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Junior High School Teachers' Attitudes Toward Inquiry-Based Science Teaching: Enabling or Disabling Dispositions?

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Abstract

This study sought to examine whether junior high school teachers' attitudes are enabling or disabling dispositions toward inquiry-based science teaching. We used concurrent triangulation mixed methods design involving surveys and multiple case studies to collect quantitative and qualitative data. We sampled 308 integrated science teachers and a subsample of 18 teachers from junior high schools in urban and rural areas. Validity and reliability of the questionnaire were satisfactory for research. Credibility and dependability of the semi-structured interview schedule were also sufficient. Findings suggest that most junior high school teachers in the study context hold weak unfavourable attitudes that are disabling dispositions toward inquiry-based science teaching. Findings also suggest that the combination of societal subjective norms, perceived context dependency, and weak unfavourable attitudes of most junior high school teachers adversely influence their intentions and behaviours toward inquiry-based science teaching. Findings further suggest that most teachers in the study context developed weak unfavourable attitudes partly because they never had inquiry-based science teaching and learning experiences when they were students. Again, the teachers developed weak general attitudes toward science teaching partly because most science teaching and learning experiences they had were in specific subjects such as biology, chemistry, and physics instead of general (integrated) science. We recommend frequent attitude-focused inquiry-based science in-service trainings for junior high school teachers. We also recommend reforms in education that engages preservice teachers in attitude-focused inquiry-based science teaching and learning experiences.

Keywords: attitudes, inquiry-based teaching, integrated science, junior high school

1. Introduction

Traditional science instruction largely involves teachers drawing on content and pedagogical content knowledge to transmit scientific knowledge and laboratory procedures for students to receive, memorize, and recall later. However, most contemporary studies show that teachers must also develop strong favourable attitudes to facilitate science teaching, including inquiry-based teaching. (Alake-Tuenter, Biemans, Tobi, & Mulder, 2013; Choi & Ramsey, 2009; Novak & Wisdom, 2018; Park, Chu, & Martin, 2016; Tsybulsky & Oz, 2019; Wilder, Butler, Acharya, & Gill, 2019). Due to the widely acknowledged effectiveness of inquiry in promoting various learning outcomes and scientific literacy (Furtak, Seidel, Iverson, & Briggs, 2012), curricula reforms to consolidate and enhance inquiry teaching have occurred in places where the culture of inquiry is well established (Chin, 2005; Marec, Tessier, Langlois, & Potvin, 2021; National Research Council [NRC], 2012; Silm, Tiitsaar, Pedaste, Zacharia, & Papaevripidou, 2017). Similarly, curricula changes to adopt and implement inquiry-based pedagogy have occurred in many other places (Chabalengula & Mumba, 2012; Curriculum Research and Development Division [CRDD], 2007, 2012; Mugabo, 2012; Ssempala, 2017). Inquiry-based science teaching involves the engagement of students in relevant, meaningful, interesting, authentic, hands-on, minds-on, and collaborative investigations that are similar to the activities and thinking processes of scientists. In this process teachers facilitate students to ask scientifically-oriented questions about natural phenomena; formulate hypotheses; design and conduct investigations; and collect, analyse, and interpret data. Again, teachers facilitate students to collaborate with peers and others; communicate and justify investigation procedures and results; search for information from books, internet, articles, and other sources; and to consider alternative procedures and explanations (Furtak et al., 2012; National Research Council [NRC], 1996).

However, studies have shown that inquiry-based science teaching is rarely or poorly implemented in classrooms in many contexts globally (Mohammed, Amponsah, Ampadu, & Kumassah, 2020; Mugabo, 2012; Ssempala, 2017). The unfavourable or weak favourable attitudes that teachers bring to the classroom contribute to this problem. Most studies aimed at examining preschool, elementary, middle, high, and secondary school preservice and in-service teachers' attitudes are conducted in places where the culture of inquiry is well established (Alake-Tuenter et al., 2013; Damnjanovic, 1999; Maier, Greenfield, & Bulotsky-Shearer, 2013; Park et al., 2016). Contrary, there have been few studies to examine teachers' attitudes in places where curricula changes have occurred to adopt and implement inquiry-based science pedagogy (Aldahmash, Alamri, Aljallal, & Bevins, 2019; Hackman, Zhang, & He, 2021; Mugabo, 2012; Ramnarain & Hlatswayo, 2018; Ssempala, 2017). Studies into elementary, middle, junior high, and senior high school teachers' attitudes in these contexts are necessary to gain insight and ascertain whether the teachers' dispositions enable or disable inquiry teaching, and to provide appropriate remedy where necessary.

1.1 Purpose of the Study

The purpose of this study was to examine junior high school (JHS) teachers' attitudes toward inquiry-based science teaching and whether the teachers' dispositions enable or disable inquiry teaching. The study also sought to examine extent to which differences in JHS teachers' attitudes and school type (public and private) enable or disable inquiry teaching.

1.2 Research Questions

The research questions used are:

1. To what extent do JHS teachers' attitudes enable or disable inquiry-based science teaching?

2. To what extent do differences in JHS teachers' attitudes and school type (public and private) enable or disable inquiry-based science teaching?

2. Conceptual Framework

The conceptual framework for this study draws from attitude and behavioural theories and models of Ajzen (1989, 2001), Krosnick and Petty (2014), van Aalderen-Smeets, van der Molen and Asma (2012) and others.

2.1 Attitudes Toward Science Teaching

Individuals' attitudes toward science teaching are their dispositions to respond favourably or unfavourably toward science teaching (Ajzen, 1989). These dispositions arise from the individuals' evaluations of science teaching experiences. Individuals may hold general attitudes toward science teaching or specific attitudes toward instructional approaches such as inquiry-based or traditional science teaching (Ajzen, 1989, 2001). Likewise, teachers may hold general attitudes toward science instruction or specific attitudes toward either biology, chemistry, or physics teaching.

Attitudes toward science teaching are latent dispositions that cannot be observed directly but inferred from individuals' verbal and non-verbal expressions. Most attitudes toward science teaching are acquired from individuals' experiences but are not their innate dispositions (Ajzen, 1989; Buaraphan, 2011). Attitude toward science teaching is multidimensional and hierarchical with underlying components and subcomponents (Ajzen, 1989; van Aalderen-Smeets et al., 2012). There are different structures of attitude in the literature, with each structure showing different relationships between attitude and its underlying components and subcomponents (Ajzen, 1989; van Aalderen-Smeets et al., 2012). However, this study adopts van Aalderen-Smeets et al's attitude structure. This structure divides attitudes toward science teaching into the cognitive, affective, and perceived control components. The cognitive component encompasses individuals' beliefs, opinions, and perceptions about science teaching (Ajzen, 1989; van Aalderen-Smeets et al., 2012). Sub-components underlying the cognitive component are perceived relevance, difficulty, and gender-stereotypical beliefs about science teaching. The affective component encompasses individuals' emotions and feelings about science teaching. This includes individuals' admirations or disgust, appreciations or disdain toward science teaching. Sub-components underlying the affective component are perceived enjoyment and anxiety toward science teaching. The perceived control component encompasses individuals' perceptions of control over internal and external impediments to science teaching. Sub-components underlying perceived control component are self-efficacy and perceived dependency on context factors. According to Van Aalderen-Smeets et al.'s (2012) theoretical framework, individuals' attitudes influence their science teaching intentions which, become the immediate antecedents of their instructional behaviours. While Van Aalderen-Smeets et al. (2012) recommend the study of self-efficacy in conjunction with other attitude components, many researchers study self-efficacy toward science teaching independently (Bleicher, 2004; Riggs & Enochs, 1989.; Smolleck, Zembal-Saul, & Yoder, 2006), in line with the social cognitive theory (Bandura, 1977). This study examined individuals' attitudes toward science teaching without their self-efficacy.

2.2 Effects of Attitudes Toward Science Teaching

Effects of attitudes toward science teaching are the extent to which expressions (verbally, written, etc.) of individuals' cognitive and affective evaluations of science teaching manifest in their instructional intentions and behaviours (Ajzen, 1989; van Aalderen-Smeets et al., 2012). Teachers who express inquiry-based attitudes are expected to manifest inquiry-based science instructional intentions and behaviours but, teachers who express traditional attitudes are expected to manifest traditional science teaching intentions and behaviours. Similarly, teachers who express general attitudes are expected to manifest general science teaching intentions and behaviours but, teachers who express specific attitudes are expected to manifest specific intentions and behaviours toward specific subject teaching, such as biology teaching, chemistry teaching, or physics teaching. Individuals' intentions are their behavioural inclinations and commitments toward science teaching. This includes what they say they do, plan to do, or would do about science teaching under appropriate conditions. Teachers' intentions indicate the effort they are willing and planning to exert in science teaching (Ajzen, 1989).

Attitudes influence individuals' behaviours by shaping their perceptions of science teaching and the context in which science teaching occurs (Krosnick & Petty, 2014). It enables individuals to process novel information, ideas, and strategies that are consistent with their attitudes and, reject new ideas and strategies that challenge their attitudes (Ajzen, 2001; Krosnick & Petty, 2014). Strong favourable attitudes enable individuals to recollect past relevant instructional episodes and strategies that are consistent with the attitudes but, disable individuals from recollecting past instructional episodes and strategies that challenge the attitudes. Individuals respond frequently and easily to science instructional tasks and problems that are consistent with the individuals' easily accessible attitudes but, find it difficult to respond promptly to tasks and problems that are inconsistent with the individuals' easily accessible attitudes. Individuals with negative attitudes avoid science teaching or teach science poorly (Bayraktar, 2011).

2.3 Demographic and Contextual Influences on Attitudes Toward Science Teaching

Contextual and personal factors do combine to promote or diminish individuals' ability to access different attitudes for evaluating and making decisions about science teaching (Ajzen, 2001). However, empirical evidence is inconclusive about the influence of contextual and personal factors on the direction and strength of individuals' attitudes, intentions, and behaviours regarding science teaching. While significant gender differences in attitudes toward science teaching were found in some studies (Riegle-Crumb et al., 2015; Turkmen, 2013) no significant gender differences in attitudes were found in other studies (Bayraktar, 2011; Çam & Geban, 2017; Chin, 2005). Similarly, while some studies show that there is significant influence of teaching experience on individuals' attitudes toward science instruction (Alake-Tuenter et al., 2013), other studies show that there is no significant influence of teaching experience on individuals' attitudes. Other personal and contextual factors that have empirically been shown to influence attitudes toward science teaching include class size, time constraint, class management, curricula demands (DiBiase & McDonald, 2015; Ramnarain & Hlatswayo, 2018), school-type (Hackman et al., 2021), and ethnicity/race (Riegle-Crumb et al., 2015).

2.4 Formation of Attitudes Toward Science Teaching

Attitudes toward science teaching can be formed from memorable episodes of science instructional experiences individuals had in the past (Krosnick & Petty, 2014). Individuals who had memorable inquiry-based experiences when they were students in elementary and high schools are more likely to form inquiry-based science teaching and learning attitudes. Likewise, individuals who had traditional science teaching and learning experiences are more likely to develop traditional science teaching attitudes. Attitudes toward science teaching can also be formed from individuals' experiences outside the formal school environment (Kazempour, 2014). Individuals' attitudes develop from their cognitive and affective evaluations of science teaching and learning experiences (Ajzen, 1989). As individuals form beliefs and perceptions about science teaching they are fundamentally, spontaneously, and inevitably evaluating and forming attitudes toward science teaching (Ajzen, 2001).

Once attitudes are formed, they are used to guide science teaching intentions and behaviours. When individuals frequently engage in instructional practices that are consistent with their attitudes, the attitudes become reinforced and, individuals become more committed to the attitudes (Krosnick & Petty, 2014). Although frequent engagement in instructional practices that are consistent with individuals' attitudes reinforces the attitudes, science instructional behaviours may produce novel information that changes individuals' attitudes and intentions (Ajzen, 1989).

2.5 Preservice and In-Service Education for Attitudes Toward Science Teaching

Traditional preservice and in-service science education largely involves equipping teachers with content and pedagogical content knowledge, with little attention to developing teachers' attitudes. However, most contemporary studies show that preservice and in-service education must also focus on developing teachers with strong favourable attitudes (Alake-Tuenter et al., 2013; Novak & Wisdom, 2018; Tsybulsky & Oz, 2019; Wilder et al., 2019). In developing favourable attitudes teachers must be helped to acquire salient knowledge and beliefs relevant to science teaching (Ajzen, 1989). Preservice and in-service teachers who acquire sufficient knowledge, skills, and beliefs relevant to inquiry-based science teaching are likely to develop favourable inquiry attitudes. Similarly, teachers who acquire knowledge, skills, and beliefs about traditional science teaching are likely to develop favourable attitudes toward traditional teaching. Individuals who acquire more knowledge about science teaching are likely to develop strong attitudes that are resistant to change. Individuals who develop strong attitudes based on their knowledge of science teaching have greater ability to process and interpret novel information that are consistent with their attitudes (Krosnick & Petty, 2014).

3. Methods

3.1 Research Design

We used concurrent triangulation mixed methods design to collect, analyse, and interpret quantitative and qualitative data in one phase (Creswell, 2009; Creswell & Plano Clark, 2007) but, in two parts. The first part involved quantitative survey of a large sample of JHS integrated science teachers using questionnaires. The second part involved multiple-case study of a subsample of the teachers using semi-structured interviews. We gave equal priority to both data types. Integration of the data occurred during presentation and discussion of the results. The survey allowed us to collect standardized data to determine the breadth of the issue. It also facilitated the use of descriptive and inferential statistics and, meaningful generalization of the findings (Ornstein, 2006; Wolf & Fraser, 2008). The qualitative results allowed us to empirically validate and interpret findings from the quantitative data. It also helped us to gain insight and varied perspectives of the phenomenon under study. The qualitative data also enabled us to unravel issues that were initially not considered.

3.2 Sample

We used multi-stage sampling procedure, involving purposive and stratified random sampling, to select 308 integrated science teachers and a subsample 18 teachers from JHSs in two rural, one urban, and one urban-rural districts and municipalities in the Central Region of Ghana. Most of the teachers were males 277(89.94%) and a few were females 31(10.07%). Most of the teachers were certificate holders 200(64.94%) with Diploma in Basic Education (DBE), Teachers' Certificate “A”, SSCE, WASSCE, and the like. Many of them were first degree holders 105(34.09%) with BED, BSC, and BA certificates. Only 3(0.97%) teachers were post graduates with MED, MSC, and MA certificates. Most of the teachers had 1-5 years teaching experience 178(58.36%). Seventy-nine teachers (25.65%) had 6-10 years, 44(14.29%) teachers had 11-15 years, and 7(2.27%) teachers had over 15 years teaching experiences respectively. Most of the teachers were located in urban centres 163(52.92%) and 145(47.08%) teachers in rural areas.

3.3 Instrument

3.3.1 Teachers' Questionnaire

We designed and developed a questionnaire to rate JHS teachers' attitudes toward inquiry-based science teaching. The design and validation of the questionnaire drew on past attitude instruments (Salta & Tzougraki, 2004; van Aalderen-Smeets & van der Molen, 2013). We identified four components of attitudes in consistent with the literature on teachers' attitudes toward inquiry-based science teaching. The four components are “perceived interest”, “perceived anxiety”, “perceived difficulty”, and “perceived relevance” of inquiry teaching. Perceived interest encompasses extent to which teachers feel excited, comfortable, and find it easy and enjoyable to engage students in inquiry-based science activities. Perceived anxiety comprises extent to which teachers feel bored, uneasy, and nervous in engaging students in inquiry-based science activities. Perceived difficulty encompasses extent to which teachers find it difficult to engage students in inquiry-based science activities. Perceived relevance comprises extent to which teachers find it important and appropriate to engage students in inquiry-based science activities.

We initially constructed 75 items to cover the four attitude components. The items were constructed on a 5-point Likert scale from strongly disagree = 1, disagree = 2, uncertain = 3, agree = 4, to strongly agree = 5. Low scores (1 and 2) indicate traditional-oriented attitudes and high scores (4 and 5) indicate inquiry-based attitudes. We used extensive literature and expert judgments from two professors in science education to establish content validity of the questionnaire. Based on recommendations of the two professors 35 items were removed. Three parallel forms of the 40-item questionnaire were constructed for pilot testing. We pilot-tested the first parallel form using 39 integrated science teachers from one municipality and pilot-tested the second parallel form using 52 teachers from another municipality in the Central Region. We pilot-tested the third parallel form using 108 teachers from one municipality in a nearby region of the country. Participants and municipalities for the pilot test were not involved in the main study.

Initial item analysis showed that the first parallel form had only 7 seven items below .3 corrected item-total correlation. The third parallel form had 18 items and the second parallel form had 23 items below .3 corrected item-total correlation respectively. We removed one item with low corrected item-total correlation from the first parallel form of the questionnaire and adopted the questionnaire for the main study. After the main data collection, we conducted confirmatory

Principal Component Analysis (PCA) with varimax rotation to further refine and establish the construct validity of the instrument (Salta & Tzougraki, 2004; van Aalderen-Smeets & van der Molen, 2013). The Kaiser-Meyer-Olkin (KMO) (.793) and Bartlett's sphericity test $\chi^2[(741) = 4398, p<.0001]$ values show that the data is appropriate for PCA. Twenty items were removed for exhibiting cross-loadings or loading onto the wrong component. The remaining 19 items resulted in four interpretable components and were extracted for analysis to answer the research questions. The percentage of total variance (52.07%) explained by the four components is satisfactory and comparable to those in similar studies (Salta & Tzougraki, 2004; van Aalderen-Smeets & van der Molen, 2013). Final reliabilities of the components (perceived anxiety, $\alpha = .73$; perceived relevance, $\alpha = .74$; perceived interest, $\alpha = .78$; perceived difficulty, $\alpha = .71$) and entire instrument, $\alpha = .72$ are above the conventional reliability estimate (.70) (Smith et al., 2007).

3.3.2 Interview Schedule

We designed a semi-structured interview schedule to collect qualitative data from a subsample of the teachers. Some items on the schedule were used to elicit respondents' demographic information such as age, gender, school type (public and private), school location (urban and rural), and years of teaching experience. Other open-ended items on the schedule were used to elicit the participants' responses on their perceived interest, relevance, anxiety, and difficulty in engaging JHS students in inquiry-based science activities. The open-ended items allowed the participants to express their views and experiences in detail. Again, the flexibility of the semi-structured schedule allowed issues initially not considered to emerge from the interviews (Jacob & Furgerson, 2012). The flexibility of the schedule also allowed the order of the questions to be changed based on participants' responses; and for the interviewer to probe, prompt, and follow-up responses for clarification.

We pilot-tested the interview schedule using six science teachers from one municipality. The pilot-test enabled us to modify the wording of some items to remove ambiguities. It also allowed us to check the working condition of our audio recording equipment and developed contingency plans to handle problems in the main study.

3.4 Data Collection Procedure

We obtained signed consents from directors of education in the districts and municipalities and head teachers in the JHSs for access into the schools. We also obtained signed consents from the integrated science teachers for their participation in the study. The data collection occurred in one phase but two parts. The first part involved administration of questionnaires to the teachers. Out of 352 questionnaires distributed, 308 (87.5% return rate) were fully completed and returned.

The second part involved individual face-to-face semi-structured interviews with a subsample of 18 teachers from 16 public and private JHSs in the districts and municipalities. We agreed on convenient dates, times, and places for the interviews. All the interviews were conducted and recorded by the corresponding author. All interviewees signed consent forms prior to the interviews. The consent forms centred on ethical issues including purpose of the interviews, participants' anonymity, confidentiality, privacy, and rights to refuse or withdraw from the study. Sufficient rapport was established with the respondents. This allowed them to talk freely and provide credible and dependable information. Most of the interviews lasted 45 minutes and a few lasted more or less.

3.5 Data Analysis

There was prior screening of the quantitative data to remove outliers and cases with missing values. Negative worded questionnaire items were recoded. Prior analysis of the quantitative data showed that assumptions of normality, multicollinearity, linearity, and equality of variance and covariance had not been violated. Analysis of the qualitative data involved transcription of all the audio recorded interviews followed by auditing and editing of the transcripts. To answer research question one, we calculated average item means, average item standard deviations, frequencies, and percentages of the quantitative data. We then triangulated the descriptive statistics with themes and sample quotations from relevant portion of the qualitative data.

To answer research question two, we conducted One-way Multivariate Analysis of Variance (MANOVA) with school type (public and private) as independent variable and components of attitude (perceived anxiety, perceived interest, perceived difficulty, and perceived relevance) as dependent variables. Means and standard deviations of items constituting the components of attitudes were also calculated. We then triangulated the quantitative results with themes and sample quotations from relevant portion of the qualitative data.

4. Results

4.1 Extent to Which JHS Teachers' Attitudes Enable or Disable Inquiry-Based Science Teaching

Table 1 shows that, generally, the JHS teachers perceived moderate favourable attitudes (M = 3.44, SD = .42) toward inquiry-based science teaching. While they perceived strong favourable interest (M = 4. 07, SD = .73) and relevance (M

= 3.90, SD = .70) of inquiry-based science teaching, they perceived moderate favourable anxiety (M = 3.54, SD = .71) and strong unfavourable difficulty (M = 2.08, SD = .74) of inquiry teaching. Most teachers expressed strong favourable interest in inquiry teaching and agreed that it is exciting 272(88.3%) and easy 192(62.3%) to allow JHS students to manipulate science equipment and materials, and enjoyable 285(92.5%) to allow JHS students to work in groups.

Table 1. Average item means, average item standard deviations, frequencies, and percentages of JHS teachers' perceived anxiety, difficulty, interest, and relevance of inquiry-based science teaching

Component of attitude	Responses					Average item mean	Average item standard deviation
	SD	D	U	A	SA		
	n(%)	n(%)	n(%)	n(%)	n(%)		
Perceived interest						4.07	.73
Teaching is exciting when JHS students manipulate equipment and materials.	0(0.0)	20(6.5)	16(5.2)	143(46.4)	129(41.9)		
It is easy allowing JHS students to manipulate science equipment and materials.	18(5.8)	58(18.8)	40(13.0)	98(31.8)	94(30.5)		
It is enjoyable making JHS students work in groups.	0(0.0)	17(5.5)	6(1.9)	164(53.2)	121(39.3)		
Perceived relevance						3.90	.70
It is relevant to make JHS students work systematically like scientists.	0(0.0)	34(11.0)	22(7.1)	151(49.0)	101(32.8)		
It is relevant to make JHS students examine and evaluate the quality of data.	0(0.0)	51(16.6)	14(4.5)	160(51.9)	83(26.9)		
It is appropriate to make JHS students examine and evaluate the quality of data.	14(4.5)	46(14.9)	29(9.4)	162(52.9)	57(18.5)		
It is relevant to make JHS students plan, design, and perform experiments.	0(0.0)	51(16.6)	20(6.5)	117(38.0)	120(39.0)		
It is appropriate to make JHS students work systematically like actual scientists.	0(0.0)	40(13.0)	24(7.8)	162(52.6)	82(26.6)		
Perceived anxiety						3.54	.71
It is uneasy to make JHS students interpret data to develop explanations for science phenomena.	53(17.2)	144(46.8)	38(12.3)	46(14.9)	27(8.8)		
It is nervous making JHS students argue and discuss scientific ideas among themselves.	77(25.0)	143(46.4)	31(10.1)	34(11.0)	23(7.5)		
Teaching takes too much time when I make JHS students examine and evaluate data.	16(5.2)	63(20.5)	18(5.8)	133(43.2)	78(25.3)		
It is nervous allowing JHS students to formulate hypotheses for science phenomena.	53(17.2)	135(43.8)	58(18.8)	39(12.7)	23(7.5)		
It is nervous making JHS students collect and record data.	95(30.8)	147(47.7)	23(7.5)	43(14.0)	0(0.0)		

(Table 1 Continued).

Component of attitude	Responses					Average item mean	Average item standard deviation
	SD	D	U	A	SA		
	n(%)	n(%)	n(%)	n(%)	n(%)		
Perceived difficulty						2.08	.74
I feel at ease writing science concepts and principles on the board for students to copy.	16(5.2)	44(14.3)	24(7.8)	154(50.0)	70(22.7)		
It is easy defining and stating science concepts for students.	0(0.0)	32(10.4)	15(4.9)	165(53.6)	96(31.2)		
It is difficult writing science concepts and principles on the board for JHS students to copy.	96(31.2)	140(45.5)	16(5.2)	56(18.2)	0(0.0)		
It is comfortable defining and stating science concepts and principles for JHS students.	0(0.0)	48(15.6)	10(3.2)	140(45.5)	110(35.7)		
Attitude toward inquiry-based science teaching						3.44	.42

N = 308, SD = Strongly Disagree, D = Disagree, U = Uncertain, A = Agree, SA = Strongly Agree

Note: High mean is inquiry-based attitude, low mean is traditional-oriented attitude

However, results from interviews with a subsample reveal that the teachers' interest in inquiry teaching is not as favourably strong as the quantitative results apparently show. While many teachers expressed strong interest in inquiry teaching based on some knowledge and beliefs about inquiry, most teachers expressed strong interest in inquiry teaching based on knowledge and beliefs about traditional science teaching.

Interviewees who expressed strong interest based on some knowledge and beliefs about inquiry teaching expressed their willingness to allow JHS students plan and perform science investigations and, felt that inquiry-based science teaching improves students' understanding and retention of knowledge better than traditional instruction. The teachers also felt that students engaged in inquiry become familiar with the names and uses of science instruments and, get first-hand knowledge from real-science experiences. Again, the teachers felt that when students are engaged in inquiry the students can transfer knowledge gained to the next grade levels.

> *If students engage in inquiry activities… they get first-hand information of what they are learning. Seeing and handling things they are learning stick in their heads more than the teacher telling them everything*. (ST 15)

However, teachers who expressed strong interest in inquiry teaching based on knowledge and beliefs about traditional teaching felt that it is inappropriate to engage JHS students in science investigations because, the students have low abilities, lack motivation for science work, are not familiar with the inquiry process, cannot read and understand English, and that allowing JHS students to conduct investigations might lead to accidents. These teachers felt that they will allow JHS students to perform science investigations only when all safety procedures and step-by-step guidance have been spelt out.

> *I will not allow JHS students to plan and perform their investigations … If you allow them to perform investigations on their own, they might add water into acid and there will be explosion*. (ST 3)

Table 1 shows that more than three-quarters of the teachers perceived strong favourable relevance of inquiry teaching and, agreed that it is important to make JHS students plan, design, and perform science investigations 233(77.0%); examine and evaluate the quality of scientific data 243(78.8%); and work systematically like actual scientists do 252(81.8%). Results from interviews with a subsample corroborate the quantitative results shown in Table 1. Most interviewees felt that allowing JHS students to conduct investigations will enable the students to acquire inquiry skills including, identifying and finding solutions to problems in day-to-day real-life experiences. The interviewees also felt that inquiry pedagogy will encourage JHS students to participate actively in the teaching and learning process and, use their own ideas to construct knowledge. Again, the interviewees felt that when JHS students are engaged in real-life inquiry experiences the students develop deeper understanding of science concepts and principles.

> *If the procedures of science become familiar to a student, they can identify certain problems and start thinking about how to solve them*. (ST 16)

Again, the teachers felt that inquiry teaching will remove students' misconceptions and superstitious beliefs. They also felt that students engaged in exploration will get to know the existence of natural and artificial science phenomena and, become convinced about the reality of these phenomena. Additionally, the teachers felt that inquiry teaching will improve JHS students' attitudes toward science and science learning and, that engagement of young students in frequent inquiry activities will make it easy for the students to learn science and for their confidence to grow.

> *If you inculcate inquiry "spirit" into kids at tender age, learning science will be easy for them when they grow up with it (inquiry spirit). They will have better understanding of science concepts and that will help promote their interests in science and learning science*. (ST 14)

Table 1 shows also that the JHS teachers perceived strong unfavourable difficulty of inquiry-based science teaching but, strong favourable perceptions of traditional instruction. Most of the teachers agreed that it is easy and comfortable to define and state science concepts and principles 250(81.2%) and write them on the blackboard 224(72.7%) for students to copy. Results from interviews with a subsample corroborate the quantitative results shown in Table 1. Most interviewees felt that inquiry teaching is difficult because science equipment and materials are not available in JHSs. They explained that even where science equipment and materials are available JHS students don't know how to use the equipment and materials. Some teachers felt that it will be difficult to achieve the objectives of science lessons because of students' unfamiliarity with the inquiry process.

> *JHS students might not have full understanding of the theories behind experiments they are performing. The students might not also have mastery of the procedures required for experiments*. (ST 7)

Again, the interviewees felt that most JHS students' inability to read and understand English language make it difficult to implement inquiry teaching and, that unless the teacher is there to explain certain statements and words it will be difficult for students to engage in inquiry. The teachers felt also that it is difficult to implement inquiry teaching in JHSs because most students have low abilities, lack motivation for science work, and are anxious toward science.

> *The students' inability to read is also part of the difficulty. Even if the teacher gives them the method and procedure to follow, reading to know that this is pipette or burette is a problem. So, leaving them to plan and do investigations on their own is very, very difficult*. (ST 2)

Table 1 shows that many teachers perceived weak favourable anxiety toward inquiry teaching and agreed that it is not nervous to allow JHS students to collect and record 242(78.5%) and interpret data to develop explanations for science phenomena 197(64.0%). However, many other teachers perceived strong unfavourable anxiety toward inquiry teaching and agreed that it takes too much time to make JHS students examine and evaluate the quality of scientific data 211(68.5%) and, nervous to allow students interpret data to develop explanations for science phenomena 73(23.7%). Again, while many teachers agreed that it is not nervous to allow JHS students to formulate hypotheses 188(61.0%) and discuss scientific ideas among themselves 220(71.4%), a considerable number of teachers agreed that it is anxious to allow JHS students to formulate hypothesis 62(20.2%), while others were uncertain about allowing students to formulate hypotheses for science phenomena 50(18.8%) (Table 1).

4.2 Extent to Which Differences in JHS Teachers' Attitudes and School Type (Public and Private) Enable or Disable Inquiry-Based Science Teaching

Results from one-way MANOVA show that there was statistically significant school type (public and private) difference in JHS teachers' attitudes toward inquiry-based science teaching Wilk's $\lambda = .966$, $F(4, 303) = 2.705$, $p<.05$, partial $\eta^2 = .034$.

Table 2. Average item means, average item standard deviations, and one-way MANOVA results (F and ŋ2) for school type for components of attitude toward inquiry-based science teaching

Component of attitude	Average item mean		Average item standard deviation		School type difference	
	Public JHSs	Private JHSs	Public JHSs	Private JHSs	F	η^2
Perceived interest	4.12	4.00	.68	.78	1.954	.006
Perceived relevance	3.97	3.81	.68	.71	4.391**	.014
Perceived anxiety	3.55	3.53	.71	.72	.045	.000
Perceived difficulty	2.15	1.99	.78	.69	3.392	.011

** p<.05, N = 178 (Public JHS teachers), N = 132 (Private JHS teachers)

Note: High mean is inquiry-based, low mean is traditional-oriented

Subsequent univariate ANOVAs show that there was statistically significant school type difference in the teachers' perceived relevance of inquiry teaching $F(1, 306) = 4.391$, $p<.05$, partial $\eta^2 = .014$, with public JHS teachers (M = 4.12, SD = .68) perceiving stronger favourable relevance of inquiry teaching than private JHS teachers (M = 3.81, SD = 71) (Table 2). However, there were no statistically significant school type differences in JHS teachers' perceived anxiety, $F(1, 306) = .045$, $p>.05$, partial $\eta^2 = .000$; perceived interest, $F(1, 306) = 1.954$, $p>.05$, partial $\eta^2 = .006$; and perceived difficulty, $F(1, 306) = 3.392$, $p>.05$, partial $\eta^2 = .011$ of inquiry-based science teaching.

Compared to private JHS teachers, public JHS teachers perceived stronger favourable relevance of engaging students in inquiry activities including making students plan, design, and perform science investigations; and making students work systematically like actual scientists do (Table 3).

Table 3. Means and standard deviations of public and private JHS teachers' ratings of items on relevance of inquiry-based science teaching

Item	Mean		Standard deviation	
	Public JHS teachers	Private JHS teachers	Public JHS teachers	Private JHS teachers
It is relevant to make JHS students work systematically like actual scientists do.	4.10	3.95	.82	1.03
It is relevant to make JHS students examine and evaluate the quality of scientific data.	3.99	3.76	.94	1.03
It is appropriate to make JHS students examine and evaluate the quality of scientific data.	3.77	3.51	1.06	1.10
It is relevant to make JHS students plan, design, and perform their own science investigations.	4.07	3.89	1.01	1.11
It is appropriate to make JHS students work systematically like actual scientists do.	3.93	3.93	.90	.97

N = 176(Public JHS teachers), N = 132(Private JHS teachers)

Note: High mean is inquiry-based, low mean is traditional-oriented

Results from interviews with a subsample corroborate the quantitative results shown in Table 3. Compared to three private teachers, five public JHS teachers felt that inquiry teaching will enable JHS students to acquire science process skills. They felt that students will acquire inquiry skills by becoming familiar with the names and uses of science instruments; by asking scientifically-oriented questions and; by developing creativity skills and abilities to identify problems in the environment.

> *Inquiry teaching will inculcate an attitude of problem identification in the student. The student can sit back and identify what is wrong, and start thinking about how it can be solved. (ST 16)*

Again, while two public JHS teachers felt that inquiry teaching improves students' attitudes toward science no private JHS teacher felt same. The teachers explained that inquiry instruction boosts students' morale, puts away the fear of science from students, makes the learning of science easier for students, and promotes students' interests in science and science learning. Again, compared to six private school teachers, eight public JHS teachers felt that inquiry-based science teaching improves students' understanding, retention, and application of science knowledge and, that the more students interact and manipulate materials the more their understanding of science concepts and ideas develop.

> *Inquiry teaching will enhance and boosts students' morale. It will also put away the fear of science from them. (ST 6)*

5. Discussion

Triangulation of quantitative and qualitative results from this study show that, generally, the JHS teachers held weak unfavourable attitudes toward inquiry-based science teaching but, held strong favourable attitudes toward traditional science teaching. Specifically, most of the teachers held strong favourable perceptions of relevance of inquiry teaching and moderate favourable perceptions of anxiety toward inquiry teaching but, held strong unfavourable perceptions of difficulty of inquiry teaching. Most of the teachers rather held strong perceptions that traditional science teaching is easy and less anxious. Individuals' attitudes toward science teaching are strong when there are consistencies in their cognitive and affective evaluations of science teaching (Ajzen, 2001). Clearly, the inconsistent cognitive (perceived relevance and difficulty) and affective (perceived anxiety) evaluations of inquiry teaching shown in this study suggests that most teachers in the study context, like teachers in similar contexts, hold weak attitudes toward inquiry-based science teaching. The strengths of individuals' attitudes are the basis for the formation of their intentions to use and actually use a teaching approach under appropriate conditions. The strengths of individuals' attitudes also show their inclinations, commitments, and efforts they are willing and planning to exert in science teaching (Ajzen, 1989). The current finding suggests that most teachers in the study context would not be fully committed and inclined to use inquiry-based science teaching under the present conditions. The current finding further suggests that most teachers in the study context would not exert the efforts required in planning and teaching inquiry under the present conditions.

The strengths of individuals' attitudes enable them to process and assimilate novel teaching information that are consistent with the attitudes and, reject new information that are inconsistent with the attitudes. Again, the strengths of individuals' attitudes enable them to respond frequently and easily to teaching problems that are consistent with the attitudes but, respond infrequently and with difficulties to problems that are inconsistent with the attitudes (Ajzen, 2001; Krosnick & Petty, 2014). Therefore, the weak attitudes toward inquiry teaching shown in this study suggests that most teachers in the study context would find it difficult to readily process, assimilate, and apply innovative strategies associated with inquiry teaching. Additionally, it would be difficult for most teachers in the study context to respond promptly to day-to-day inquiry instructional problems in the classroom. Strong attitudes are very stable and difficult to change, and remain unchanged even if they are deliberately challenged to change (Krosnick & Petty, 2014). Obviously, the weak attitudes toward inquiry teaching shown in this study suggest that most teachers in the study context, like teachers in similar contexts, would easily abandon inquiry-based science instruction if they encounter challenging tasks and problems.

The aforementioned finding in this study is partly similar to some findings (Choi & Ramsey, 2009; DiBiase & McDonald, 2015) but differs from many findings (Houseal, Abd-El-Khalick, & Destefano, 2014; Riegle-Crumb et al., 2015; Smit et al., 2017; van Aalderen-Smeets & van der Molen, 2013, 2015; Zacharia, 2003) from individualistic societies (Ajzen, 2001). In individualistic societies, teachers' science instructional intentions and behaviours are more influenced by their attitudes than societal subjective norms (Ajzen, 2001). However, in collectivist societies, like this study context, teachers' science instructional intentions and behaviours are almost equally influenced by the teachers' attitudes (Ajzen, 1989, 2001; van Aalderen-Smeets et al., 2012), perceived behavioural controls (Ajzen, 1989, 2001; van Aalderen-Smeets et al., 2012), and societal subjective norms (Ajzen, 1989, 2001). Clearly, it is much more difficult in collectivist than individualistic societies for teachers with weak unfavourable attitudes, as shown in this study, to nurture the intention and engage in inquiry-based science instructional behaviours. In fact, studies conducted in collectivist societies have shown that teachers are less inclined to engage in inquiry-based science instruction because of their perceptions of lack of certain opportunities and resources including, science equipment, time, skills, and cooperation of others (Ramnarain & Hlatswayo, 2018).

Another finding from this study is that while many teachers perceived strong interest in inquiry teaching based on some knowledge and beliefs about inquiry, most teachers perceived strong interest in inquiry teaching based on knowledge and beliefs about traditional science teaching. Teachers who are more knowledgeable about science teaching are more likely to develop strong attitudes that are resistant to change (Krosnick & Petty, 2014). Additionally, teachers with strong attitudes based on their knowledge of science teaching have greater abilities to process and interpret novel information that are consistent with the attitudes. Clearly, the present finding suggests that most teachers in the study context hold weak interest in inquiry-based science teaching but, hold strong interest in traditional science teaching. This also suggests that most teachers in the study context have minimal abilities to process and interpret novel information and strategies associated with inquiry-based science instruction. Teachers' attitudes develop from their salient beliefs about science teaching (Ajzen, 1989). Therefore, the inquiry-based science teaching attitudes of most teachers in this study are based on non-salient beliefs about inquiry.

Like some teachers in other contexts (Choi & Ramsey, 2009; Minger & Simpson, 2006), most teachers in this study context never had inquiry-based science teaching and learning experiences when they were students in elementary and high schools. Instead, they had traditional science teaching and learning experiences. As individuals go through teaching and learning experiences they spontaneously and inevitably engage in cognitive and affective evaluations of their experiences (Ajzen, 1989, 2001). In the process they retain memorable episodes of science instruction that develop into attitudes (Krosnick & Petty, 2014). Since most teachers in this study context never had inquiry-based science teaching and learning experiences, they lacked or had insufficient opportunities to engage in cognitive and affective evaluations of inquiry teaching. Consequently, most of the teachers lack or have inadequate memories of inquiry teaching. This is partly accountable for the formation of weak unfavourable attitudes toward inquiry teaching, shown in this study.

Again, most high school and university science teaching and learning experiences in the study context, and similar contexts, occur in specific subjects such as biology, chemistry, and physics. Similarly, most teachers in these contexts are trained to handle specific science subjects such as biology, chemistry, and physics. Individuals' experiences in specific science subjects inevitably engages them in specific cognitive and affective evaluations of teaching and learning experiences (Ajzen, 2001), instead of general evaluations of (integrated) science experiences. This could also be partly accountable for the weak general attitudes toward (integrated) science teaching, shown in this study.

In other contexts preservice and in-service teachers are regularly engaged in explicit-reflective inquiry-based science methods courses and professional developments to promote the teachers' attitudes (Choi & Ramsey, 2009; van Aalderen-Smeets & van der Molen, 2015). However, results from this study shows that teachers in the study context are rarely given in-service trainings. Even the rare in-service trainings given to teachers are designed to treat some difficult topics identified in the syllabus but not to engage them in attitude-focused inquiry-based science experiences.

Another finding from this study is that there was statistically significant school type difference in JHS teachers' attitudes toward inquiry-based science teaching. Specifically, public JHS teachers held stronger perceptions of relevance of inquiry-based science teaching than private JHS teachers. This finding differs from many findings in other contexts (Erden & Sönmez, 2011; Gheith & Al-Shawareb, 2016). Researchers acknowledge that combination of contextual and personal factors promote or diminish individuals' ability to access different beliefs for evaluating and making behavioural decisions about inquiry-based science teaching (Ajzen, 2001). Compared to public JHS teachers, private JHS teachers' stronger perceptions of dependency on contextual factors account for their less strong attitudes toward inquiry teaching. Private JHSs in the study context, and similar contexts, are highly examination-oriented because their expansion and subsequent profitability depend on the extent to which their students pass external examinations (BECEs) with excellent grades. Therefore, science instruction in private schools largely involve covering the nationally-mandated syllabus, providing extra tuition for students, revising content already taught, solving past examination questions, teaching examination techniques, and writing mock examinations among others. Most private school science teachers perceive excellent performance of their students in external examinations as sufficient proofs of their effectiveness. These traditional science teaching, learning, and assessment behaviours are partly accountable for the private JHS teachers less strong attitudes toward inquiry teaching.

6. Conclusions

Findings from this study suggests that JHS teachers in the study context, and similar contexts, hold weak attitudes that are disabling dispositions toward inquiry-based science teaching. The teachers hold disabling dispositions partly because they never had inquiry-based science teaching and learning experiences when they were students in elementary and high schools. Also, the teachers hold weak attitudes because they are not given regular and sufficient explicit-reflective inquiry-based science teaching in-service trainings. Again, most teachers in these contexts hold weak general attitudes toward (integrated) science teaching partly because their high school, university, and preservice science teaching and learning experiences occurred in specific science subjects such as biology, chemistry, and physics; instead of general (integrated) science.

Based on findings from this study it is recommended that there should be regular explicit-reflective inquiry-based in-service trainings for science teachers in the study context. It is also recommended that there should be reforms in preservice education to engage prospective teachers in attitude-focused inquiry-based science teaching and learning experiences. More studies are required to examine the effects, prospects, and challenges of engaging in-service teachers in the study context in attitude-focused inquiry-based science teaching professional developments.

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