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Media Exposure and Students' Attitude as Mediators Between Subjective Norms and Choice Intention for Science, Technology, Engineering, and Mathematics Careers

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Abstract: Many countries have taken various forms of efforts and initiatives to attract more students to join the science, technology, engineering, and mathematics (STEM) workforce, but shortage of STEM talents remains a worldwide challenge. Concerning this issue, previous studies have frequently discussed the roles of parents, teachers, and peers (subjective norms), as well as media exposure and students' attitude as predictors of students' career choice in STEM. However, there are few studies that examined the mediating roles of media exposure and students' attitude in the relationship between subjective norms and career choice intention. It was indicated in previous studies that there could have been a shift in students' STEM choices because there are changes in their attitude and exposure to the media alongside technology advancement. Hence, this study aimed to determine the mediating roles of media exposure and students' attitude in the relationship between subjective norms and STEM career choice intention in addition to examining the direct causal relationships among the constructs. The hypothesised model was tested with 806 secondary school students in Malaysia. Results from partial least squares structural equation modelling found that subjective norms had both direct and indirect influence on career choice intention. Another highlight of this study is that media exposure and students' attitude were significant mediators between subjective norms and career choice intention. The findings drawn from this study provide insights into the design and development of STEM initiatives for parents, teachers, and students in Malaysia.

Keywords: Subjective norms, media exposure, students' attitude, career choice intention, mediator

1. Introduction

The science, technology, engineering, and mathematics (STEM) fields have been growing rapidly across the globe. STEM is often related to innovation and growth of a country because a high-capacity STEM workforce is anticipated to boost the country's competitiveness and productivity (Shin et al., 2018). Many countries have been investing heavily in the STEM fields as STEM workers are in high demand globally (Dockery et al., 2021; Shin et al., 2018). According to Li et al. (2021), shortage of competent STEM talents has been a worldwide challenge and has raised concerns if the existing education systems are compatible with the demand of STEM industries. It was mentioned that effective incorporation of STEM components to the respective education systems can be a solution to this global issue (Navy et al., 2020).

Warne et al. (2019) revealed that preparing middle school students for STEM careers is indeed one of the most critical educational challenges in the United States. The educational issue is pressing in the United States not only because it is important to ensure constant economic growth and technological innovation at large, but also to fill vacancies in the STEM workforce (Warne et al., 2019; Wyss et al., 2012). This is not uncommon in the Asian contexts as changes in national policies have been attempted in view of the challenges in Asia as well. In developing Asian countries like Indonesia, the government offered lucrative financial incentives for STEM employees to encourage more Indonesian students to pursue careers in STEM (Shin et al., 2018). Shin et al. (2018) also reported that Korea has implemented

a national policy for STEM enhancement to attract more students to STEM fields, but it was only effective in the short term.

In Malaysia, STEM reformation has also been done to encourage students' participation in STEM. One of the most substantial initiatives was the implementation of the new secondary school national curriculum. Alongside the implementation of the new national curriculum, STEM subjects have been made eligible to all upper secondary school students (Year 10 and 11) nationwide (Curriculum Development Division, 2016). The STEM-oriented curriculum aims to create STEM awareness among all upper secondary school students and to prepare them for STEM careers. STEM subjects offered in Malaysian schools are such as Computer Science, Invention, and Technical Graphic Communication (Curriculum Development Division, 2016).

In view of immense attempts to encourage students' participation in STEM, Li et al. (2021) indicated that there could have been a shift in perception of how students perceive STEM careers in tandem with technology advancement. It was suggested that media and students' close contacts could be particularly important for their STEM career decisions (Li et al., 2021). Besides, Wyss et al. (2012) suggested that adolescents' attitude and perceptions towards STEM are associated with their exposure to media. Batool and Ghayas (2020) also found that adolescents' career choice can be affected by multiple factors such as parents, teachers, peers, and media.

Findings from past research probes the authors' curiosity: (i) what is the influence of subjective norms (parents, teachers, and peers), media exposure and students' attitude towards STEM career choice intention? and (ii) do media exposure and students' attitude mediate the relationship between subjective norms and career choice intention? Based on the research questions, the purpose of the study was to examine the influence of subjective norms (parents, teachers, and peers), media exposure, and students' attitude on their STEM career choice intention. Besides, this study also aimed to investigate the mediating roles of media exposure and students' attitude between subjective norms and career choice intention in STEM fields.

2. Literature Review

According to Chen et al. (2020), students' career choice intention is an indication of their job pursuit after they complete their education. Mokhtar et al. (2016) proposed that students' career intention can be determined through factors such as subjective norms and attitude as presented in the Theory of Planned Behaviour. In this theory, subjective norms refer to an individual's perceived social pressure from significant others to perform or avoid a specific behaviour (Ajzen, 2002). Based on the review of literature, it was noticed that the most frequently mentioned significant others were parents (Razali, 2021; Sheehan et al., 2018), teachers (Avargil et al., 2020; Kong et al., 2020), and peers (Batool & Ghayas, 2020; Raabee et al., 2019).

This is consistent with findings reported by Hoag et al. (2017) that students regarded parents, teachers, and peers as significant others who had influence over their choices and decisions. Mohtar et al. (2019) also found that parents, teachers, and peers were students' close contacts who offered support to students, and they could ultimately affect students' career choice in the STEM fields. More specifically, it was found in previous research that parental support was significant for STEM career choice among Indonesian students (Shin et al., 2018). It was also explained in Sheehan et al. (2018) that the family environment provided early exposure to STEM concepts, hence promoting their engagement with STEM from young at home. Besides, Avargil et al. (2020) suggested that teachers could also create awareness about career opportunities and increase students' likelihood to pursue careers in the respective taught subjects. Similar finding is also reported in Batool and Ghayas (2020) that students considered teachers as role models whose encouragement and comments could affect their future career paths. In the same study, students' career choice was influenced by peers (Batool & Ghayas, 2020). Rabee et al. (2019) explained that while the roles of family members were important, the roles of peers also become more crucial as children grow older.

Besides, Gómez-Galán (2020) suggested that technologies and media do not only change how students learn, but also how they develop habits and understanding about their environment. This is because students in primary and secondary education today are digital natives in which ICT has an important part in developing their career paths (Ottestad & Gudmundsdottir, 2018). It was reported that students learnt about STEM from the media (Sheehan et al., 2018), and STEM media consumptions played a vital role in teenage students' career aspirations (Chen et al., 2022). Batool and Ghayas (2020)

also explained in their study that the media could affect students' preferences towards careers as how they were portrayed in media such as television shows, dramas and songs. Li et al.'s (2021) research also found that students believed they would be able to pursue STEM careers when they received positive information regarding STEM careers via social media. Additionally, Kettunen et al. (2020) described the Internet as the first contact point for students to explore career opportunities. This is supported by Hasin and Nasir (2021) that the Internet was important for students not only for learning, but also to seek information about careers. Students are indeed very resourceful that they can also retrieve occupational information from various types of media. These emerging adults use the media, especially the Internet, to gather career information and prepare for future careers (Levine & Aley, 2020). Kricorian et al. (2020) also revealed that students would take the initiative to follow STEM news on social media or websites and watch movies about STEM careers which they perceived useful.

In addition, Badri et al. (2016) suggested that students' willingness to engage in STEM career pathways is associated with their attitude. This is consistent with the Aziz et al.'s (2020) study which found a significant positive relationship between attitude and intention. Attitude is an indication of favourable or unfavourable judgement and individuals were more inclined to choose a career which they had more favourable judgement (Aziz et al., 2020). James et al.'s (2018) reported that students who showed a positive attitude towards the pharmacy career had greater intention for careers related to the field. A similar finding was also found in Solikhah (2014) that attitude had significant influence on students' career choice intention in accounting context.

As reviewed earlier, many past studies confirmed that subjective norms (parents, teachers, and peers) had a direct influence on students' career choice intention. On top of that, it was also noticed that media exposure and attitude could have mediating effects between subjective norms and career choice intention. For example, Batool and Ghayas (2020) pointed out that students did not follow parents' advice uncritically although students perceived them as influential significant others who were wise and reliable. Steinke et al. (2022) also emphasised in their study that information on the media and online resources are seemingly more accessible than in real life for students. Therefore, teachers were recommended to use the media to introduce STEM professions and highlight the achievements of the professionals to reinforce students' sense of STEM belonging (Kricorian et al., 2020). Moreover, Aziz et al.'s (2020) study also confirmed that attitude had a significant mediating effect between subjective norms and intention. This finding is in line with the finding of Al-Swidi et al. (2014) that subjective norms had both direct and indirect effects on intention, and attitude was a significant mediator between subjective norms and intention.

The research model is presented in Figure 1. The hypotheses of this study were established based on the research objectives and review of literature:

H_1: Subjective norms significantly influence media exposure.
H_2: Subjective norms significantly influence students' attitude.
H_3: Subjective norms significantly influence career choice intention.
H_4: Media exposure significantly influences career choice intention.
H_5: Students' attitude significantly influences career choice intention.
H_6: Media exposure mediates the relationship between subjective norms and career choice intention.
H_7: Students' attitude mediates the relationship between subjective norms and career choice intention.

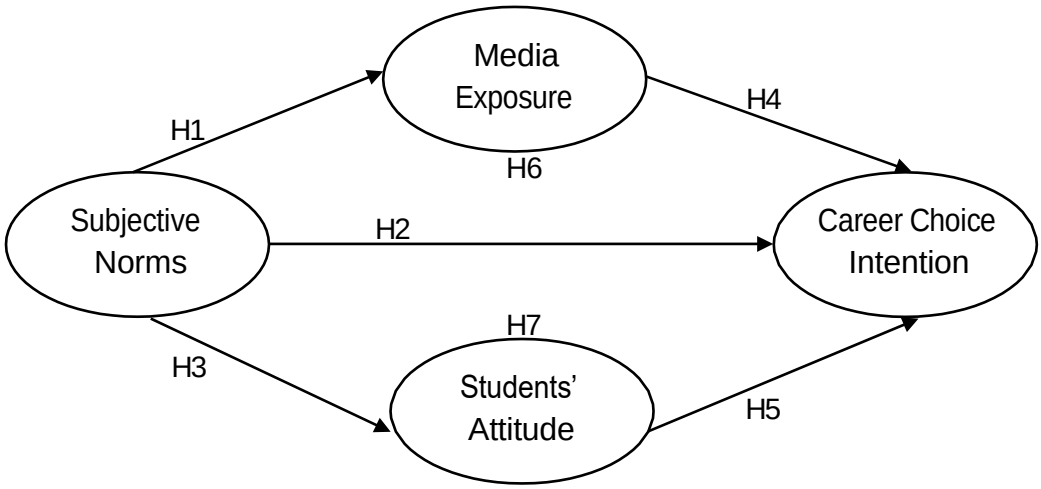

Figure 1: Research model with direct and indirect relationships.

3. Methods

Prior to data collection, permissions were sought from the Malaysian Ministry of Education, and state educational departments, school authorities and students' guardians which were involved in this study. Data was collected using a bilingual online questionnaire which students were given the options to answer in either English or the national language of Malaysia.

Three experts in the research areas were invited to review the questionnaire for its face and content validity. This step helped the researcher to ensure the survey items represent the aspects of examination aligned with the research objective. Besides, another three language experts were involved in the translation and back translation process to ensure translation accuracy as well as to reduce reliability and validity issues related to the questionnaire (Brace, 2018). The questionnaire consisted of 32 adapted and self-developed items to meet the objective of this research. The measures adapted for this study are listed in Table 1. In this questionnaire, respondents indicated their responses on a five-point Likert scale, from strongly disagree to strongly agree.

Table 1. *Referenced Sources for Questionnaire Development*

Constructs	Items	Referenced sources
Subjective Norms	15	Ajzen (2002); Francis et al. (2004)
Media Exposure	7	Hoag et al. (2017); Qader & Zainuddin (2011)
Students' Attitude	6	Ajzen (2002); Francis et al. (2004)
Career Choice Intention	4	Ajzen (2002); Francis et al. (2004)

As a result, a total of 806 complete responses were received from upper secondary school students from 13 states in Peninsular Malaysia. The respondents were all Form Four students (equivalent to Year 10) who were typically 16 years old. The respondents were recruited using proportional stratified sampling approach, hence 44% (f=354) of them were from STEM stream whereas 56% (f=452) were from non-STEM stream. More than half (60.8%) of the respondents were female, while the remaining 39.2% of them were male.

4. Results

Structural Equation Modelling (SEM) was used in this study to examine the relationships of the constructs as proposed in the research model. Hence, a two-stage analytical procedure was conducted using the SmartPLS 3.2.8 software by Ringle et al. (2015). Through this approach, reliability and

validity can be established with a measurement model, whereas hypotheses can be tested with a structural model.

4.1 Assessment of Measurement Model

Construct reliability of the model was assessed with Cronbach's alpha (α), composite reliability (CR) and the average variance extracted (AVE). According to Hair et al. (2017), the recommended threshold values for α and CR indices are 0.70 and 0.50 for AVE respectively. Table 2 shows that the α values of the constructs range from 0.808 to 0.948, while CR values range from 0.858 to 0.962, hence verifying the internal consistency of the constructs. In the same table, it was shown that AVE values of the construct are larger than the recommended threshold of 0.50 except media exposure (CR=0.465). According to Malhotra (2010), AVE is a stringent measure of convergent validity. This is also supported by Fornell and Larcker (1981) that convergent validity of a construct is still adequate when AVE is below 0.50, but it is acceptable when CR is above 0.60. As the CR value of media exposure was above 0.60 (CR=0.858), the convergent validity of the construct was established.

Table 2. *Measurement Model Assessment*

Constructs		α	CR	AVE	HTMT			
					1	2	3	4
1	Subjective Norms	0.948	0.953	0.577				
2	Media Exposure	0.808	0.858	0.465	0.451			
3	Students' Attitude	0.881	0.910	0.627	0.728	0.447		
4	Career Choice Intention	0.947	0.962	0.862	0.722	0.455	0.753	

At this stage, outer loadings of the constructs were also assessed. Hair et al. (2017) suggested that it is ideal to obtain all loadings larger than 0.708, but it is also common to see outer loadings smaller than 0.70 especially in social science research. It was suggested to retain the items for content validity if they load between 0.40 and 0.70, unless the AVE and CR values are increased after removing the items (Hair et al., 2017; Wong et al., 2016). Based on the results, outer loadings of the items ranged from 0.612 to 0.941 (>0.40), and the values of AVE and CR did not increase after removing items that loaded <0.70. Therefore, all items in the measurement model were retained.

Discriminant validity of the constructs was verified with Heterotrait-Monotrait Ratio of Correlations (HTMT) (Henseler et al., 2015). HTMT ratio with values above 0.85 indicates issues of discriminant validity, whereas values below 0.85 suggests the constructs are distinctively different from one another (Hair et al., 2017; Henseler et al. 2015). As presented in Table 2, HTMT values of the constructs range between 0.447 and 0.753 (<0.85). Hence, the constructs were distinctively different from one another, and discriminant validity was not a threat in this study.

4.2 Assessment of Structural Model

In the assessment of the structural model, the Variance Inflation Factor (VIF) was calculated to examine multicollinearity issues. It was found that the highest VIF was 2.238 (VIF<5), indicating that there was no multicollinearity issue among the exogenous constructs as the VIF values were below the recommended cut-off (Hair et al., 2017). In Table 3, the results indicated that all path coefficients were significant because the t-values were above 2.58 ($p<0.01$), and there was no zero straddled between the 95% confidence intervals.

Table 3. *Structural Model Assessment and Hypothesis Testing*

Direct Paths		β	SD	t-value	p-value	BC LL	BC UL	Result
H1	SN➔ME	0.467**	0.036	13.003	0.000	0.387	0.532	Supported
H2	SN➔ SA	0.732**	0.022	32.84	0.000	0.686	0.773	Supported
H3	SN➔CCI	0.447**	0.046	9.727	0.000	0.686	0.773	Supported
H4	ME➔ CCI	0.082*	0.030	2.766	0.006	0.025	0.141	Supported
H5	SA➔ CCI	0.392**	0.047	8.28	0.000	0.298	0.486	Supported

Note: SN: p<0.01*, p <0.001**. t-value>2.58 for p<0.01; t-value>1.96 for p<0.05. BC LL: Bias corrected lower level (5%), BC UL: Bias corrected upper level (95%). VIF<5.

PLS-SEM was employed to test the hypotheses and significance of path coefficients (β) was assessed with a bootstrapping setting of 5000 resamples. Table 3 shows that all hypotheses proposed in this study were supported by the results with p<0.01. In specific, subjective norms had a positive significant influence on students' attitude (β=0.732, p< 0.001), media exposure (β=0.467, p<0.001), and career choice intention (β=0.447, p< 0.001). The results thus supported H1, H2 and H3. Besides, H4 and H5 were also supported by the results shown in Table 3. Career choice intention was found to be significantly influenced by students' attitude (β=0.392, p<0.001) and media exposure (β=0.082, p<0.01).

In addition to the assessment of path coefficients, this study also evaluated the coefficient of determination (R^2), predictive relevance (Q^2), and effect size (f^2) of hypothesised causal relationships. Based on the results in Table 4, results suggested that 68.2% (R^2=0.682) of the variance of career choice intention can be explained by the research model of this study. It was also found that the research model explained 53.6% (R^2=0.536) of students' attitude variance and 21.8% (R^2=0.218) of media exposure variance.

Table 4. *Coefficient of Determination (R^2), Predictive Relevance (Q^2), and Effect Size (f^2)*

Constructs	R^2	Q^2	f^2		
			Media Exposure	Students' Attitude	Career Choice Intention
Media Exposure	0.218	0.068			0.016
Students' Attitude	0.536	0.263			0.172
Career Choice Intention	0.682	0.499			
Subjective Norms			0.202	0.324	0.289

Stone-Geisser's Q^2 index was also used to determine the predictive relevance of the model. Hair et al. (2017) noted that Q^2 values above zero indicate that the exogenous constructs have predictive relevance towards the respective endogenous constructs. Based on the results in Table 4, the Q^2 values ranged from 0.068 to 0.499 (Q^2>0), hence the predictive relevance of the exogenous constructs towards the endogenous constructs (media exposure, students' attitude, and career choice intention) was established. Besides, the effect sizes of the paths were also calculated with f^2. Cohen (1988) recommended that the magnitude effect size is considered small when f^2=0.02, medium when f^2=0.15, and large when f^2=0.35. As presented in Table 4, all paths had medium to large effect (f^2=0.172-0.324) except for media exposure to career choice intention which suggested small effect with f^2=0.016.

4.3 Mediation

In line with the purpose of this study, the mediating relationships of the research model were assessed using bootstrapping procedure on SmartPLS (Zhao et al., 2010). As shown in Table 5, H6 proposed that media exposure is a mediator between subjective norms and career choice intention, whereas H7 hypothesised students' attitude as the mediator between subjective norms and career choice intention. Based on the results in mediation analysis, it was found that both students' attitude (β=0.287, p<0.001) and media exposure (β=0.038, p<0.01) were significant mediators between subjective norms and career

choice intention. Since subjective norms had significant direct influence on career choice intention with β=0.447, it can be concluded that students' attitude and media exposure had partial mediating effects in the relationship between subjective norms and career choice intention in this model.

Table 5. *Mediation Effect Testing*

Indirect Paths		Indirect β	SD	t-value	p-value	BC LL	BC UL	Direct β	Result
H6	SN➔ME➔CCI	0.038*	0.015	2.629	0.009	0.012	0.069	0.447**	Partial
H7	SN➔SA➔CCI	0.287**	0.036	7.891	0.000	0.217	0.361		Partial

Note: SN: p<0.01*, p<0.001**. t-value>2.58 for p<0.01; t-value>1.96 for p<0.05. BC LL: Bias corrected lower level (5%), BC UL: Bias corrected upper level (95%). VIF<5.

5. Discussion

In general, all proposed hypotheses of this study were supported by the results. The results demonstrated that subjective norms had a positive significant influence on media exposure, students' attitude and career choice intention in STEM, hence supporting H1, H2, and H3. In other words, parents, teachers, and peers were significant others who had direct influence over student's media exposure, attitude, and intention to pursue careers in STEM. This finding is consistent with those from Hoag et al. (2017) and Bergin (2016) that parents, teachers, and peers play the biggest roles in students' career choice intention, and they develop students' exposure and shape their preferences at school and at home. This finding is also aligned with Mohtar et al. (2019) that parents, teachers, and peers' support and encouragement would increase their intention to opt for STEM careers in future.

Results also supported the proposition that students' career choice intention in STEM can also be predicted by media exposure and attitude (H4 and H5). This finding is indicative of the importance of students' media exposure and attitude in their intention to choose a career in STEM. Similar to the findings from Gómez-Galán (2020), this study confirms that the power of media was beyond teaching and learning that students' exposure to media also developed their understanding about the environment. This can be explained by Chen et al.'s (2022) that teenage students' consumptions of STEM media increased their career aspirations in STEM fields. In the context of this study, media exposure in general refers to the opportunities for a secondary school student to attain information from different types of media. This finding implies that students explored information about STEM careers via various forms of media such as the Internet, social media platforms, and television contents. Besides, the finding of this study concurs with Badri et al. (2016) and James et al. (2018) that students' attitude had significant influence on students' STEM career choice intention. This means that students were more likely to choose a STEM career when they showed greater preference and judgement to STEM careers.

Interestingly, this study also confirmed that both media exposure and students' attitude were significant mediators with partial mediating effects in the relationship between subjective norms and career choice intention, thus supporting H6 and H7. Recent studies had suggested media exposure (Steinke et al., 2022) and attitude (Aziz et al., 2020) as the mediators between subjective norms and career choice intention. Similar to these studies, finding of this research suggests that parents, teachers, and peers had direct influence on students' career choice intention and the influence could also take place via media and attitude. This finding could imply that students took significant others' encouragement and advice while considering STEM careers, but they did not follow their advice uncritically. Instead, students also took into considerations the information they obtained from the media and their personal evaluations to decide whether they are likely to choose a career in STEM.

6. Conclusion

Theoretically, this study offers new insights into the influence of subjective norms on STEM career choice intention as well as the mediating roles of media exposure and students' attitude between the

aforementioned variables. Findings of this study could be used as the latest reference for the authorities and policy makers to support the initiatives for STEM workforce in in the Malaysian context by emphasising the importance of subjective norms, media exposure, and students' attitude.

Based on the findings, parents, teachers, and peers should also be included in STEM initiatives to effectively pave students towards STEM careers. This is to ensure students' significant others are also aware of the importance of STEM and be aware of their roles for students' STEM pursuits, as well as the opportunities in STEM industries. The roles of parents, teachers, and peers are important because they can also affect students' evaluation and judgement towards STEM professions and ultimately influence their intention to participate in STEM. Therefore, parents, teachers, and peers should also be involved in the planning and implementation of STEM initiatives.

Indeed, the existing STEM initiatives such as the revamp of the national curriculum could bridge the boundaries between academic contents and vocational implications for students (Ottestad & Gudmundsdottir, 2018). Further enhancements can be considered based on the findings of this study. For example, classroom or non-academic activities can include video interviews of STEM professionals who are able to provide students with accurate information and real-life stories about STEM careers (Wyss et al., 2012). This is because even though today's students are familiar with the use of media, they might not know how to use these resources to obtain accurate information for career planning purposes (Ottestad & Gudmundsdottir, 2018). Hence, when they are exposed to media for STEM-related information under the guidance of teachers whom they perceive to be more knowledgeable and reliable, they are more likely to develop likelihood for STEM careers with accurate understanding of the professions. This finding is potentially applicable to other contexts because students today are digital natives who depend on media for career information acquisition regardless of nationalities.

There are several limitations in this study. The data was collected using a self-report online survey; hence this could have caused issues on common method variance. Besides, findings of this study can only be generalised to Form Four (Year 10) students. This study was planned to involve all upper secondary students, but the scope of study was limited to only Form Four students because Form Five (Year 11) students were preparing for national exams during the research period. In terms of locality issues, the research findings of the present study can only represent students in Peninsular Malaysia because East Malaysia which comprises Sabah, Sarawak, and the Federal Territory of Labuan were excluded from this study due to budget and time restrictions.

Future researchers could expand the scope of study by including both Form Four and Form Five students from Peninsular and East Malaysia for greater generalisation of research findings. It would be meaningful to involve Form Five students in this study because they are generally more mature and have clearer ideas about STEM career choices since they are close to completion of secondary education. Future studies could also apply the research model presented in this study in other developed countries or western cultures to examine if the results remain the same in other contexts. Researchers are also recommended to use a longitudinal approach in future studies. This approach will help researchers to better understand the underlying explanations of the causal and mediating relationships among constructs. A longitudinal approach will also allow researchers to observe changes in students' responses over a longer period because students' knowledge, exposure and experience will develop as they grow older (Shin et al., 2018).

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