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Knowledge, attitudes and practices on use of white board marker pen ink among school teachers

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Abstract: *Teachers use whiteboards written on using whiteboard marker pens. The solvents in the whiteboard marker pen ink are toxic and irritants making chemical safety necessary in schools. Chemical safety is the prevention of the short and long term adverse effects to humans and the environment from the production, storage, transportation, use and disposal of chemicals. The use of chemicals therefore requires an understanding of what makes the chemicals dangerous as well as its both acute and chronic hazards. This study sought to establish the safety knowledge, attitude and practices of teachers on use of dry erase ink. The study design was Cross Sectional with 224 respondents. Questionnaireswere used to collect data on the level of knowledge and attitude of teachers while observation checklist was used to collect information on the teachers' practices. Only 0.6%had good knowledge on safety issues of the dry erase while 64.8%had positive attitude towards its use. The teachers had poor safety practices on the use of dry erase. This study concludes that teachers are not knowledgeable and lack of knowledge coupled with positive attitude leads them to poor safety practices. It recommends training of teachers on chemical safety of dry erase.*
Keywords*: Attitude, Chemical safety, Knowledge, Practices, Teachers*

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I. Introduction

Teaching, as an occupation, involves imparting knowledge by the teacher to the learners. To enhance this, methods of visually presenting information to a full room of students all at once are used. Traditionally, school teachers used chalkboards written on using chalk. The chalk produces a lot of dust which accumulates on surfaces and the computer machines making many schools to substitute the chalkboards with whiteboards. The whiteboards or dry-erase boards came into use during the late 1980s. By 1990s most of the class rooms were replaced with whiteboards instead of blackboards (Muttappallymyalil*et al*., 2016). The whiteboard marker pen inks have organic solvents which can cause many health hazards including the central nervous toxicity, respiratory effects and eye irritation (ATSDR, 2015; Malik *et al*., 2016).

Chemical safety is the prevention of the short and long term adverse effects to humans and the environment from the production, storage, transportation, use and disposal of chemicals (WHO, 2011). Schools can be insecure for teachers and students because of the presence of toxic chemicals. The use of chemicals therefore require an understanding of what makes the chemicals dangerous as well as its both acute and chronic hazards (Fivizzani, 2007). Weekes (2017) says that to be safe, one must have core learning around safety and have a grasp of specific safety knowledge that one can apply at work. Knowledge improves safety at the workplace (Vinodkumar and Bhasi, 2010).

Several research studies have shown that the teachers in schools lack knowledge on chemical safety (Sedghpour*et al*., 2013; Malik *et al*., 2016). Malik *et al*. (2016) found that Chemical safety other than environmental health issues is given less attention especially in academic institutions although there has been an effort to manage these chemicals in industrial sectors. Most of the teachers in the schools have not been given safety training and therefore they are not fully aware of the health hazards associated with use of whiteboard marker pens. The protective clothing and Material Safety Data Sheet (MSDS) are absent at the schools as a workplace (Larson and Liverman, 2011; Eastlake*et al*., 2012).

Use of technology in education has come a long way since the earliest times of human civilization. This ranges from slates, blackboards, green and brown boards, the white boards and finally interactive boards. The whiteboards or dry-erase boards came into use during the late 1980s. They have a glossy-white surface for writing. Instead of chalk pencils, whiteboard pens were used to write on whiteboards. Considering the health reasons and cost-effectiveness, by 1990s most of the classrooms were replaced with whiteboards instead of blackboards (Muttappallymyalil, 2016). Although some research has shown that the appearance of new technologies into the field of education is accompanied by some resistance from some teachers (Enayati*et al*.,

2012), several other studies have shown that teachers have positive attitude towards the use of a new technology (Kabadayi 2006; Ozdamli*et al*., 2009; Yalcin*et al*., 2011; Zanguyi, 2011; Enayati*et al*., 2012).

Fishbien and Ajzen (1975) defined "attitude" as the individual's evaluation of an object. There are several models that try to explain the attitude of workers towards a new technology. These include the theory of diffusion of innovations (DIT) (Rogers, 1995), the theory of task-technology fit (TTF) (Goodhue and Thompson, 1995), the theory of reasonable action (TRA) (Fishbein and Ajzen, 1975), theory of planned behavior (TPB) (Ajzen, 1991), decomposed theory of planned behaviour, (Taylor and Todd, 1995), the technology acceptance model (TAM) (Davis *et al*., 1989), technology acceptance model 2 (TAM2) (Venkatesh and Davis, 2000), unified theory of acceptance and use of technology (UTAUT), (Venkatesh*et al*., 2003) and technology acceptance model 3 (TAM3) (Venkatesh and Bala, 2008).

Attitudes and values have a tendency to influence practice. They have more influence on teacher practice than teacher knowledge (Ottenbreit-Leftwich*et al*., 2010). Teachers' attitudes as regards to technology are based on whether or not they think technology can help them achieve the instructional goals they perceive to be most important (Watson, 2006). Davis *et al*. (1989) purported that a causal linkage exists between beliefs around perceived usefulness and perceived ease of use, user attitudes, intentions, and subsequent technology adoption and that these beliefs are mediated by external variables. Teachers' attitudes toward technology, perceived ease of use and perceived usefulness (beliefs that the technology will enhance job performance) influence teachers' intention to use technology (Courduff*et al*., 2016).Several researchers have studied the behaviour and practices of teachers and students in the classrooms. Many of them found that the teachers do not open windows often and when they do they only respond to temperature changes and not indoor air quality (Wyon and Wargocki, 2008; Wargocki and Wyon, 2006). This can allow the ink VOCs to accumulate and contaminate the air in the classrooms (Willem, 2013; Singer *et al*., 2014) and this can affect the teachers and the learners. It is therefore important for teachers to have an understanding of what makes the ink vapourdangerous as well as its both acute and chronic hazards. This study sought to establish the safety knowledge, attitude and practices of teachers on use of dry erase ink.

II. Materials and methods

The research design was Cross Sectional. The study limited itself to the thirteen schools in Nakuru County in Kenya which used whiteboards in the classrooms only. Teachers in the selected schools were randomly and proportionately selected giving a total of 224 teachers.Questionnaires were used to collect data on the level of knowledge and attitude of teachers while observation checklist was used to collect information on the teachers' practices. Data was managed using SPSS (Version 23.0 for Windows).Data was analyzed using descriptive statistics. Tables and charts were used to represent data.

III. Results And Discussion

3.1 Knowledge levels of teachers on marker pen ink

The teachers' knowledge on the whiteboard marker pen ink was studied using a Likert Scale with a scale of five ratings (strongly agree, agree, neutral, disagree and strongly disagree). During the analysis, the questions were rephrased to ensure a common direction because the questions in the questionnaire were in both direction of positive and negative (Table 1)

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Table 1: Knowledge levels of teachers on marker pen ink

Question regarding knowledge	SA (5)	A (4)	N (3)	D (2)	SD (1)
Ink irritates the nose, eyes and throat					
Ink is toxic and therefore not safe					
Ink vapours can cause harm if inhaled directly					
Ink vapours released have an effect on the health of persons					
It is necessary to open windows when using the marker pens					
Marker pens ink not safe for people including the asthmatic					
One should use protection against the ink vapours					

Key: SA=Strongly Agree; A=Agree; N=Neutral; D=Disagree; SD=Strongly Disagree

The average score was obtained by dividing the total score obtained by the number of the questions. One was considered as very knowledgeable if he/she scored an average of 5. Those that had an average of 4

were considered as having fair knowledge while those who had 3 and below were considered to be unknowledgeable. The results showed that 79.9% of the teachers were not knowledgeable while only 0.6% of the teachers had good knowledge on the safety aspects of the marker pen ink (Figure 1).

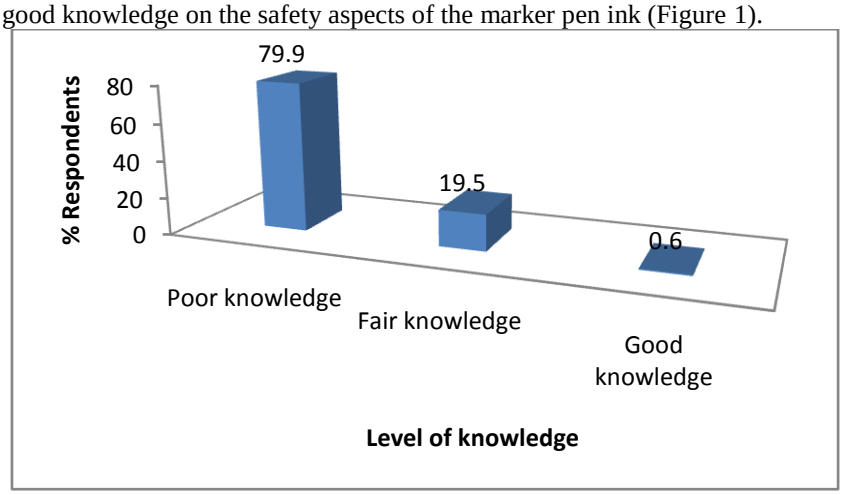

Figure 1: Knowledge levels of teachers on marker pen ink safety

The whiteboards were simply fixed on top of the black boards in the classrooms and teachers seemed to have taken up the use of the marker pen as a simple replacement of the chalk. As such the traditional way of teaching and learning was not interfered with and therefore the teachers were not bothered to know more about the marker pen ink. Clarke and Pittaway (2014) say that teachers take any form of technology for granted if they do not seem to interfere with the traditional mode of instruction. Also, there was no material safety data sheet available and its absence contributes to lack of information on chemical safety (Eastlake*et al*., 2012). Absence of material safety data sheets is in line with the findings of Suleiman and Svendsen (2014) that many suppliers of commodities are less conscientious when it comes to informing users on health risks.

Mytton*et al*. (2010) and NPCS (2017) outline the need for training as a way of improving knowledge on chemicals and technology. Occupational Safety and Health Act (2010) also require that an occupier trains the employees and provides information to ensure the safety and health at work. Lack of training on the ink use of the marker pen may therefore have contributed to lack of knowledge among the teachers. Lack of knowledge on a new technology among the teachers agrees with several research studies which found that teachers lacked knowledge on new technologies introduced in schools (Lawless and Pellegrino, 2007; Ertmer and Ottenbreit-Leftwich, 2010). Although these studies dealt with computer technologies, the technology considered was equally new just as the whiteboard marker pen use in the studied schools and therefore the studies can be compared with the current study. These studies attributed the lack of knowledge on lack of effective training of the teachers on the use of the new technologies.

Lack of knowledge on the whiteboard marker pen ink makes the teacher ignorant on the hazards associated with the chemicals present in the ink. This increases the risk of exposure to these chemicals during the use of the marker pen because an ignorant teacher cannot work safely or protect himself/herself or other persons in the school. He is therefore likely to contravene Occupational Safety and Health Act of 2010 that outlines the duties of the employee to include ensuring his safety and health and that of other persons who may be affected by his acts or omissions at the workplace. Lack of knowledge would also hinder the response to any poisoning from the chemicals in the ink because knowledge determines the type and effectiveness of response accorded to the victims (WHO, 2004).

3.2 Attitude of teachers on use of marker pen ink

The attitude of teachers on the use of whiteboard marker pens was studied using a Likert Scale with five items. The questions in the questionnaire were in both direction of positive and negative. They were rephrased during analysis to ensure a common direction and scored as shown in Table 4.13.

Table 2: Attitude of teachers on use of whiteboard marker pen ink

Question regarding attitude	SA (5)	A (4)	N (3)	D (2)	SD (1)
Ink smells good					
The marker pen is easy to use					

Stains on the whiteboard are easy to remove	
The marker pen is economical	
Writing notes on the board using marker pen is interesting	
I write fast using pen	
Clothes remain clean	
Ink writing dries fast on the board	
Marker pen ink is safe	
It does not bother me that I was not consulted when the marker pen was introduced	
I believe KEBs has already checked the safety of marker pen	

Key: SA=Strongly Agree; A=Agree; N=Neutral; D=Disagree; SD=Strongly Disagree

The mean score was obtained by dividing the total score obtained by the number of the questions. One was considered to have a positive attitude towards the use of the whiteboard marker pen ink if he/she scored an average of 4 or 5. Those that had an average of 3 were considered as being neutral, while those who had 2 and below were considered to have a negative attitude towards the use of whiteboard marker pen ink. The results showed that 64.8% of the teachers had a positive attitude towards the use of whiteboard marker pens while only 0.9% had a negative attitude towards the use of the marker pens on the whiteboards. Figure 4.18 summarizes the findings.

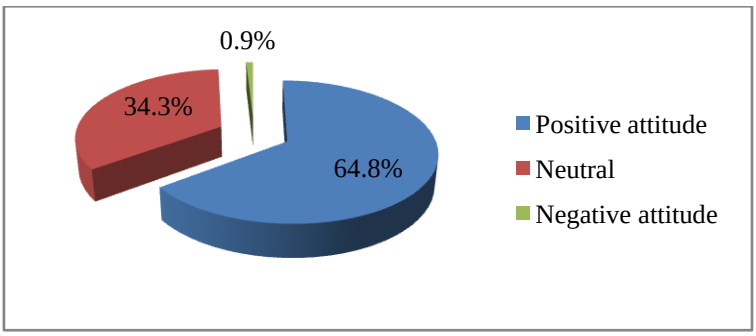

Figure 2: Attitudes of teachers on use of whiteboard marker pen

The results indicate that the teachers had a positive attitude towards the use of the marker pens to write on the whiteboards. They were therefore more likely to use the pens as user attitude influences the intention to use (Moon and Chang, 2014). The acceptance may have been influenced by the fact that the pen was easy to use. Merschbrock and Nordahl-Rolfsen (2016) demonstrated that the workers who foundthe use oftechnology easy accepted it and were positive in utilizing it.This is also in line with the technology acceptance model which predicts that the acceptance of a new technology by workers depend on usefulness and perceived ease of use (Davis *et al*., 1989; Hsu and Lin, 2008).

Clarke and Pittaway (2014) says that teachers do not fear or hate a new technology as long as it does not bring about new groupings of students, the role of the teacher is not reduced and the teacher does not have to learn new skills. In this study the whiteboard replaced the chalkboard and the marker pens replaced the chalk in the classrooms leaving the rest of teaching and learning approaches intact. The technology did not interfere with the teacher's authority or role and the teachers did not have to learn new skills. They therefore embraced the technology willingly.

Many of the teachers (76.5%) believed that the pens had already gone through the checking by Kenya Bureau of Standards (KEBS) which is the body mandated to ensure quality and safety of products in Kenya (GoK, 2012). Wu and Jang (2013) found that consumers' awareness of a certified product has a positive influence on perceived quality and safety. Priest (2010) says that people are more likely to support that which they believe is safe. Positive attitude combined with lack of knowledge on safety aspects of the whiteboard marker pen ink make the teachers to embrace the use of the marker pen without any safety precautions (Eastlake*et al*., 2012). This exposes them to the hazards associated with this technology such as inhaling the vapours from the ink as well as some of the ink vapours getting into their eyes.

Although Occupational Safety and Health Act (2010) provides that an employee should wear or use protective equipment or clothing provided by the employer for the purpose of preventing risks to his safety and health, the teachers did not see the need to wear the protective equipment. 95.9% of the teachers did not use any

form of protection and the remaining number of teachers who used protection said that they used lab coats as a form of protection. This is an indication that the employer did not provide any special equipment to protect their eyes from getting into contact with the ink vapours.

3.3 Practices of teachers related to use of whiteboard marker pens

The practice of the teachers related to use of marker pens was studied as the researcher sat in the classrooms when the teachers were teaching. The researcher observed for those practices of teachers which were likely to increase the exposure of the teachers to the VOCs from the ink as well as the whole ink.

Occupational Safety and Health Act of 2010 outlines the duties of the employee and they include ensuring his safety and health and that of other persons who may be affected by his acts or omissions at the workplace. This means that the teacher should have practices at school which do not contribute to hazards so that he can be safe as well as the other persons at school such as his fellow teachers and students. However the results in general showed that majority of the teachers lacked safe practices in relation to the use of whiteboard marker pen ink. Embracing the use of whiteboard marker pen ink without knowledge on chemical safety make the teachers to have unsafe practices and in the process contravene the OSHA of 2010. Table 3 summarizes the findings concerning the practices of the teachers in the classrooms.

Table 3: Practices of teachers related to use of marker pens

Observed practice	Never		Rarely		Often	
	n	%	n	%	n	%
Replacing the lid when the pen is not in use during the lesson	40	80	7	14	3	6
Rubbing the board with bare hands	4	8	12	24	34	68
Rubbing the eye with hands	11	22	26	52	13	26
Placing the pen close to the face when not writing	15	30	15	30	20	40
Moving away from the board	30	60	10	20	10	20
Rubbing the board with the duster	3	6	15	30	32	64
Sitting down during the lesson	46	92	3	6	1	2
Writing with the face very close to the white board	3	6	5	10	42	84

Only 6% of the teachers replaced the lid of the marker pen often. At the start of the lesson, some teachers would remember to replace the lid as soon as they stopped writing. However, they would soon forget about replacing the lid as the lesson progressed. When the marker pen is left uncovered, the ink may continue to vaporize from the tip of the marker pen and in the process expose the teacher especially if the teacher holds the pen close to the eyes or the face. This is based on the findings of Anderson and Anderson (2003) who studied the effects of VOCs from the felt tips on mice and found that the concentration of the VOCs from the tips were similar to those generated from a marking pen in use. Uncovered felt tips therefore continue to release the VOCs and can increase their concentrations in the classroom.

In this study, 40% of the teachers placed the pen close to the face when not in use while 84% had their face very close to the whiteboard as they wrote. Placing the pen close to the eyes or the face reduces the distance that the VOCs have to travel from the felt tip to reach the eyes of the teacher. Writing on the whiteboard with the face very close to the whiteboard also shortens the distance between the writings and the eyes. The shorter the distance the higher the rate of diffusion (MoE, 2018).This increases the concentration of the VOCs that can reach the eyes of the teacher.

Sixty percent of the teachers remained in front of the classroom close to the whiteboard throughout the lesson. This agrees with Epri (2016) who found that many teachers in Papua New Guinea spent a lot of time in front of the classroom. Rands and Gansemer-Topf, (2017) says that the movement of the teacher in the classroom is hindered by the large number of students or the arrangement of furniture. The study to establish whether the teacher stays close to the whiteboard was based on the findings of Noguchi *et al*. (2016) who found that the concentration of the VOCs was highest closer to the carpet which was the source in a newly built day care center in Kashiwa City of Japan. It was therefore expected that the concentration of VOCs would be highest close to the whiteboard where the writing was being done.

It was also expected that hot exhaled air would push up the VOCs to the upper parts especially at 1.5m above the floor which is the breathing level of a standing person *(*Olumayede and Okuo, 2013). Sitting would therefore remove the teacher from a region of high concentration of VOCs reducing his/her exposure levels. In this study, only 2% of the teachers sat down during the lesson with 92% remaining standing throughout the entire lesson time.

Many would rub the board with the duster at the beginning of the lesson but would switch to the use of the hands to rub especially if the amount of writing to be rubbed was little. Subconsciously a few (26%) would go ahead and rub their eyes with hands as they continued teaching after rubbing the whiteboards with bare hands. When one rubs the whiteboard with bare hands, the ink sticks on the hands. If the ink is wet and the solvents have not yet evaporated, the teacher can transfer the whole ink into the eyes when he/she rubs the eyes

with bare hands. Bloomfield *et al*. (2016) indicate that hands can transfer pollutants to the eyes when one rubs the eyes with bare hands.

Rubbing the board with the duster ensures that the teacher does not come into direct contact with the ink and does not transfer whole ink into the eyes. However, rubbing the writings from the whiteboards separates out the markings and this increases the surface area of the marks increasing the rate of evaporation of the solvents (Brady, 2007). This therefore increases the rate of emission of VOCs from the ink and this increases their concentration in the classroom. If left alone to dry, they evaporate slowly releasing the VOCs slowly and therefore the concentration is expected to remain low but consistent.

IV. Conclusion

Majority of teachers (79.9%) were not knowledgeable on ink safety while 64.8% had a positive attitude towards the use of whiteboard marker pens. A positive attitude towards adoption coupled with no knowledge on safety predisposes the teachers to poor practices thus enhancing their occupational exposure.

V. Recommendations

The policy makers should ensure that the teachers are trained on chemical safety especially the chemicals in the ink. The teachers and students should also be made aware of the importance of opening the windows so that the ventilation is effective to prevent the accumulation of ink VOCs in the classroom.

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