Learning Styles Of Yemeni Undergraduate Science Students

Angela Abu-Asba
angelamansoor@yahoo.ca
School of Language Studies and Linguistics
Faculty of Social Sciences and Humanities
Universiti Kebangsaan Malaysia

Hazita Azman
hazita@ukm.my
School of Language Studies and Linguistics
Faculty of Social Sciences and Humanities
Universiti Kebangsaan Malaysia

Rosniah Mustaffa
rosniah@ukm.my
School of Language Studies and Linguistics
Faculty of Social Sciences and Humanities
Universiti Kebangsaan Malaysia

Abstract

The aim of this paper is to investigate the preferred learning styles of 179 Yemeni students studying science at the Faculty of Science, Sana'a University, Yemen in response to a need for improving the learning of science among Yemeni students. A learning style refers to the ways of learning that include how learners perceive, interact with and respond to the learning environment. This paper applies Reid's (1995) taxonomy of six learning style preferences: visual, auditory, kinesthetic, tactile, group, and individual styles to classify the styles of the students in this study. Data was collected through questionnaires, interviews, observation checklists, and field notes. The questionnaire data was coded and analyzed using the SPSS program while the interview data was transcribed, organized, coded, categorized, and analyzed. The findings show that the tactile and kinesthetic styles were the most prevalent styles among the students, followed by the auditory style. This has pedagogical implications for the teaching of science in Yemen.

Keywords: learning styles, learning preferences, science students, perceptual learning style preference, academic literacy.

Introduction

Yemen aspires to be a progressive and developed country, and it views knowledge and advancement in science and technology as a vehicle towards the attainment of this goal (Mahyoub, 1996). There was tremendous advancement in the past but after the Gulf War

1990, things soured and the Kuwait government withdrew its support for Yemen's Faculty of Science. As a result things started to deteriorate gradually. The University of Sana'a itself was supported by the State of Kuwait at the beginning of 1974 till 1990. However the decline in science and technology standards in education is appalling and there is substantial evidence from many studies in the field (Mahyoub, 1996; Nour, 2003) to support this claim. Both Mahyoub (1996) and Nour (2003) recognize the process of teaching and learning science in Yemen as unsatisfactory and lagged too far behind to meet the current standards of teaching and learning modern science. The whole process is viewed to be insufficient in leading progress and development in the country.

At the Faculty of Science, students learn science in order to gain and acquire facts but apparently not for the purpose of applying science knowledge. Mahyoub (1996) claimed that Yemeni science students have little knowledge of application in learning science and found their ability to comprehend scientific knowledge unsatisfactory.

Mahyoub (1996) and Ropo (1993) investigated the teaching of science and the classroom learning environment and discover that Yemeni science students were very weak in science. They recommended more research into how learning occurs and what can be done to help students expand their skills in this area, as well as further research into the study processes that affect the quality of student learning. The evaluative research study reported here, carried out in response to the need, aimed at investigating the learning styles of second and fourth level science students at the Faculty of Science located in Sana'a University, Yemen.

The term "learning style" has been defined and revisited in many ways over the years. Learning styles are made up of factors directly affecting a student's learning processes (Duman, 2010). The elements of a learning style appeared in the research literature in 1892, but most of the earlier researches (before 1940) were more interested in the relationship between visual teaching methods and memory (Thang, 2003). Reid (1995) used the term "learning style" as a generic term and as an umbrella concept to refer to individual learning differences and further clarified:

> Learning styles are the ways of learning that include how learners perceive, interact with and respond to the learning environment while they are dealing with their teachers and their science subject. It is the preference of an individual to perceive and process information through one or more of the sensory modalities: visual, auditory, kinesthetic, and tactile (Reid, 1995, p.17).

Thus, learning styles are the ways in which individuals prefer to learn, and it is based upon the brain's ability to receive and process new information. According to Reid (1996) people learn differently and at different paces because of their biological and psychological differences. Reid (1995) categorizes students' learning styles into six types: visual, auditory, kinesthetic, tactile, group, and individual styles. She explains these learning styles as follows: 1-Visual learners prefer images and graphics, 2-Auditory

learners prefer listening, 3-Kinesthetic learners prefer active participation/experiences, 4-Tactile learners prefer hands-on work, 5-Group learners prefer studying or working with others and 6-Individual learners prefer studying or working alone. All learners have individual attributes relating to their learning processes; that is to say, different students have different ways of acquiring information. Some students can reason logically and intuitively, while others memorize and visualize, while quite a number could be sociable extroverts and globally oriented. Some individuals develop mental images and others only remember what they experience (through feeling or touching) during the learning process (Tubic & Glu, 2009).

Brown (1994) illustrated that students learn more effectively when they learn through their own initiatives. He found that when they are responsible for their own learning and when progress in their learning can be seen, their motivation, performance and achievement are enhanced and tend to increase. He recommends that educators should establish optimal environmental and psychological climates that foster learning by allowing students to learn in accordance with their own preferred learning styles. In this regard, differences in learning styles vary depending on students' cultural and educational backgrounds. Investigating learning styles has thus become a complex field of study (Butler 1984, p.3). It has been suggested by NATA Education Council (cited in Barnum, 2011, p. 34) that "learning style assessment should be conducted early in the students' academic experience to identify their preferred learning style and to provide them with information on learning styles that may enhance their educational experiences". This is an important suggestion to take up because, according to Rosniah (2007), when students are taught in ways that are not compatible with their learning style preferences, they feel bored, uncomfortable, confused, frustrated, angry and tend to give up easily.

Literature Review

Research has shown that the most preferred learning style in North American culture is the visual style (Oxford, 1995). Reid (1987) and Stebbins (1996) found that among Hispanics, kinesthetic and tactile learning styles are the major preferences. Stebbins (1996) also found in another study that Hispanics tend to choose social, interactive strategies compared to Asians who opt more for rote learning. Hence, culture seems to be related to the development of learning styles.

On the other hand, Arabic students show a strong preference for learning via auditory mode, which may be explained by Reid's (1987) and Farquharson's (1989) discovery that in Arab society, spoken language and oral eloquence is emphasized through poetry reading. Chinese and Vietnamese learners demonstrate a preference for visual learning, which could be partly explained by the pictorial nature of their written language. The Japanese, however, do not strongly identify with any style preferences (Stebbins, 1996, p.10).

Over the past three decades, a theoretical body of work has been developed and studies have been carried out investigating learning styles, defining and classifying them, and

exploring the relationship between culture and learning styles. The results indicate that such studies have contributed to a rich literature covering many areas and contexts. It was interesting to note that even though most of these studies were conducted in different cultural learning contexts, English was the medium of instruction in these studies. Furthermore, based on the library research by the researcher, studies on learning in the science domain in the Arab World are few compared to those in the Arts. Therefore, the study reported here seems to be the first contribution of this nature to the field of science education in Arabic society.

Previous studies on learning styles

Considerable research in the general area of learning styles has been conducted so far on students whose native language is English. One study conducted with U.S school children (Dunn & Dunn, 1979 cited in Reid, 1987, p. 89) demonstrated that learners have four basic perceptual learning modalities, visual, auditory, kinesthetic, and tactile learning. Dunn and Dunn (1979) found that only 20-30% of the school age children in their study appeared to be auditory learners, 40% were visual learners and the modalities of the remaining 30-40 % were tactile / kinesthetic, visual / tactile or some other combination.

Reid (1987), in a comparative study of college students learning English as a second language (ESL), reported significant cultural differences in visual, auditory, kinesthetic, tactile, group, and individual learning styles among Korean, Chinese, Japanese, Malay, Arab, and Spanish students. She found that college ESL students strongly preferred kinesthetic and tactile learning and that most groups showed a negative preference for group learning. She also found that students who had been in the United States for more than three years were significantly more auditory in their learning style preferences than those who had been in the United States for shorter periods of time. The mean for the learning style preferences of those who had lived and studied in the United States the longest resemble closely the mean for the preferences of native speakers of English.

In a study by Felder (1993), who found that students manifested different learning styles**.** Students, whose learning styles matched the teaching style of the teacher/lecturer, retained information longer, were able to apply it more effectively, and had favourable perceptions of and attitudes towards the course than those who experienced learning /teaching style mismatches. She concluded that if educational institutions fail to accommodate and address the matching of teaching and learning styles, adverse effects will be manifested in the performance and output of the students.

Mulalic, Mohd Shah and Ahmad (2009) explored a spectrum of problems and challenges related to perceptual learning styles of students in English as Second Language situation (ESL) in Malaysia. Their study attempted to determine the learning styles of the students, and to analyse the differences in learning styles of the students according to gender and ethnicity. Results revealed that the students' preferred learning style was kinesthetic. There were minor indications of preference for visual, auditory and group learning, as well as negative preference for individual and tactile learning styles.

This study aims at exploring the nature of Yemeni science students' learning styles as they are perceived to be very weak in learning science (Mahyoub, 1996; Ropo, 1993). It is hoped that the findings will provide insights into how learning occurs among science students that will lead to useful implications for improving students' learning of science.

Methodology

Participants

The participants of this study were second and fourth year Biology students at the Faculty of Science, Sana'a University, Yemen. This faculty was the first to be established in Yemen in 1974. It is one of the biggest and most crowded faculties at the University of Sana'a, and it comprises six areas of specializations or majors: mathematics, physics, computer science, chemistry, biology and geology. Participants were made up of 51 males and 128 females from the biology division which is divided into three specializations: Botany, Zoology, and Microbiology. The participants were drawn from the population using a simple random sampling method. There were 108 students out of 150 from level two and 71 students out of 100 taken from level four. 179 students in the science class were observed and 26 of them were randomly selected for interview. Level two and four students were considered most suitable for the study because these two levels are called "general study" students, whereas level three students specialized in Botany, Microbiology or Zoology. The students' ages ranged from 18-25 years.

Instruments

There were four instruments used in this study: the questionnaire, the interview, the observation checklist and field notes.

The questionnaire

The questionnaire (Appendix A) comprised the background information of the Biology science students, and the Perceptual learning style preferences (PLSPQ) which was adopted from Reid (1995). The background information of Biology science students' elicited students' age, sex, and reasons for studying science. The questionnaire comprised 30 statements covering Reid's six learning style preferences: visual, auditory, group, kinesthetic, tactile and individual. The data was processed using the SPSS or Statistical Package for Social Sciences. Students responded to the statements using the Likert 5-point scale of agreement: strongly agree, agree, undecided, disagree and strongly disagree. The participants were required to tick in the columns that corresponded to their degree of agreement.

Open-ended interviews

The interview questions (Appendix B) from Reid (1995) were adapted and modified with appropriate prompt questions. The objectives of this interview were to obtain data in

order to understand the respondents' views on learning styles and on how science is perceived at the Faculty of Science. To ensure that the interviewed participants understood the questions clearly, the researcher translated the questions from English into the Arabic language for clarity and understanding of the interviewed participants.

Observation checklist

A classroom observation checklist (Appendix C) was used during the observation process and was designed to account for all the necessary and related aspects of the present study. The observation checklist was prepared by the researchers based on the objectives of the study. There were thirteen main categories in the observation checklist, including science classroom, science class lesson, students' attitudes towards learning science, and the science classroom ambience.

Field notes

The field notes were used to record the information from the science classroom, science labs, and the science library to supplement the observation checklist Field notes are not scribbles; the researcher should have explicit note-organizing and note-management strategies. Observers' comments are often a quite fruitful source of analytic insights and clues that focus data collection more tightly. They may also provide important questions for subsequent interviews (Marshall & Rossman, 2006). Field notes were also taken to record salient points. It is also taken from student's comments on learning styles and used to support evidences from the other sources of information.

Data Collection Procedures

The data collection process was initiated by inviting students to participate in this research and only those who willingly agreed were included in the study. The process was completed within one month at the Faculty of Science, Sana'a University, Yemen. The students were first given the perceptual learning style preference questionnaire (PLSPQ) where they took approximately 30 minutes to complete the questionnaire. Second, the semi-structured interview was conducted with 26 students, which lasted 15 to 25 minutes per interview. In addition to the listed questions, probes were used to explore their responses in greater depth. The interview sessions were videotaped and recorded using an audio tape recorder. As for the observation, one of the researchers observed the students in two Biology Science labs and six Biology classrooms as a non-participant observer using the observation checklist. The observation entailed an audio-recording of classroom interaction to facilitate observing students and instructors during the observation session. The observation technique was used in conjunction with the interview session. Biology science classrooms observations were video recorded to allow researcher access to both the verbal and nonverbal elements. The nonverbal was not for the purposes of analysis but to contextualize the lessons.

Data Analysis Procedures

Quantitative data from the questionnaire were analyzed using descriptive statistical tools. Data collected from the qualitative data (interviews, observations, field work) were transcribed, translated, categorized and analyzed using Reid's (1995) framework. After collecting the data, patterns or matching trends were categorized according to the findings. All the results were then analyzed by categorizing them according to the aforementioned taxonomy of learning style preferences (Reid, 1995). The data obtained from the questionnaire were coded and analyzed using the SPSS program (version 16) to accomplish the descriptive analysis of inferential statistics such as frequency (%), means (μ), and standard deviation (σ). The students' interview data were transcribed and translated into English and were used to supplement data from the questionnaire. Data from the classroom observation checklist and field notes were also used to triangulate the findings.

Findings and Discussion

This section presents the findings and discussion on students' learning styles at the Faculty of Science, Sana'a University, Yemen based on the data collected from the questionnaire, interviews, classroom observations, and field notes.

The results from Reid's Perceptual learning style preferences (PLSPQ) questionnaire applied to the science students are given in tables 1, 2, 3, 4, 5, and 6. As mentioned earlier, this questionnaire contains 30 statements covering Reid's six learning style preferences: visual (items 6,10,12, 24,29), auditory (items 1,7,9,17,20), tactile (items 11,14,16,22,25), kinesthetic (items 2,8,15,19,26), group (items 3,4,5,21,23), and individual (items 13,18,27,28,30). Students were asked to indicate their learning style preferences on a five–point scale from SA – Strongly Agree (5), A – Agree (4), UND – Undecided (3), D – Disagree (2), to SD – Strongly Disagree (1). Calculations were carried out to obtain the Mean (μ) and Standard Deviation (σ) to obtain the percentages in order to answer the question: What is/are the preferred learning style/s of science students?

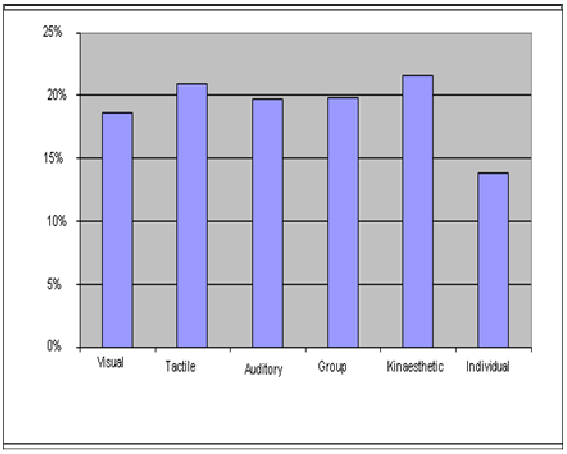

Figure 1: Students' learning styles

In general, the findings indicated that the learning styles most preferred by students were: the kinesthetic, tactile, and group learning styles; followed by the auditory and visual styles of learning. Students in this study expressed the least preference for the individual learning style. This finding seems to be consistent with what Porter (2007) mentioned regarding students' preferences for tactile and kinesthetic styles. Porter (2007) stated that most students in science laboratory situations prefer hands-on kinesthetic and visual learning styles.

Table 1: Preference for kinesthetic learning style

No. of items	Question item	SA %	A %	UND %	D %	SD %	μ	Σ
2	I prefer to learn by doing something in class.	**55.3**	**40.2**	1.7	2.2	0.6	4.4749	.69766
8	When I do things in class, I learn better.	**52.5**	**43**	2.8	1.7	-	4.4637	. 63826
15	I enjoy learning in class by doing experiments.	**48.6**	**43**	6.7	0.6	1.1	4.3743	.73409
19	I understand things better in class when I participate in role-playing.	**34.6**	**46.9**	11.2	5.6	1.7	4.0726	.91202
26	I learn best in class when I can participate in related activities.	**36.9**	**49.2**	8.4	5	.6	4.1676	.82439

Note: Strongly Agree = SA; Agree =A; Undecided=UND; Disagree= D;
Strongly Disagree=SD; μ= Mean; σ=Standard deviation

The results for kinesthetic learning style are presented in Table 1. The percentages of students who strongly agreed and agreed for the kinesthetic category are as follows: item no. 2 (95.5%), no. 8 (95.5%), no.15 (91.6%), no. 19 (81.5%) and no. 26 (86.1%) respectively. There were just a few who indicated some difficulty when working with this style. Figure 1shows that the kinesthetic learning style is ranked first in the overall list of the Yemeni science students' preferred learning styles categories. Two students interviewed explained why they preferred the kinesthetic learning style: student 10 explained that she preferred the kinesthetic way of learning because she felt that active participation would reinforce the learning of new information. Student 1 indicated that students liked to have activities in the science classrooms. However, previous studies (Mahyoub, 1996; Nashwan & Badran, 1993) have demonstrated that science teachers in Yemen were using the traditional approach and considered the approach a good method of science learning and teaching. These traditional approaches were teacher-centred and based on chalk- and- talk (Mahyoub, 1996). The term 'chalk-and-talk' (the teacher writes on a board and speaks while learners listen and look and try to absorb facts) refers to a style of teaching or training which contains no experiential learning aspect whatsoever. Kolb believed that a person's learning style results from an interaction between an individual's internal characteristics and their external environment (Schellhase, 2006).

Table 2: Preference for tactile learning style

No. of items	Question item	SA %	A %	UND %	D %	SD %	μ	Σ
11	I learn more when I can make a model of something.	**45.8**	**44.7**	6.7	2.2	0.6	4.3296	.74785
14	I learn more when I make something for a class project.	39.1	**46.4**	11.2	2.8	0.6	4.2067	.79093
16	I learn better when I make drawings as I study.	**35.8**	**37.4**	13.4	9.5	3.9	3.9162	1.10602
22	When I build something, I remember what I have learned better.	**49.7**	**43.6**	5.0	1.7	-	4.4134	.66792
25	I enjoy making something for a class project.	29.1	**53.6**	10.6	6.1	0.6	4.0447	.83344

Note: Strongly Agree = SA; Agree =A; Undecided=UND; Disagree= D;
Strongly Disagree=SD; μ= Mean; σ=Standard deviation

Table 2 demonstrates that the percentages of students who strongly agreed and agreed with statements indicating preference for tactile style category were as follows: item no. 11 (90.5%), no. 14 (85.5%), no.16 (73.2%), no. 22 (93.3%) and no. 25 (82.7%) respectively. The tactile learning style is ranked second in the overall list of students' preferred learning style categories (Figure 1). When compared to the kinesthetic learning style, the tactile learning style means that learners learn best when they have opportunity to do "hands-on" experiences with materials, for instance working on experiments in a laboratory and handling and building models. This indicates that the science students like active participation, working with materials by hand, problem-solving activities, and role-play. The excerpts from the interview data provided an expanded understanding of the Yemeni students' preference for the tactile learning style: one student interviewed explained that he likes to work and touch with materials while another said that he learns more when he makes something for a class project.

The findings show that science students have a strong preference for "hands-on" learning which engages them physically and experientially. Hands-on learning involves activities in which students use their hands or other parts of their bodies while they are engaged in learning; an example of the physical activities which are preferred is 'making and building a model of something', 'making something for a class project', and 'making drawings as they study'. Therefore, it is clear that Yemeni undergraduate science students have a strong preference for the tactile learning style. It was found that these students felt they benefitted from this kind of learning style in their lab setting, where they could manipulate materials to learn new information. At the same time, findings also revealed that students felt they could learn best when they themselves were actively and physically involved with the learning environment. They benefitted from instructors who encouraged in-class demonstrations, "hands-on" student learning experiences and field work outside the classroom.

Although the tactile learning style is the most preferred style among the styles, this type of learning is occasional and not the norm practiced in Yemen. The tactile learning style is one of the best styles for learning science; the "hands-on" activities assist in the retention of facts, findings and concepts. The results of this study suggest that more kinesthetic and tactile styles of teaching and learning science should be implemented as the science students favour these styles in learning science.

Table 3: Preference for group learning style

No. of items	Question item	SA %	A %	UND %	D %	SD %	μ	σ
3	I get more work done when I work with others.	**41.3**	**45.3**	6.1	6.1	1.1	4.1955	.88735
4	I learn more when I study with a group.	**32.4**	**49.7**	9.5	6.1	2.2	4.0391	.93234
5	In class, I learn best when I work with others.	**36.9**	**44.1**	10.6	6.7	1.7	4.0782	.94484
21	I enjoy working on an assignment with two or three classmates.	**22.3**	**44.7**	16.2	9.5	7.3	3.6536	1.14294
23	I prefer to study with others.	**27.9**	**44.1**	15.1	8.4	4.5	3.8268	1.06958

Note: Strongly Agree = SA; Agree =A; Undecided=UND; Disagree= D;
Strongly Disagree=SD; μ= Mean; σ=Standard deviation

Table 3 shows the percentages of students who strongly agreed and agreed with statements indicating a preference for group learning style were as follows: item no. 3 (86.6%), no. 4 (82.1%), no. 5 (81%), no. 21 (67%) and no. 23 (72%) respectively. These science students liked to work in groups, share ideas, opinions and knowledge. The group learning style is ranked third in the overall list of students' preferred learning style categories (Figure 1). This is supported by excerpts from the students' interview data. Student 15 emphasized that "When I work with others I learn best", student 18 says that "this makes me understand better with others than by myself, in the final exam I remember what my friends discussed". The excerpts show that students prefer learning by working in groups because they remember better what they have discussed with their friends.

Based on the questionnaire data, observation data and field notes, it is indicated that students found it enjoyable and they learned best as well as got more work done when they worked with others, and that they did not remember things better or learned better when they studied alone. This phenomenon of enjoying working in groups can be explained by the Social Development Theory of learning by Vygotsky (1978) which emphasizes the need for social interaction of students and "more knowledgeable others" (e.g. teachers, parents, coaches, peers and experts, etc). Vygotsky believed that students' cognition is influenced by social and cultural contexts, and that is why students, who are social creatures, manifest the psychological and natural social needs of normal human beings to be in a social group or setting as supported by findings of other researchers. In a society, such as that in Yemen, in which group cohesiveness is thought to be essential,

students are supposed to de-emphasize self and to be concerned about the group. Thus it is not surprising as Yemeni students are taught that "acting out" or "speaking out" is not part of socially acceptable behaviour, and that group success is rewarded in this society more than individual performance (Nashwan & Badran, 1993 as cited in Connect: UNESCO International Science, Technology & Environmental, 2003)

Moreover, the finding here seems to resonate with findings obtained from a study by Hofstede (1980). He stated that Arabic society is a collectivistic society as compared to the individualistic stance in western society. Hofstede (1980) elaborated that in collectivistic societies, people are integrated into strong, cohesive in-groups, often extended families (with uncles, aunts and grandparent) which will continue protecting them from birth and though out their lives in exchange for unquestioning loyalty.

Table 4: Preference for auditory learning style

No. of items	Question item	SA %	A %	UND %	D %	SD %	μ	σ
1	When the teacher tells me the instructions, I understand better.	**36.9**	**59.2**	2.8	-	1.1	4.3073	.63644
7	When someone tells me how to do something in class, I learn it better.	**23.5**	**55.3**	17.3	3.4	0.6	3.9777	.77136
9	I remember things I have heard in class better than things I have read.	**40.2**	**38.5**	11.2	7.8	2.2	4.0670	1.01449
17	I learn better in class when the teacher gives a lecture.	**20.7**	**57**	17.9	3.4	1.1	3.9274	.78632
20	I learn better in class when I listen to someone.	**13.4**	**48.6**	16.8	14	7.3	3.4693	1.11320

Note: Strongly Agree = SA; Agree =A; Undecided=UND; Disagree= D
Strongly Disagree=SD; μ= Mean; σ=Standard deviation

Table 4 shows the percentages of students who strongly agreed and agreed with statements indicating preference for the auditory style category were as follows: item no. 1 (96.1%), no. 7 (78.8%), no. 9 (78.7%), no. 17 (77.7%) and no. 20 (62%) respectively. Auditory science learners learn better when information is presented via audio mode. This learning style is ranked fourth in the overall list of students' preferred learning style categories (Figure 1). The excerpts from the interview data provided an expanded understanding of the Yemeni students' preference for auditory learning Student 17 says that "When the lecturer tells us how to do something in class, we learn it better", student 6 mentioned that "it is preferable to listen to the lecturer … and not just to come and read from the handouts". These excerpts show that students learn from hearing words spoken and from oral explanations. The finding is also reinforced from the classroom observation and field notes, where the researcher observed that the science students listened and absorbed passively what is being given to them. This type of learning is frequent and the norm practiced in Yemen where the teachers use the traditional approach of teaching. This finding supports the earlier studies done by other researchers regarding the

traditional approach to learning that favours visual and auditory type of learning styles (Mahyoub 1996, Nashwan cited in UNESCO, 2003).

Table 5: Preference for visual learning style

No. of items	Question item	SA %	A %	UND %	D %	SD %	μ	Σ
6	I learn better by reading what the teacher writes on the board.	**36.1**	**43.6**	9.5	5.6	2.2	4.1173	.94968
10	When I read instructions, I remember them better.	**22.5**	**59.8**	10.1	1.1	0.6	4.1453	.67965
12	I understand better when I read instructions.	**26.8**	**60.9**	9.5	2.2	0.6	4.1117	.70219
24	I learn better by reading than by listening to someone.	**10.6**	**38.5**	25.7	20.1	5	3.2961	1.06346
29	I learn more by reading textbooks than by listening to lectures.	**11.7**	**22.9**	25.1	29.6	10.6	2.9553	1.19372

Note: Strongly Agree = SA; Agree =A; Undecided=UND; Disagree= D;
Strongly Disagree=SD; μ= Mean; σ=Standard deviation

The results displayed in Table 5 show that the percentages of students who strongly agreed and agreed with the statements indicating preference for visual learning style were as follows: item no. 6 (79.7%), no. 10 (82.3%), no. 12 (86.7%), no. 24 (49.1%) and no. 29 (34.6%) respectively. As indicated in the results, visual science learners learn better when information is presented visually. This learning style is ranked fifth in the overall list of students' preferred learning style categories (Figure 1). The excerpts from the students' interview data explain why this learning style is preferred: student 16 says that "Of course, when the lecturer writes on the board, we tried to remember better", student 2 says "I prefer to learn when seeing pictures or drawing in books or blackboards". These excerpts show that the students felt that they learned better from seeing words in books and on the checkbooks. Through classroom observation and filed notes, the researcher noted that the teacher did not shift from one style to other, where he could have created a participating and motivating environment. The students just listened and passively absorbed what was given to them. They are using the low order cognitive skills when they are passively receiving science content through the visual style of learning (Mahyoub, 1996). They are not engaged in the higher order skills (thinking skills), problem solving capability and critical thinking (Mahyoub, 1996).

Table 6: Preference for individual learning style

No. of items	Question item	SA %	A %	UND %	D %	SD %	μ	Σ
13	When I study alone, I remember things better.	**22.3**	**31.8**	24.6	17.9	3.4	3.5196	1.12350
18	When I work alone, I learn better.	**8.4**	**21.8**	30.7	27.9	11.2	2.8827	1.12813
27	In class, I work better when I work alone.	**5.0**	**11.7**	25.7	39.7	17.9	2.4637	1.07189
28	I prefer working on projects by myself.	**5**	**17.3**	20.7	40.8	16.2	2.5419	1.10778
30	I prefer to work by myself.	**6.1**	**14**	20.1	33.5	26.3	2.4022	1.19230

Note: Strongly Agree = SA; Agree =A; Undecided=UND; Disagree= D;
Strongly Disagree=SD; μ= Mean; σ=Standard deviation

Figure 1 indicates that the least preferred learning style was the individual learning style. It is ranked sixth in the overall list of students' preferred learning styles categories. Table 6 shows the percentages of students who strongly agreed and agreed with statements indicating preference for individual learning style category: item no. 13 (54.1%), no. 18 (30.2%), no.27 (16.7%), no. 28 (22.3%) and no. 30 (20.1%) respectively. Many of the students indicated that they do not like to work alone. The data is supported by students' interview excerpts where student 18 said that "I do not understand new material when I learn it alone", student 7 stated that "I like to work with my friends to understand more information from different perspective". The results show that students do not prefer learning science entirely on their own because they preferred to work with others. The researcher observed that the Yemeni science students do not understand new material best when they learn it alone and they do not make better progress in learning when they work by themselves. For this reason, they preferred to work in groups and did not prefer the individual learning style. According to Hofstede (1980), in the individual societies, the ties between individuals are loose: everyone is expected to look after him/herself and his/her immediate family. This is due to the fact that these students are Yemeni students whose Arabic culture greatly influenced their lives and attitudes. Hofstede (1980) expounds that the Arab society is a collectivist society as opposed to being an individualistic society.

Conclusion

This study aimed to investigate the students' preferred learning styles at the Faculty of Science, Sana'a University, Yemen. The findings revealed that the students favoured the kinesthetic, tactile, and group learning styles. The auditory and visual styles were the next preferred style while the least preferred was the individual learning style. The main implication for teaching is that multiple approaches should be adopted in order to accommodate the different and multiple learning styles. Science teachers should be aware that there are diverse learning styles in the student population and should try out different

procedures and techniques in the classrooms and gradually phase out the practice of teacher-centered or teacher-dominant pedagogy.

The results of this research have shown that despite coming from similar cultural background students may still differ in their learning styles. Although the findings also suggest that science students prefer kinesthetic and tactile styles, yet the kinesthetic and tactile styles such as role-play and handling materials or taking notes have been ignored in science learning. The National Science Teachers Association in the United States, is the largest organization of science teachers worldwide emphasizes that the learning science standards should focus more on kinesthetic and tactile styles which encourage science students to engage in a "hands on" activity. It is suggested that kinesthetic, tactile and group teaching styles are very important styles for science students because there are lots of opportunities for students in a group to discover concepts and build physical relationships as they move about and manipulate materials. Furthermore, tactile learning style is considered to be one of the best styles of learning science, apart from the "hands on" activity, whereby the activities assist in the retention of facts, findings and concepts (NSTA, 2004).

The findings of the study can be used as a beginning point for collaboration between both science instructors and syllabus designers at Sana'a University. Teachers of the Faculty of Science should have a balanced teaching style and adopt activities to cater to students' learning styles. It is helpful to design class tasks and activities in which students can utilize their different learning styles. This will motivate almost all, if not all, students to participate in class and become engaged with real learning. This is hoped to lead to improvement in the standard of the teaching and learning of science, resulting in well-educated science graduates who will be able to make significant contributions to the development of Yemen.

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Appendix A

Background information of students

Background of informant

1) Faculty:……
2) Department:……
3) Specialization:
   Major:…….
   Minor:…….
4) Student status (level):…….

Please tick (√) where appropriate:

5) Age:
   a) 17-20 ☐
   b) 21-25 ☐
   c) 26-30 ☐
   d) 31 and above ☐

6) Sex: a) Male ☐ b) Female ☐

Student's perceptual learning style preference

This questionnaire has been designed to help you identify the way(s) you learn best or the way(s) you prefer to learn. Read the statements in the following pages. Please respond to the statements below as they apply to your study of science. Tick (√) a box for each item.

Item	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
1. When the teacher tells me the instructions I understand better.					
2. I prefer to learn by doing something in class.					
3. I get more work done when I work with others.					
4. I learn more when I study with a group.					

Student's perceptual learning style preference (cont.)

5. In class, I learn best when I work with others.					
6. I learn better by reading what the teacher writes on the board.					
7. When someone tells me how to do something in class, I learn it better.					
8. When I do things in class, I learn better.					
9. I remember things I have heard in class better than things I have read.					
10. When I read instructions, I remember them better.					
11. I learn more when I can make a model of something.					
12. I understand better when I read instructions					
13. When I study alone, I remember things better.					
14. I learn more when I make something for a class project.					
15. I enjoy learning in class by doing experiments.					
16. I learn better when I make drawings as I study.					
17. I learn better in class when the teacher gives a lecture.					
18. When I work alone, I learn better.					
19. I understand things better in class when I participate in role-playing.					
20. I learn better in class when I listen to someone.					
21. I enjoy working on an assignment with two or three classmates.					
22. When I build something, I remember what I have learned better.					

Student's perceptual learning style preference (cont.)

23. I prefer to study with others.					
24. I learn better by reading than by listening to someone					
25. I enjoy making something for a class project.					
26. I learn best in class when I can participate in related activities.					
27. In class, I work better when I work alone.					
28. I prefer working on projects by myself.					
29. I learn more by reading textbooks than by listening to lectures.					
30. I prefer to work by myself.					

Appendix B

Interview questions on the students' learning styles preferences

Do you prefer to work by yourself?

When you study alone do you remember things better?

Do you learn better by reading what the teacher writes on the board?

Do you prefer and enjoy working with others?

Do you learn best when you work with others?

Do you enjoy making something for a class project?

Do you enjoy learning in class by doing experiments?

Do you learn best in class when you participate in related activities?

Appendix C

Observation checklist

Class teacher-student observed:
Name of the lecturer:
Date:
Time:
Place:
Level:

	Not demonstrated	Needs improvement	Satisfactory	Outstanding
A. Science classroom				
1. Classroom seating arrangement is well organized				
2. Classroom is conducive for learning (condition, location, etc)				
3. Classroom promotes science learning (decoration, poster, etc)				
B. Science class (lesson)				
4. Class lesson promotes learning science				
5. Class lesson creates interest in students				
6. Class lesson is in order.(no interruption, no problems (difficulties)				
C. Science class (lesson atmosphere)				
7. Class atmosphere invites students to volunteer.				
8. Class atmosphere encourages participation.				
D. Students' attitudes				
9. students show participation by responding to teacher				
10. students ask questions				
11. students are quiet in class				
12. students are hesitant to respond to the teacher				
13. students are well behaved during lesson				

About the authors

Angela Abu-Asba (Ph.D) has worked for two years as a university instructor at Sana'a University's Faculty of Languages, English language department, Yemen. She obtained her Ph.D of Applied linguistics from Universiti Kebangsaan Malaysia (UKM). Her areas of interest are culture, science learning and teaching styles and English Language Teaching (ELT) research.

Hazita Azman (Ph.D) is Professor of Applied Linguistics at the School of Language Studies and Linguistics, Faculty of Social Sciences and Humanities, UKM. She has conducted research and published in the areas of language policy, digital literacy, youth literacy practices and literacy assessment. She currently heads the Language and Informatics research group of the ICT-Informatics research niche at UKM.

Rosniah Mustaffa (Ph.D) is an Associate Professor of Applied Linguistics and Head of the English Language Studies Programme, at the School of Language Studies and Linguistics, Faculty of Social Sciences and Humanities, UKM. Her research interests include learning styles and teaching & learning of English grammar. She has co-authored and published books and articles in the field of ELT.

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