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The effects of gender on knowledge, attitude and behaviour of science teachers towards climate change

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ABSTRACT

This article presents the defense for the education area as an undiscovered chance to battle environmental change, through the execution of climate change education across the curriculum. Hence, the work to distinguish the variables that decide the knowledge, attitude, and behavior of educators towards climate change is significant, since educators are significant partners in making powerful climate change education an outcome in schools. Nonetheless, not much consideration has been given to endeavors to evaluate the knowledge, attitude, and behavior of science educators related to climate change. Along these lines, this study was directed to distinguish distinctions in gender in science educators' knowledge, attitude, and behavior related to climate change. Using a stratified cluster random sampling method, a survey of 632 national secondary school science teachers in six states—Kedah, Johor, Terengganu, Selangor, Sabah, and Sarawak—was used to take a quantitative approach. The information gathered through the survey was then examined utilizing a descriptive and inferential technique. Discoveries show that the degree of knowledge, attitude, and behavior of teachers about climate change is high. The outcomes obtained from this study likewise uncover that socio-demographic factors, for example, gender can influence teachers' knowledge, attitude, and behavior about climate change. The aftereffects of this study can help policymakers to conclude the proper moves that can be made in dealing with the impacts of climate change through further developing climate change education across the curriculum, and further reassuring mitigative activities to shield the environment from the antagonistic impacts of climate change.

Contribution/ Originality: It plays an important role in showing the impact of gender on teachers' knowledge, attitudes and behavior towards climate change. The influence of gender helps in designing professional development programs according to the needs of teachers. It is a good contribution to strengthening climate change education across the curriculum.

1. INTRODUCTION

The continuous peculiarity of climate change and its impacts as regional, local and worldwide of natural, social and monetary emergencies are as of now the greatest difficulties confronting human development (Nepras, Strejckova, Kroufek, & Kubiatko, 2023). The IPCC (2014) reported that an Earth-wide temperature boost has been occurring for quite a while and a progression of phenomenal changes have been seen since the 1950s. According to Raftery, Zimmer, Frierson, Startz, and Liu (2017) there is a 95% chance that global temperatures will rise by more than 2°C by 2100. About 30% of all the world's population lives in an area where the average surface air

temperature and relative humidity (RH) exceed dangerous levels at least 20 times a year (Mora et al., 2017). Openness to outrageous intensity has been connected to an expanded gamble of respiratory framework, cardiovascular, kidney issues, as well as mental and social problems (Tawatsupa, Lim, Kjellstrom, Seubsman, & Sleigh, 2012).

Catastrophic events, for example, storms, woods flames and dry spells compromise the world's food supply, make individuals lose their homes and influence lives. Climate change has an impact on economic, social, and political systems as well as the environment (Mokhtar, 2019). The declining specialist efficiency because of intensity heat stress could increment internationally by up to 20% by 2050 (Dunne, Stouffer, & John, 2013). According to Kjellstrom (2015), heat-exposed occupations account for 15% to 20% of annual lost work hours in Southeast Asia. These losses are anticipated to double by 2050 as a result of climate change. In addition, poor environmental management and natural disasters have contributed significantly to the loss of a third of the world's arable land over the past 40 years. More than 1.3 billion of the total populaces live in horticultural land that is progressively barren and it brings about a lack of harvests, which can likewise expand the gamble of starvation and poverty (Mokhtar, 2019).

Malaysia is no special case in communicating worry in confronting the peculiarity of climate change when it sees local area activities that are the primary supporters of greenhouse gas discharges via completing activities like open copying, deforestation, as well as unnecessary energy and water utilization (Junsheng, Akhtar, Masud, Rana, & Banna, 2019). A National Policy on Climate Change has been drafted by the Malaysian government to control the anthropogenic causes of climate change like greenhouse gas emissions. Indeed, even following 14 years of the National Policy on Climate Change being presented and carried out, the antagonistic impacts of climate change are as yet perceptible particularly in the farming, forestry, biodiversity, water assets, seaside and marine assets, as well as general wellbeing areas (Tang, 2019). According to Khan, Karpudewan, and Annamalai (2021), the Malaysian community's current climate situation demonstrates the necessity of context-based climate change education.

The role of education in dealing with global sustainability issues is clearly stated in Sustainable Development Goals (SDG) 4 Agenda 2030 which states that quality education must be provided to all groups to empower society's ability to face the challenges of globalization and build a more sustainable world in the future (Singer-Brodowski, Etzkorn, & von Seggern, 2019). In Malaysia, climate change education has been integrated into the curriculum to increase the school community's understanding and take proactive steps to reduce climate change issues. Furthermore, a guideline provided by the Curriculum Development Division at the Malaysian Ministry of Education has mapped elements to unify all important elements related to the SDGs across the curriculum (Karim et al., 2022).

Teaching climate change education across the educational program requires proficient and profoundly talented teachers to improve student understanding to become problem solvers. Sadly, a lot of reports show that teachers only have a basic understanding of climate change, and there are even misunderstandings about the idea of climate change (Winter, Kranz, & Moller, 2022), teachers frequently associate climate change with atmospheric pollution because they cannot tell the difference between global warming and the greenhouse effect (Arslan, Cigdemoglu, & Moseley, 2012) and are less clear about the causes and outcomes of climate change (Liu, Roehrig, Bhattacharya, & Varma, 2015). As a result, it is reasonable to assume that the majority of teachers are not yet prepared to teach about the complicated subject of climate change. Various initiatives are needed to clear up teachers' misconceptions about the issue and further improve teachers' attitudes and actions toward it.

Nevertheless, studies on pro-environmental behavior, especially on climate change among teachers still receive little attention. Studies on environmental sustainability have been conducted among high school students (Abd Wahab & Mapa, 2020; Beddu Asis, Marinsah, & Ramlie, 2021; Mahat, Hashim, Nayan, Saleh, & Norkhaidi, 2018), teenagers (Mahat, Hashim, Saleh, Nayan, & Norkhaidi, 2019a) and pre-school (Dato, Mahat, Hashim, & Saleh, 2020; Mahat, Hashim, Saleh, Nayan, & Norkhaidi, 2019b). In fact, many studies related to pro-environmental behavior are

conducted specifically for high school students (Hashim et al., 2021; Mahat et al., 2022), primary school students (Karpudewan, 2019), indigenous students (Rahman, Halim, Ahmad, & Tuan Soh, 2018) as well as among the general public or the community (Tsai, Li, & Wu, 2021; Wi & Chang, 2019). Despite the fact that there are a few investigations of knowledge, attitude and behavior of teachers with respect to climate change (Seroussi, Rothschild, Kurzbaum, Yaffe, & Hemo, 2019), sadly, less research is done specifically on science teachers. The majority of studies only focus on future educators (Nayan, Mahat, Hashim, Saleh, & Norkhaidi, 2020; Skarstein, 2020; Tolppanen, Claudelin, & Kang, 2021), primary school teachers (Garcia & Cobar-Garcia, 2018), and pre-school teachers (Raman & Abu Bakar, 2019). Thusly, this study was led to distinguish the elements that impact the knowledge, attitude and behavior of Science educators about climate change.

In spite of the fact that there are a few examinations on conduct toward climate change, few have provided details regarding the connection between science educators' information, perspectives and conduct towards climate change in light of gender. Most investigations center around students as an objective (Vinuesa, Mucova, Azeiteiro, Cartea, & Pereira, 2020). As a result, we don't have a complete picture of the factors that influence people's attitudes toward climate change. The concept of climate change knowledge, attitude, and behavior is also taken into account in this study. Further exploration should be conducted considering different constructs in the climate change education part to help the discoveries of this review.

Thusly, the general point of this review is to recognize the degree of knowledge, attitude and behavior of secondary school Science educators towards climate change to evaluate their availability and ability to execute climate change education across the curriculum. What's more, this study expects to accomplish the accompanying explicit goals:

1. Determine the teachers' climate change knowledge, attitudes, and behaviors.
2. Distinguish contrasts in knowledge, attitude and behavior of educators towards climate change as per gender.

2. LITERATURE REVIEW

2.1. Teachers' Knowledge of Climate Change

The utilization of sustainability knowledge should be applied right on time to make mindfulness that prompts the advancement of harmless to the environment conduct. In spite of the fact that there are without a doubt educator who have profound information in the field of climate change, numerous teachers report that they feel underprepared to teach climate change in their classroom (Hestness, McDonald, Breslyn, McGinnis, & Mouza, 2018). This is on the grounds that their insight into climate change originates from media sources that don't mirror a logical perspective and depict climate change as a profoundly disputable peculiarity (Lambert, Lindgren, & Bleicher, 2011); consequently, making teachers have less information about climate change (Plutzer et al., 2016).

In the meantime, Garcia and Cobar-Garcia (2018) stated that teachers are less effective at teaching about climate change because they don't get enough training on how to teach about it. In this manner, the capacity and desire of educators to teach the theme of climate change in the classroom will be improved with in-service training that is frequently executed for teachers (Garcia & Cobar-Garcia, 2018; Opuni-Frimpong, Essel, Opuni-Frimpong, & Obeng, 2022; Rahman et al., 2018). Additionally, teachers' reliance solely on textbooks is thought to be insufficient to provide them with the most recent information and concern (Marques & Xavier, 2020). Therefore, in order for teachers to be able to impart knowledge to students, they should constantly make an effort to keep up with the most recent findings concerning issues related to climate change.

2.2. Teachers' Attitude towards Climate Change

The way a person generally feels about something or a situation is called their attitude. Educators' perspectives assume a significant part by the way they sort out information and plan their teaching (Waters-Adams, 2007), and can altogether affect the climate literacy of people in the future. According to Liu et al. (2015), understanding

teachers' perspectives and predicting teachers' climate change behavior depends on their attitudes. Feelings and concerns about climate change issues can lead to actions to solve climate change-related problems that lead to responsible behavior in reducing the impact of climate change.

What's more, climate change keeps on being acknowledged by teachers as a disputable theme which makes educators frequently hesitant to teach topics related to climate change (Seow & Ho, 2016). A few educators conquer their hesitance by deciding to teach two contradicting convictions of human obligation in climate change, and this makes teachers bound to conceal the genuine issue in their teaching (Plutzer et al., 2016). Along these lines, they focus on different things that are vital to teach in science class. This makes educators be less keen on teaching topics connected with climate change (Skarstein, 2020). This demonstrates that teachers are less prepared to effectively teach about climate change and demonstrates that teachers' attitudes toward the issue are moderate.

2.3. Teachers' Behavior Regarding Climate Change

Teachers who are aware of the significance of environmental sustainability will adopt a lifestyle that emphasizes environmental sustainability and translate it into daily practice. Unfortunately, teacher sustainability practices are still low and unsatisfactory. For example, the practice of transportation facilities among teachers shows the lowest frequency percentage, which is below 15%. The proof is that only 10% of teachers use bicycles or choose to walk to reduce the use of motor vehicles and as many as 12.5% of teachers conspire with friends to share vehicles (Raman & Abu Bakar, 2019). This shows that most teachers do not fully practice the knowledge they have which is closely related to the level of behavior towards climate change which is at a moderate level.

Climate conservation behaviors are actions that reduce the effects of climate change, such as using public transportation, sharing vehicles, conserving energy at home, and recycling (Khan et al., 2021). In a study by Mahat et al. (2019a), a high level of practice is demonstrated to be behavior for conserving water, electricity, and environmentally friendly products. As indicated by Aarnio-Linnanvuori (2019), the act of teachers who decide to utilize stairs or electrical equipment that saves energy will lessen the adverse consequences of climate change assuming countless people reliably do exactly the same thing every day.

3. METHODOLOGY

3.1. Research Design

A cross-sectional survey is the method used in this quantitative study. This technique can save time (Creswell & Creswell, 2018) in light of the fact that the study can be completed in one time and can gather an assortment of data (Abd Wahab & Mapa, 2020), taking into account that the study includes five zones in Malaysia - the north, south, east coast, central, and East Malaysia zones. This study has received ethical support from Education Policy Planning & Research Division (EPPRD) and State Education Department, together with approval from the school organization in which this study was conducted. Additionally, respondents had the choice to opt in or opt-out to answer the questionnaire, and their personal information was kept confidential.

3.2. Study Participant

The research conducted involved respondents from among 632 science teachers in daily secondary schools. Teachers who teach Science, including elective subject areas such as Physics, Chemistry and Biology are the criteria for selection of teachers.

3.3. Study Instrument

The instrument used in this study is a questionnaire adapted from Akhir, Lun, Yeang, Rahman, and Halim (2022) based on construct fit. Demographic data of the respondents is collected in Part A. Part B contains 14 items that assess three aspects of knowledge about climate change, namely the cause of the problem of climate change, the

effects of climate change, as well as actions to address this issue of climate change using a scale of 'Yes', 'No' or 'Uncertain'. Part C contains 8 items that assess three aspects related to attitudes, which include cognitive, affective, and psychomotor aspects towards climate change, and finally, Part D contains 8 items that assess two types of respondent behavior towards climate change, namely the type of activism towards climate change and non-activism types against climate change. A 5-point Likert scale is used for both Part C and D. In addition, 50 science teachers from the same demographic group participated in a pilot study of this instrument.

The content validity of the questionnaire as an instrument was obtained with the help of two experts. The chosen experts have expertise in the field of science and environmental education, particularly concerning climate change, as well as great knowledge about the format and content of science education outlined by the Malaysia Ministry of Education. Reliability was obtained by calculating Cronbach's alpha coefficient value. The value of Cronbach's alpha coefficient for knowledge was 0.736, while the value of Cronbach's alpha coefficient for both attitude and behavior was 0.744 respectively. Cronbach's alpha coefficient values that exceed 0.70 have acceptable reliability (Pallant, 2020).

3.4. Data Analysis

Statistical Package for the Social Science (SPSS) software version 29 was used to analyze data from this study. This analysis makes use of percentage, mean, and standard deviation as descriptive statistics. The percentage and frequency are analyzed in Part A, which is the demographic profile of the respondents.

The interpretation of the mean score was based on Mahat and Che Ngah (2016) as shown in Table 1, to answer a research question concerning teachers' levels of knowledge about climate change.

Table 1. Interpretation of the mean score of teachers' knowledge of climate change.

Mean score	Mean score interpretation
0.00 – 1.00	Low
1.01 – 2.00	Moderate
2.01 – 3.00	High

Source: Mahat and Che Ngah (2016).

Next, the mean score interpretation based on Mariapan, Mahat, and Nayan (2018) was used to answer the research question about teachers' attitudes and actions toward climate change, as shown in Table 2, was utilized.

Table 2. Interpretation of the mean score of teachers' attitudes and behavior towards climate change.

Mean score	Mean score interpretation
0.00 – 2.33	Low
2.34 – 3.66	Moderate
3.67 – 5.00	High

Source: Mariapan et al. (2018).

The Multivariate analysis of variance (MANOVA) test was used for inferential statistical analysis to examine the distinctions in knowledge, attitudes, and behavior toward climate change among male and female educators.

4. FINDINGS

4.1. Demographic of Respondents

Based on Table 3, a total of 78.5% are female teachers and 21.5% are male teachers.

Table 3. Distribution of the number and percentage of respondents by gender.

Demographic characteristics	Profile	N	%
Gender	Female	496	78.5
	Male	136	21.5

4.2. Level of Knowledge, Attitude and Behavior of Teachers towards Climate Change

The mean score, standard deviation, and the level interpretation of the construct of knowledge based on Mahat and Che Ngah (2016) and the construct of attitude and behavior based on Mariapan et al. (2018) are shown in Table 4. Referring to Table 4, the construct of teachers' knowledge (M=2.82, SP=0.19), attitude (M=4.66, SP=0.35), and behavior (M=4.57, SP=0.44) with regard to climate change are at a high level.

Table 4. The overall distribution of mean and standard deviation by knowledge, attitude and behavior.

Demographics	Knowledge			Attitude			Behavior		
	Mean	Standard deviation	Level interpretation	Mean	Standard deviation	Level interpretation	Mean	Standard deviation	Level interpretation
Gender									
Male	2.84	0.18	High	4.62	0.34	High	4.53	0.46	High
Female	2.80	0.19	High	4.69	0.35	High	4.60	0.42	High
Overall	2.82	0.19	High	4.66	0.35	High	4.57	0.44	High

4.3. Knowledge, Attitude and Behavior of Teachers towards Climate Change based on Gender

Table 5 shows the results of the MANOVA analysis for the differences in the construct of knowledge, attitude and behavior towards climate change among Science teachers based on gender. The findings of the study show that for gender there is a significant difference in the mean score for the dependent variable which is knowledge, attitude and behavior towards climate change (Pillai's Trace = 0.016; $F(3,626) = 3.419$, $p = 0.017$ ($p < 0.05$). Based on the analysis, the null hypothesis is rejected. This means, overall, gender of teacher is a factor that affects teachers' knowledge, attitude and behavior towards climate change.

Table 5. MANOVA analysis of knowledge, attitude and behavior based on gender.

Effect	Pillai's trace	F	dF between groups	dF in groups	Sig.
Gender	0.016	3.419	3.000	626.000	0.017*

Note: *significant at level < 0.05.

5. DISCUSSION

The study examines the differences in knowledge, attitudes and behaviour of science teachers on climate change with regard to gender. In order to increase teachers' desire to deliver climate change education across the curriculum for students, it is essential that they have knowledge of causes, effects and prevention measures. The results of the survey revealed that there is a strong level of climate change knowledge among teachers. In line with the findings of Nayan et al. (2020), which found that a teacher's level of knowledge is highly correlated to the levels of education and overall knowledge, this study has resulted in similar results. Teachers can now obtain knowledge related to climate change from various sources such as television, the web, maps, simulations, films, teacher manuals, newspapers, or through field studies and experiments (Opuni-Frimpong et al., 2022). In this way, teachers' effectiveness in teaching will be indirectly improved and the educational process of climate change education throughout the curriculum can be effectively and adequately taught.

Teachers' knowledge of climate change is additionally affected by gender. Little contrasts were seen in the knowledge of climate change among male and female teachers. The degree of knowledge of male teachers in regard to climate change is somewhat higher than that of female teachers. Xiao and McCright (2014) likewise found that men have higher knowledge about environmental issues than women. This is on the grounds that, as indicated by Vicente-Molina, Fernández-Sainz, and Izagirre-Olaizola (2018), the socialization role of men makes men have more prominent admittance to education. Zsóka, Szerényi, Széchy, and Kocsis (2013) concentrated on the connection between the degree of training and information on environmental issues, for example, climate change found that an elevated degree of education impacts an individual's dominance of knowledge.

Overall, teachers' attitudes towards the issue of climate change are at an undeniable level. This demonstrates that teachers have a high level of environmental sustainability awareness. The results of this study are consistent with Winter et al. (2022) who discovered that teachers will think more positively about climate change. Most teachers will decrease the solace of life to protect the environment and believe that they can contribute to a better environment, in this way diminishing the effect of climate change (Ahmad, Mustafa, Hamid, & Wahab, 2011).

The analysis also additionally shows that the general degree of teacher behavior towards climate change is high. Teachers who hold firm to the stance that the sustainability of nature should be preserved and maintained are translated through lifestyle practices that reduce the risk of climate change from continuing to worsen (Raman & Abu Bakar, 2019). The desire of teachers to maintain the sustainability of nature affects the practice of teachers in lessening the effect of climate change. This is unknowingly applied by the teacher during the teaching and learning process in the classroom, either verbally or through actions.

Zelezny, Chua, and Aldrich (2000) directed a study on distinctions in gender in attitude and behavior towards the environment and reasoned that women show higher support of ecological demeanor and behavior than men, notwithstanding more significant levels of socialization and responsibility. The socialization hypothesis contends that individual behavior patterns are formed by gender assumptions with regard to social standards or cultural norms (Zelezny et al., 2000). In light of this hypothesis, women are coordinated towards the job of family guardians, which urges them to have more sympathy, compassion, and participation than men; as a result, women become more nature-aware. Men, on the other hand, are encouraged to be more skilled, rational, and competitive than women because male socialization emphasizes their role as economic providers; also, along these lines, men are all the more firmly connected against natural perspectives. Contrasts in socialization since youth are the reason for distinctions in gender in attitude and behavior towards climate change (Xiao & McCright, 2015). As a matter of fact, the contention of gender socialization has likewise been stretched out by numerous scientists to consider factors that can intervene in the impact of gender on attitude and behavior towards climate change like religious beliefs, values, motivation, as well as roles and societal position (Vicente-Molina et al., 2018).

6. CONCLUSION

The discoveries of this study give an outline of educators' readiness to take part in ways of behaving that diminish the unfriendly impacts of climate change. The discoveries of the concentrate additionally give direct ramifications on the execution of climate change education across the educational plan in Malaysia. More importantly, it suggests efficient approaches for evaluating teachers' perspectives on climate change and offers significant implications for upcoming professional development programs on climate change education. Along these lines, future expert advancement ought to consider putting more accentuation on giving logical data to educators to expand their ability and trust in executing climate change education. In addition to the quantitative survey methods used in this study, qualitative methods should be used in future studies to provide both general and specific explanations for the differences in teachers' knowledge, attitudes, and actions regarding climate change.

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Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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