) and 1 (Strongly disagree). This questionnaire instrument was adapted from a study conducted by (Suzlina Hilwani & Jamaludin, 2015). The questionnaires were distributed during the COVID-19 pandemic period. The collected data will be coded for analysis using SPSS software (Statistical Package For Social Science) version 26.0. Descriptive and inferential statistical analysis was used to analyse the findings. A total of 217 teachers were taken as the study sample. A pilot study was also conducted on 33 respondents who were not involved in this study to see the reliability of this instrument. Cronbach's Alpha value was obtained as 0.875.

| Table 1. Reliability statistics |
|---------------------------------|
| Reliability Statistics          |
| Cronbach’s Alpha   | N   |
| 0.875                  | 33  |

Results
Inferential statistical analysis (independent sample t-test and One-Way ANOVA) was used to analyse the demographics of the respondents to answer the research questions.
Table 2. Showed the demographic of 217 respondents in this study

| Category           | Demographic | Frequency | Percentage (%) |
|--------------------|-------------|-----------|----------------|
| Gender             | Male        | 42        | 19.4           |
|                    | Female      | 175       | 80.6           |
| Location           | Urban       | 113       | 52.1           |
|                    | Rural       | 104       | 47.9           |
| Teaching experience| Less than 5 years | 2 | 0.9 |
|                    | 6 – 10 years | 25       | 11.5           |
|                    | 11 – 15 years | 75       | 34.6           |
|                    | 16 years and above | 115 | 53.0 |
| Age                | 20 – 30 years | 4        | 1.8            |
|                    | 31 – 40 years | 89       | 41.0           |
|                    | 41 – 50 years | 94       | 43.3           |
|                    | 51 years and above | 30   | 13.8           |

Inferential Analysis

Research question: To what extent is the mean difference between teachers' evaluation of the effectiveness of the use of Web 2.0 applications in teaching and learning (T&L) based on demographic factors?

Gender

Ho1: There is no significant difference between the mean evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by gender.

Table 3. Independent sample t-test analysis of differences in Science teachers' assessment of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by gender

| Construct       | Gender | n  | Mean | SD   | Value-t | df   | Significance Level |
|-----------------|--------|----|------|------|---------|------|--------------------|
| Science Teacher | Male   | 42 | 3.85 | 0.065| -1.394  | 215  | 0.165              |
| Assessment      | Female | 175| 3.96 | 0.036|         |      |                    |

Table 3 shows no significant differences in the evaluation of Science teachers when implementing Web 2.0 in T&L based on gender. In terms of mean, male teachers (M = 3.85, SD = 0.065) were lower than the mean of female teachers (M = 3.96, SD = 0.036). The value of t = 1.394 and sig. = 0.165 (p > 0.05). This indicates that the null hypothesis failed to be rejected because there was no significant difference in the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) according to gender. Although there was a difference in mean score readings between the two groups, the difference was not significant. This means that the differences in the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) are at the same level between male and female teachers.
Location

Ho2: There is no significant difference between the mean evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by location.

**Table 4.** Independent sample t-test analysis of differences in Science teachers' assessment of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by location

| Construct            | Location | n    | Mean | SD   | Value-t | df  | Significance Level |
|----------------------|----------|------|------|------|---------|-----|-------------------|
| Science Teacher      | Urban    | 113  | 3.99 | 0.461| 1.731   | 215 | 0.085             |
| Assessment           | Rural    | 104  | 3.88 | 0.471|         |     |                   |

Table 4 shows no significant difference in the evaluation of Science subject teachers when implementing Web 2.0 in T&L based on location. In terms of mean, urban (M = 3.99, SD = 0.461) is higher than the rural mean (M = 3.88, SD = 0.471). The value of t = 1.731 and sig. = 0.085 (p> 0.05). This indicates that the null hypothesis failed to be rejected because there was no significant difference in the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by location. Although there was a difference in mean score readings between the two groups, the difference was not significant. This means that the differences in the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) are at the same level between teachers living in urban areas and teachers living in rural areas.

Teaching Experience

Ho3: There is no significant difference between the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) based on teaching experience.

**Table 5.** One-Way ANOVA test results for Science teacher evaluation based on teaching experience

| Construct            | Source          | Sum of Square | df | Mean Square | F   | Sig.  |
|----------------------|-----------------|---------------|----|-------------|-----|-------|
| Science Teacher      | Between Groups  | 0.39          | 3  | 0.13        | 0.59| 0.62  |
| Assessment           | Within Groups   | 46.86         | 213| 0.22        |     |       |
|                      | Total           | 47.25         | 216|             |     |       |

Table 5 shows that the One-Way ANOVA analysis for Science teacher evaluation based on teaching experience showed that null hypothesis failed to be rejected. There was no significant difference between the group and within a group, F (3,213) = 0.59, p = 0.62. These values indicate no significant interaction between the less than 5-year-old group, the 6 to 10-year-old group, the 11 to 15-year-old group and the 16-year-old group and on Science teachers evaluation of the effectiveness of Web 2.0 use in teaching and learning (T&L).
Ages

H04: There is no significant difference between the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) based on age.

Table 6. One-Way ANOVA Table for age-based Science teacher assessment

| Construct               | Source            | Sum of Square | df | Mean Square | F    | Sig.  |
|-------------------------|-------------------|---------------|----|-------------|------|-------|
| Science Teacher Assessment | Between Groups    | 1.99          | 3  | 0.67        | 3.14 | 0.026 |
|                         | Within Groups     | 45.25         | 213| 0.21        |      |       |
|                         | Total             | 47.25         | 216|             |      |       |

Table 6 shows the results of One-Way ANOVA analysis for age-based assessment of Science teachers showing that the null hypothesis was rejected and there was a significant difference between groups and within groups, F (3,213) = 3.14, p = 0.026. This value indicates a significant interaction between groups aged between 20 to 30, 31 to 40, 41 to 50 and 51 years and above based on the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L).

Table 7. Scheffe post-hoc test of differences in Science teachers' assessment of the effectiveness of Web 2.0 use in teaching and learning (T&L) based on age

| Ages                  | n | Subset of alpha = 0.05 |
|-----------------------|---|-----------------------|
| 20 – 30 years         | 4 | 4.03                  |
| 31 – 40 years         | 89| 4.00                  |
| 41 – 50 years         | 94| 3.94                  |
| 51 years and above    | 30| 3.71                  |

Based on table 7, Scheffe post-hoc test at significance level p < 0.05 was conducted to identify differences between groups. The post-hoc test results in table 4.28 show that the evaluation of Science teachers aged 51 years and above (M = 3.71, SD = 0.51) was significantly lower than that of Science teachers aged 20 to 30 years (M = 4.03, SD = 0.26), 31 to 40 years (M = 4.00, SD = 0.49) and 41 to 50 years (M = 3.94, SD = 0.41).

Discussion

Gender

An independent sample t-test analysis was conducted to obtain findings on the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by gender. The study's findings are in line with previous studies where Science teachers 'evaluation of the effectiveness of Web 2.0 use in teaching and learning (T&L) by gender is no significant difference (Kauts & Kaur, 2020; Singh, 2021). This is because the use of Web 2.0 applications does not differ by gender. This shows male and female teachers together using Web 2.0 applications for the T&L process in the classroom. These results may indicate that the traditional gender gap where men are more confident in using Web 2.0 applications than women disappears. The similarity of Web 2.0 application usage between male and female teachers is not a surprising finding as Female and male teachers often use Web 2.0 applications for different educational and daily activities. For example, Web 2.0
applications like Google share documents with students using file-sharing tools like Dropbox, collaborate with colleagues using collaboration tools like Google Drive and communicate with students and peers using online communication tools like Facebook and email. Thus, the use of Web 2.0 applications among teachers can bridge the gap between female and male teachers.

Location
An independent sample t-test analysis was conducted to obtain findings on the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by location. The study's findings are in line with previous studies where Science teachers' evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by location is that there is no significant difference (Senthamarai & Amutha, 2016; Vivakaran & Maraimalai, 2018). This is because the use of Web 2.0 applications does not vary by location. This shows that Web 2.0 applications among teachers in urban areas are not different from rural areas. Thus, the researchers found that urban and rural teachers have similar beliefs about the value of technology integration and have equal access to Web 2.0 applications. Reducing this digital divide is primarily due to rural and urban communities being able to access resources and develop good infrastructure. Thus, urban and rural teachers value and use Web 2.0 applications well for the T&L process in the classroom. Furthermore, the quality of urban and rural teachers is similar as they both have basic computer knowledge and skills learned while at university.

Teaching Experience
One-way ANOVA test analysis was conducted to obtain findings on the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) according to teaching experience. The study’s findings are in line with previous studies where Science teachers’ evaluation of the effectiveness of Web 2.0 use in teaching and learning (T&L) according to teaching experience is no significant difference (Hol & Aydin, 2020; Chung-Yuan et al., 2020). This is because the use of Web 2.0 applications among teachers do not differ according to teaching experience. This makes teachers feel confident to use Web 2.0 applications in the classroom. Teacher-minded researchers have shown that they have no problems managing classrooms and integrating educational tools and Web 2.0 applications effectively in the first years of their teaching. The use of Web 2.0 applications on age does not impact many years of teaching experience. For example, with academic education experienced with traditional boards and blackboards for many years and teachers willing to change at any time where young teachers and senior teachers tend to integrate Web 2.0 applications into their teaching. This is because a teacher’s teaching experience does not affect the acceptance of technology. The findings of this study are in line with the study of Marni Izzati (2020), who stated that young teachers and senior teachers could accept the innovation of this virtual learning environment in their T&L. In summary, as long as the teacher works in the school, the teacher can improve themselves in using technology in the school.

Ages
One-way ANOVA test analysis was conducted to obtain findings on the evaluation of science teachers on the effectiveness of the use of Web 2.0 in teaching and learning (T&L) according to age. The study's findings are in line with previous studies where Science teachers’
evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by age is that there are significant differences (Sabeh et al., 2018; Doley, 2021). This is because the use of Web 2.0 applications among teachers varies with age. The study's findings showed that teachers aged 20 to 30 years, 31- to 40 and 41 to 50 were more active in using Web 2.0 applications than teachers aged 51 years and above. Perspective researchers for young teachers were born and raised in the era of Web 2.0 applications. Thus, teachers are more interested in using Web 2.0 applications such as Moodle or Glogster, using other Web 2.0 application teaching strategies, such as MOOCs, and not limiting themselves to using tools traditionally used in teaching strategies: video, projectors and computers. Their level of use of Web 2.0 applications continues to increase, and they will continue to practice online teaching both inside and outside the classroom. Thus, digital competencies will depend on good teaching practices and their positive inclinations towards this type of teaching method. Nevertheless, teachers aged 51 and above show teachers are still limited by their practical thinking, which encourages them to reproduce the knowledge and ways of teaching classes that they have acquired throughout their schooling. These teachers continue to use traditional methods without producing innovative changes in teaching practice.

**Conclusion**

This study was conducted quantitatively using a questionnaire. The summary of this study shows that Science teachers in this study have a moderate level of knowledge and skills, and a high level of attitude to implement T&L online. Science teachers' evaluation of the effectiveness of the use of Web 2.0 in teaching and learning (T&L) by gender, location, and teaching experience showed no significant differences. However, there were significant differences in ages. The MOE needs to pay serious attention to issues that cause teachers to use fewer Web 2.0 applications in T&L. DOE needs to increase courses and training to improve teachers' skills in using Web 2.0 applications in T&L. Schools also play a significant role in changing the situation of weak mastery of Web 2.0 applications among science teachers. Teachers are close to students when the teaching and learning process takes place in the classroom. They need to be wise to use different and appropriate teaching approaches while ensuring that Web 2.0 applications can be implemented in T&L. The limitations of this study are limited to evaluating the effectiveness of Web 2.0 applications in teaching and learning (T&L) among teachers only. This study is limited to collecting data through a questionnaire instrument and only selects one place in Malaysia to collect data. To study the factors related to the practice of Science teachers and the level of knowledge of content pedagogy technology of teachers in schools. Future studies could be conducted on a broader location and a larger sample of studies to see more specific findings. To see whether the level of readiness of teachers in integrating Web 2.0 applications in T&L has a relationship with student achievement, it is recommended that the study be conducted using questionnaires and document analysis and interviews. The readiness of Science teachers in the implementation of Web 2.0 applications during learning from home can be used as a study because it seems to be a new norm today, which is likely to be one of the new learning alternatives in the future.

**References**

Aida, M. B. (2018). Students’ attitudes towards implementing blended learning in teaching English in higher education institutions: A case of Al-quds open university. *International Journal of Humanities and Social Science, 8*(6), 131–139.
Akgunduz, D., & Akinoglu, O. (2016). The effect of blended learning and social media-supported learning on the students’ attitude and self-directed learning skills in science education. *Turkish Online Journal of Educational Technology, 15*(2), 106–115.

Ambikapathy, A., Halili, S. H., & Ramasamy, M. D. (2020). Kemahiran TMK dalam kalangan guru-guru bahasa Tamil sekolah menengah. *Muallim Journal of Social Science and Humanities, 4*(3), 99–114.

An, Y.-J., Aworuwa, B., Ballard, G., & Williams, K. (2010). Teaching with Web 2.0 technologies: benefits, barriers and best practices college of liberal arts and education. *International Journal of Instructional Technology and Distance Learning, 7*(3), 41–48.

Aslan, A., & Zhu, C. (2016). Influencing factors and integration of ICT into teaching practices of pre-service and starting teachers. *International Journal of Research in Education and Science (IJRES), 2*(2), 359–370.

Callaghan, M. N., Long, J. J., van Es, E. A., Reich, S. M., & Rutherford, T. (2018). How teachers integrate a math computer game: Professional development use, teaching practices, and student achievement. *Journal of Computer Assisted Learning, 34*(1), 10–19.

Cetin, H. S. (2018). Implementation of the digital assessment tool ‘Kahoot!’ in elementary school. *International Technology and Education Journal, 2*(1), 9–21.

Chung-Yuan, H., Jyh-Chong, L., Tsung-Yen, C., & Ching, S. C. (2020). Probing in-service elementary school teachers’ perceptions of TPACK for games, attitudes towards games, and actual teaching usage: A study of their structural models and teaching experiences. *Educational Studies, 1*(5), 1–17.

Darmaji, D. A. K., Astalini, A. L., & Samosir, S. C. (2019). Mobile learning in higher education for the industrial revolution 4.0: Perception and response of physics practicum. *International Journal of Interactive Mobile Technologies, 13*(9), 4–20.

Doley, P. P. (2021). *ICT awareness among the provincialised college teachers of Nagaon district, Assam, India*. 64, 118–125.

Eraslan, L., & Kukuoglu, A. (2019). Social relations in virtual world and social media aggression. *World Journal on Educational Technology: Current Issues, 11*(2), 1–11.

Faridah, C. I., & Zulhusmi, A. (2019). Kajian keberkesanan pembelajaran interaktif berasaskan aplikasi Kahoot: Satu kajian tindakan terhadap kursus Principles of Marketing. *Online Journal For Tvet Practitioners, 1*(1), 1–13.

Fidan, M., & Tuncel, M. (2019). Integrating augmented reality into problem based learning: The effects on learning achievement and attitude in physics education. *Computers and Education, 142*(May), 1–31.

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science, 1*(2), 175–191.

Hol, D., & Aydin, I. (2020). Is technology in our classrooms? Efl teachers’ beliefs and engagement with technology in the classroom. *Journal of Educational Issues, 6*(2), 38.

Hursen, C. (2020). The effect of problem based learning method supported by web 2.0 tools on academic achievement and critical thinking skills in teacher education. *Technology, Knowledge and Learning, 3*(2), 1–19.

Jalal, G., Lachand, V., Tabard, A., & Michel, C. (2018). How teachers prepare for the unexpected bright spots and breakdowns in enacting pedagogical plans in class. In M. P. S. H. D. R. E. M. S. Viktoria Pammer-Schindler (Ed.), *13th European Conference on Technology Enhanced Learning* (Vol. 11082, Issue 1).

Kauts, D. S., & Kaur, N. (2020). Survey of competencies among teachers to integrate Web 2.0
tools into teaching learning process. Journal of Critical Reviews, 7(19), 8375–8384.

Kementerian Pendidikan Malaysia. (2017). Annual report 2017 Malaysian education blueprint 2013-2025. https://www.padu.edu.my/wp-content/uploads/2018/07/AR2017-English-PPPM-.pdf

Krishnan, D. (2005). Effect of blended learning strategy on learning science among secondary school students. European Scientific Journal, 210–218.

Lee, J. E. (2017). Preschool teachers’ pedagogical content knowledge in mathematics. International Journal of Early Childhood, 49(2), 229–243.

Lin, Y. W., Tseng, C. L., & Chiang, P. J. (2017). The effect of blended learning in mathematics course. Eurasia Journal of Mathematics, Science and Technology Education, 13(3), 741–770.

Izzati, M. K. (2020). Perbezaan tahap pengetahuan, penggunaan, dan penerimaan guru bahasa melayu berdasarkan faktor umur dan pengalaman mengajar ketika mengaplikasikan persekitaran pembelajaran maya. Jurnal Pendidikan Bahasa Melayu – JPBM, 10(2), 15–28.

Martin, M. O., Mullis, I. V. S., Foy, P., Kelly, D. L., & Fishbein, B. (2019). TIMSS 2019 International results in Mathematics and Science. TIMSS and PIRLS. https://timss2019.org/reports/

McComas, W. F. (2014). The language of science education: An expanded glossary of key terms and concepts in science teaching and learning. In Sense Publisher. Sense.

Metcalf, S. J., & Tinker, R. F. (2004). Probeware and handhelds in elementary and middle school science. Journal of Science Education and Technology, 13(1), 43–49.

Nair, S. M., & Gopal, S. D. (2014). Kesan penggunaan kaedah pembelajaran mastery terhadap pencapaian dan minat pelajar dalam mata pelajaran pengajian am. Asia Pacific Journal of Educators and Education, 29, 55–80.

National Council of Teachers of Mathematics. (2015). Strategic use of technology in teaching and learning mathematics. https://www.nctm.org/Standards-and-Positions/Position-Statements/Strategic-Use-of-Technology-in-Teaching-and-Learning-Mathematics/

National Science Teacher Association. (2011). An NSTA position statement: Quality science education and 21st-century skill. Science Education. https://www.nsta.org/nstas-official-positions

Fadila, N. M. A., & Chiew, K. W. (2010). Persepsi guru terhadap penggunaan perisian multimedia dalam proses pengajaran dan pembelajaran mata pelajaran kemahiran hidup sekolah jenis kebangsaan Cina. Academia.Edu, 1–8. https://www.academia.edu/

Norfarahi, Z., Isa, M. H., & Khadijah, A. R. (2020). Isu dan cabaran penggunaan MOOC dalam proses pengajaran dan pembelajaran. Journal of Research, Policy & Practice of Teachers & Teacher Education, 10(1), 77–94.

Nurulwahida, A., Rozita, H., Fazilah, N. M. N., & Ruzlan, M. A. (2020). Embracing industrial revolution 4.0: The effect of using web 2.0 tools on primary schools students’ mathematics achievement (Fraction). International Journal of Instruction, 13(3), 711–728.

Poobalan, N., Rozniza, Z., & Ting, V. Y. (2019). Penggunaan bahan multimedia interaktif 3D animasi (‘scratch’) dalam kaedah pembelajaran teradun terhadap minat dan pencapaian murid tahun 5 bagi mata pelajaran Sains. Jurnal Pendidikan Sains & Matematik Malaysia, 9(1), 49–56.

Sabeh, H. N., Suhaimi, A. B., & Rosni, A. (2018). Web 2.0 applications usage: A comparative study between Erbil and Istanbul. International Journal of Advanced and Applied
Sciences, 5(3), 82–88.
Senthamarai, S., & Amutha, S. (2016). Ict knowledge of teacher educators at Bharathidasan university. In Higher Education in The Knowledge Age: Techno-Pedagogical Perspectives and Innovations. University Tiruchirappalli.
Singh, B. (2021). Assessment of teachers’ knowledge with respect to gender at secondary level: A comparative study in Indian context. Journal Innovations, 64, 300–308.
Siong, W. W., & Kamisah, O. (2018). Pembelajaran berasaskan permainan dalam pendidikan STEM dan penguasaan kemahiran abad ke-21. Politeknik & Kolej Komuniti Journal of Social Sciences and Humanities, 3, 121–135.
Hilwani, S. B., & Jamaludin, B. (2015). Tahap penggunaan Web 2.0 dalam pengajaran guru bahasa Melayu sekolah menengah. Jurnal Pendidikan Bahasa Melayu – JPBM (Malay Language Education Journal – MyLEJ), 5(2), 38–48.
Vivakaran, M. V., & Maraimalai, N. (2018). The feasibility and acceptance of social media interventions in higher education classrooms of developing nations with special reference to India. Contemporary Educational Technology, 9(3), 284–296.
Xiang, H., Yang, G., Chun, L., & Frederick, K. S. L. (2018). The relationship between ICT and student literacy in mathematics, reading, and science across 44 countries: A multilevel analysis. Computers and Education, 125(3), 1–13.