

SUGGESTED STRATEGIES FOR TEACHING SCIENCE IN KURDISH UNIVERSITIES USING ENGLISH AS A MEDIUM OF INSTRUCTION

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ABSTRACT

The Kurdistan region is a vastly growing area in the Middle East. Rapid economic growth is accompanied by a high demand of competent university graduates with strong global communication skills. Learning and teaching in the Middle East, particularly in Kurdistan face several challenges. Among such challenges we may identify (i) lack of interest and high dropout rate in science subjects, (ii) Lack of adequate knowledge at pre-university institutions, and (iii) Language and methods of assessment.

This paper assesses different science teaching and learning approaches or strategies using English as a language of instruction at private and public universities in Hawler, Kurdistan. It uses a mixed mode of assessment including a structured survey, interviews and a teaching/learning case study. The paper concludes that the surveyed learning/ teaching approaches are substantial to both students and academic staff. Such approaches may prove to be a helpful guide for teaching science in universities of Kurdistan.

KEYWORDS: Teaching Challenges, Teaching Strategies, Mixed Mode Assessment, Structured Survey and Interviews

INTRODUCTION

Reformation of the current education system in Kurdistan has to be realized within the framework of the short and long term economic policies and plans. It is clear that the education system in Kurdistan must be geared toward preparing new generations for conditions of a culturally vibrant, productive, and complex society. Statistics published by Kurdistan Regional Government, shows a high demand of competent science teachers and instructors that can teach science using English as a medium of instruction. There are 19 public and state recognised private higher education institutions at present time. The academic year is normally divided up into two semesters. The period in which the college degree program can be attained is no less than eight to ten academic semesters at universities, (Ministry of higher Education, 2011).

The institutions mentioned in the above, embrace universities and equivalent higher education institutions such as technical universities, broad universities and particular institutions at university level (e.g. for medicine, sport, administrative studies, philosophy and theology). Apart from the public universities, all other universities and institutions are not allowed to confer doctorates (Ministry of higher Education, 2011). Overall the students number at the third level of higher educational institutions is 94, 700. The rate of female students is 48%. In Kurdistan region, the education is free for all, so there are no tuition fees (Ministry of higher Education, 2011).

The languages of instruction vary depending on colleges or departments, Kurdish/English/Arabic are the languages of instruction that can be applied in all lectures, classes and seminars. In order to be admitted, a student is usually required to obtain a high school certificate, and in some universities a Kurdish/English/Arabic language, mathematics and computer application diagnostic tests are required at this level. The diagnostic test is a general test and is

usually overseen by the institution itself. It is completed by the student before commencing the first academic year. Different language courses are offered through the Kurdish Cultural Institute in Kurdistan Region, in addition to this, there are also courses accessible by language schools and higher education institutions in Kurdistan region; these comprise summer holiday courses, pre-study courses and courses accompanying regular study.

The third level of Higher Education institutions in Kurdistan Region provide the degrees of Diploma, Bachelor, higher Diploma, Master and Doctor of philosophy (Ph.D.) in numerous academic grounds of science (Ministry of higher Education, 2011).

When teaching students using English as a second language, two important questions are addressed; (1) what teaching strategies teachers should use to meet the students' needs; And (2) what learning strategies students should acquire through and after the teaching\learning process. According to the American Association for the Advancement of Science (1989) (American Association for the Advancement of Science, 1989), several factors affect the learning and teaching of science using English as a second language. First, is the existing knowledge, students usually come with certain pre-built knowledge and attitude towards science that may correspond positively or negatively with re-visited or newly introduced concepts.

Second, the extent to which knowledge moves from being a fact to the actual practice of classification, hypothesizing, interpretation and reaching a conclusion (Rupp & J.H. Discovery, 1992). Third, the extent to which learning goes beyond the textbook. This involves inside classroom activities such as demonstrations and hands-on activities. It also includes outside classroom activities such as field trips. Fourth, assessment, evaluation and feedback in which teachers should communicate the course objectives clearly and check continuously for their students' understanding. Finally, science instructors should be aware that learning is not necessarily a result of teaching. Students learning with English as a second language bring with them special learning styles and challenges that should be addressed (Curtain, H. A., & Pesola, C. A., 1988). Many researchers have evaluated different approaches to incorporate English in teaching science. This paper attempts to identify challenges and assess strategies to improve teaching science to a sample group of students in several private and public universities in Hawler, Kurdistan.

CHALLENGES OF TEACHING SCIENCE USING ENGLISH AS A MEDIUM OF INSTRUCTION

Among the most identified challenges when teaching science in Kurdish universities is the lack of interest among students as well as the different learning styles that the students need to acquire the required knowledge. The teaching methods applied at the colleges of science are basically limited to lecturing and few demonstrations whenever the required materials are available. Otherwise, the instructors use traditional teaching tools. Another major challenge that faces learning and teaching science in Kurdish universities is the pre-existing knowledge base that the students reach the universities with. The majority of secondary schools teach science in Kurdish language using some English terminology. Not only does the academic staff have to build the terminology, but also ensure that the students are capable of understanding the objectives and expressing their newly acquired knowledge using correct English. In most cases, instructors provide the students with written resources and summary notes to help them pass required written assessments (Lori M. Edmonds, 2009; Dr. Paul Robertson and Dr. Joseph Jung, 2006; Briggs, L.L., 2007; Christine Shaffer, 2007).

While academic staff acknowledges the importance of applying new and innovative teaching strategies, the transition from traditional teaching methods to innovation will require strong effort and support from academic staff and administration. The lack of audio visual aids that can help students and lecturers attain the required knowledge represents another major challenge that teaching science using English as a medium of instruction faces at universities in Kurdistan.

When teaching science, it is important that the students understand the concepts on both the micro and macro levels. Audio visual aids can be very effective in comprehensively illustrating such concepts (Briggs, L.L., 2007).

The application of such tools requires suitable budgets, well-equipped computer laboratories and continuous training, updating and upgrading. The lack of such factors can play a negative role in introducing the proper information and communication technologies to the field of science teaching in Kurdistan. Many studies have proved that the teaching time in classrooms, is considered most valuable in the teaching \learning process. Teachers should plan their contact time with their students to ensure effective comprehension. When assessing teaching science using English as a medium of instruction in Kurdistan, the lack of organized preparation and clear teaching objectives and road maps on the teachers' side lead students to become very isolated, and prefer buying ready notes to study, rather than trying to make use of classroom time.

The limited English linguistic skills of both teachers and students represent a major challenge to the use of academic language when teaching scientific concepts. In most cases and particularly when explaining complex concepts, teachers revert to the use of Kurdish language to ensure that students have understood the concept. Such use of the Kurdish language sets an incorrect role model for the students to follow when teaching. It also reflects weakness on the teachers' side. Even though text books may include some illustrative diagrams and pictures, it remains essential that teachers use simplified diagrams in class. The lack of use of simplified diagrams while teaching science in Kurdish universities represents another challenge. For example, when teaching the processes of meiosis I & II, while the text book provides diagrams, it remains necessary for the teacher to simplify the diagrams by using hand-drawn schemes to ensure complete comprehension. The teacher should encourage the students to re-invent the simplified diagrams to ensure comprehensive understanding. Such practice is rarely detected when teaching science in Kurdish universities.

While the need for English language is vital, competent science teachers is recognized on the governmental level, it remains unknown to the public or university students. This information can work as a strong motive to encourage students to work in parallel on both their language and scientific knowledge competency.

The laboratory practice represents an essential tool for learning\teaching science. It not only allows the learner to understand the concept, but also helps develop proper scientific writing skills through writing laboratory reports. While in some Kurdish universities, practical sessions may take place, yet, students usually hand-in final calculation results without any theoretical background, analysis or discussion. In most cases, and if teachers insist on discussions or analysis, the students tend to plagiarize.

SUGGESTED STRATEGIES IN TEACHING SCIENCE USING ENGLISH AS A MEDIUM OF INSTRUCTION

Structure of Teaching Session

Establishing a Consistent Teaching Routine

One of the most useful approaches of teaching science in English is to formulate a consistent teaching session routine. This allows for clearer objective learning. The instructor should establish a certain routine to follow in class. A routine can start by revising material taught during the last teaching session, followed by viewing the objectives of the session and then using the well-defined focused objectives as a guideline for the lesson. The students should be encouraged to write the objectives and the instructor should constantly refer to the objectives and link them as the session progresses. It is also necessary to check the comprehension of students using small activities or exercises within the lesson. Establishing and maintaining this consistency allows the students to predict and focus on the learning objectives rather than being constantly distracted by several routines during the teaching session.

Constructing a Science Course Road Map

The purpose of this approach is to minimize the distraction and confusion among science learners. The vast amount of new vocabulary and scientific terminology that are covered during the course of learning may leave the student without a clear direction. A road map to the science curriculum or an organizational structure of the course should be developed and briefly reviewed at the beginning of the course. The teacher should constantly refer to the course road map to remind the students where they are now and what to expect next (see Figure 1).

In some cases, it even maybe more helpful, particularly at junior and senior levels engage the students in constructing the course road map. Activating students' participation in this process should help them feel involved and responsible for their own learning. The finalized road map should be posted during teaching session and is to remain throughout the course. Instructors should refer to the road map throughout the course (Bernard Laplante, 1997; Norman Herr, 2007).

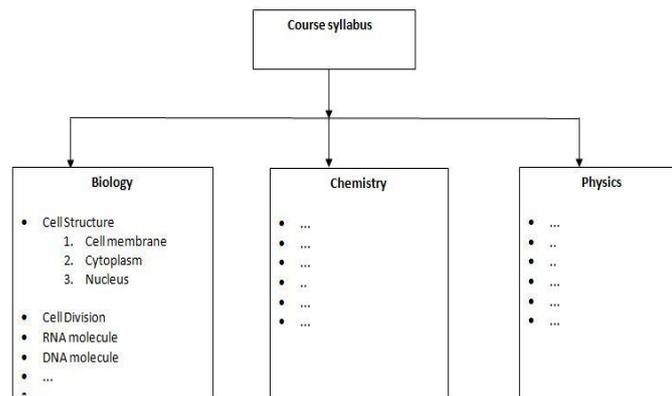


Figure 1: Displays a Sample of Road Map

Providing Science Learners with Outlines

It is evident that students learning science in English prefer an outline of the material taught during the session. While providing an outline to the students is time and effort consuming, it remains a crucial factor on directing the students' attention to the important core knowledge of the course or chapter. The teaching session outline should be provided prior to the teaching session. This allows the students to have guided lesson preparation. The outline should be accompanied by clearly defined and written objectives on the board. The students should also refer to the outline during studying and preparing for assessments. Students with better English abilities may also be asked to prepare outlines for future teaching sessions guided by the course textbook (Norman Herr, 2007).

Relating to Prior Knowledge

The focus of this strategy should be the scientific concept. Teaching a scientific concept to English non-native speakers can be very challenging. Instructors should make use of prior knowledge to help establish a common base of understanding (Norman Herr, 2007; Rashid & Elfara, 2001). Yet, instructors should check the prior knowledge while teaching the concept and make the proper corrections as the teaching session progresses.

Enhancing the Listening Skills of the Students

Slow Speech and Writing Key Terms

This strategy addresses a major challenge for learners. It is vital that the teachers speak slowly and clearly. It is important to mention that English language is scarcely used in any communications in Kurdistan; therefore, the students

only hear English within the classroom barriers. It is well recognized that these students need slower and clearer English language, particularly when complex terminology is used. Teachers should persistently write key terms on the board to allow students to keep track of information.

Key terms should be introduced within the context of the lesson objectives. Teachers should also allow the students enough time to write the key terms or new terminology and encourage them to write definitions using their own words in English. Another strategy is to ensure the use of closed captioning when science videos are used. Closed captioning allows students to listen to what the narrators and actors are saying. This helps them correlate written and spoken English and improve their pronunciation, spelling and sentence construction. Manual video control is another means by which teachers can pause the video to allow time to discuss new concepts and terminology. Teachers can also use bookmark and video clip features to return to the exact sequence to review. Slow motion and replay are other options to help students focus on the concept (Norman Herr, 2007).

The Use of Visualization in Teaching/Learning Science

Visual literacy is defined as the ability to evaluate, apply, and create conceptual visual representation. It is relatively independent of language and is therefore invaluable to learning science and English simultaneously. Pictures can be interpreted with minimal linguistic skills (Norman Herr, 2007; Jeremy Roschelle, 1995). Pictures help ensure comprehension in a shorter time, and therefore allow both students and teachers more time to formulate well-structured definitions. Teachers should help the students interpret simple and complex diagrams or pictures using their own words. Vector diagram, scientific diagram, pictorial riddles, photographic analysis, movie analysis, and map development and analysis, are a few of the many activities that can be used to build visual literacy (Norman Herr, 2007).

Another essential means that science teachers should use are graphic organizers (see Figure 2). Graphic organizers are diagrams, maps or flow charts that show the relationship between new and existing concepts. The teacher should construct the graphic organizer with the students in class. It is a very successful means to review existing knowledge and help introduce new knowledge. They require minimal language and can allow the students to use their own words to explain. Conceptual grids, Venn diagrams, flow charts, mind maps, and concept maps are some of the more common graphic organizers (Jeremy Roschelle, 1995).

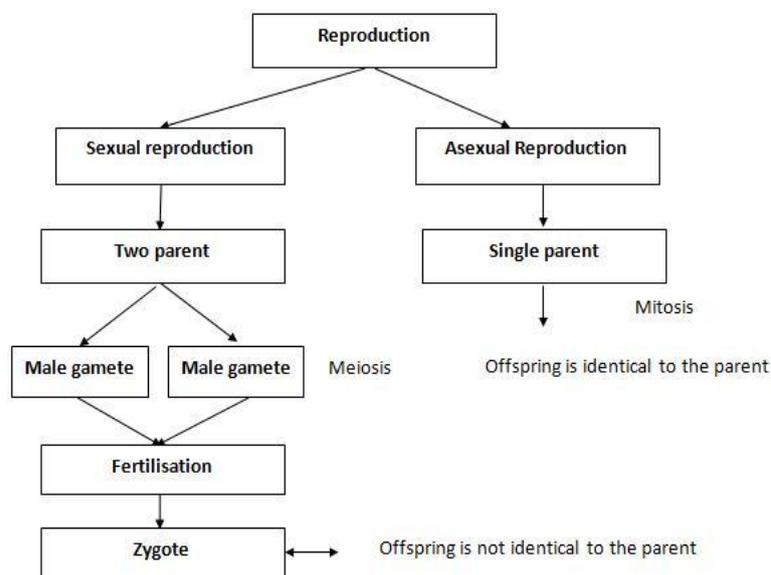


Figure 2: Displays a Sample of Organiser

The Use of Interpersonal Strategies When Teaching/Learning Science

Research and experience have consistently proven that group projects and cooperative learning are effective means by which knowledge is acquired particularly when teaching or learning a subject using English as a medium of instruction. Such activities provide opportunities for students to exchange, write, and present their ideas. Cooperative projects allow students to use many skills that help enhance their knowledge retention.

This paper uses three approaches of interpersonal strategies: (1) Partner English learners with strong English speakers; (2) Think/Pair/Share and (3) Encourage participation (Norman Herr, 2007).

Partner English Learners with Strong English Speakers

The partnership between an English learner and a strong English speaker benefits both of them. It is obvious that the best way to learn something is to teach it. It can become more beneficial if the strong English speaker speaks the local language. The English learner will have a quick and immediate translation and explanation of complex concepts and will certainly find it easier to express him/herself with a classmate instead with a teacher or with the whole class. The English learner will also get the one-on-one tutoring inside and outside the class. Teachers are highly advised to develop seating charts that pair English learners with strong English Speakers. At the tertiary level, it is highly advisable to have the partners choose each other to ensure success and efficiency of this approach. Teachers should encourage this approach by providing different activities that allow students to work in pairs or in groups.

Think/Pair/Share

It is essential to acknowledge the need for scientific conversation and being able to communicate in a clear scientific language for science learners. The pairing of students is an effective opportunity to share their ideas and check their understanding with their peers. The Think/ pair/share strategy gives all the students the opportunity to practice English by asking questions, explaining concepts and reaching conclusions. It provides students with the necessary time to formulate their response by discussing it with their neighbour before sharing with the whole class. The think/pair/share technique is an effective way to encourage English language learners to express science concepts both orally and in writing.

Encourage Participation

It is important to acknowledge that science learners using English as a medium of instruction face two main challenges: (1) The complexity of the concepts; (2) Being able to express their concepts using English. It is vital that teachers recognize such challenges and encourage the students' participation. Both positive and supportive types of environment have a significant influence on student comfort level, participation, and success. Students must be allowed enough time to formulate their responses before they are asked to express themselves in class. Teachers also, should ensure that the students are continuously exposed to English scientific communications through suggesting the right audiovisuals.

Using the Laboratory & Demonstrations to Teach Science

Hands-on activities are considered as an excellent learning environment for English language learners. It is important to remember that a science laboratory can be a confusing and potentially dangerous setting for English language learners. Teachers should present procedures clearly using flow charts, pictures, and outlines. It may be helpful to demonstrate activities in front of class to ensure that English language learners can see the procedures before engaging in an activity. The laboratory setting is a good initiator for the students to express their knowledge using proper writing. This is a safe environment for peer tutoring; bearing in mind that teachers ensure that the work is divided equally.

Before beginning the laboratory session, the teacher should provide a visual reference to glassware and other materials used in experiments and activities. It is important that safety symbols are reviewed and posted in the lab. The teacher must consistently refer to them before any experiment. The laboratory practice should be based on the tools of scientific inquiry. This includes making an observation, researching work others have done, asking a question that can be answered with an experiment, forming a hypothesis, planning procedures, collecting data, analysing data and sharing procedures and results with others. It is essential that the teacher spends enough time explaining and giving enough examples for the students. The final outcome of the scientific inquiry should be a scientific laboratory report. This requires proofreading by the teacher making sure that he provides clear comments for his students. This is a great opportunity for collaborative work and with more practice; the students should learn valuable scientific writing skills. It would be helpful if the teacher provides the students with examples from previous works to help make the concepts clearer. Students should also be advised to consult with their English teachers to help improve their grammar and sentence structure whenever needed.

The Use of Reading and Writing

Journaling & Science Reading Comprehension Activities

Teachers should motivate and encourage students to write throughout the contact time in class. Students should be encouraged to keep a journal that includes the learning objectives of the lesson. Students should also write all key terms and newly introduced terminology. The teacher must allow time for the students to write the definitions. At a later stage, students should be encouraged to re-formulate the definitions using their own words.

Science reading comprehension can be a very successful tool for learning. Students may read paragraphs and answer questions first in groups, then individually. Science reading comprehension can also be an effective formative assessment of language and science learning.

Instruction Tips When Teaching Science

Wait time and analogies are two of the many tools used in teaching science. When teaching science using English as a medium of instruction, it is vital that the teacher allows the students the time to translate terms while formulating an explanation. The teacher should express this clearly in the class to make the students comfortable for their slow responses. This will not only help them improve their responses, but increase their confidence.

In early stages of teaching science, teachers are certainly encouraged to use analogies and use concepts that can be easily linked. A very helpful example can be the teaching of the process of mitosis followed by meiosis. Both processes use the same terms and concepts in different contexts.

The Use of Vocabulary When Teaching Science

New scientific terminology is a challenging part of acquiring a strong scientific base. Teachers should provide students with variable resources and options to reinforce their knowledge. Pictorial flash cards are a helpful tool for students to remember the vocabulary and relate it to the concept. The student learns to correlate concepts directly with words, eliminating the need for translation. Teachers may also post new vocabulary terms on the wall in an organized, grouped manner. For example, you may wish to post new biology terms in columns according to the level of organization (cell, tissue, organ, etc.).

Teachers may also help students learn and understand new terminology by explaining the Latin or Greek prefixes, suffixes and roots of words. It may also be helpful to guide the students to be able to change word problems into

mathematical expressions that can help them when learning physics or math. Teachers may start by introducing the word or phrase clues, then asking the students to find them within the problem context. Teachers should supervise the students in the process and solve as many examples as possible.

METHODS AND DESIGN

It is a mixed mode investigation technique that comprises two steps: The first step includes interviewing a focus group of science academic staff. This step aims at collecting in depth insights, responses and opinions to help guide, design and construct a reflective survey. The focus group interview is semi-structured to ensure that all interviewees are asked the same set of open ended questions. The duration of the interview is 120 minutes. The number of focus group members is five. Groups were selected to ensure effective participation and substantial coverage of science teaching methods at different universities. Upon concluding the focus group activity, the authors defined eight approaches/categories of active learning.

The second step includes the design of a structured questionnaire. The structured questionnaire comprised 41 questions. Questionnaires were circulated among 250 students and 30 academic staff. The survey was conducted in several private and public Kurdish universities at different levels and stages in different departments and faculties related to science teaching (See the index provided in the paper). The researchers explained the research objectives to all participants (students and academic staff). A Kurdish translated version of the questionnaire was provided to the participants whenever necessary. The survey/questionnaire allowed the participants to choose from five different categories which included: 1: Strongly disagree; 2: Disagree; 3: Neither agree nor disagree; 4: Agree and 5: Strongly agree.

The participants were allowed 20-40 minutes to respond and the researchers were available to answer questions or queries. Incomplete & biased forms were discarded to ensure effectiveness of the results produced. The designed questionnaire\ survey included different approaches of active learning which were divided into 8 categories: 1) Listening, 2) Visualization, 3) Structure, 4) Interpersonal strategies, 5) Laboratory, 6) Reading and writing, 7) Instruction & 8) Vocabulary. The first category addressed in the research survey involves two aspects of listening: oral speech of the teacher and summarizing the lesson into key terms that are clearly written on the board.

By examining the listening aspect of the survey results, it is evident that both students and academic staff recognize the importance of teachers who use slow, clear and distinct speech. Throughout this research, science is taught in an English language medium. According to the survey the teacher should focus his speech to provide clear information and instructions, answer questions and help improve the language proficiency of the students. The teacher, therefore, should simplify their language and allow the students to take effective and useful notes.

Under the structure category, a majority of surveyed population, including both students and academic staff, identify the importance of the organized teaching session with a distinct road map of both the course and the teaching session. The group also prefers the substance of lessons that are related to previous knowledge. It is clear that the students' comprehension increases dramatically when the subject taught is related to pre-existing knowledge. When learning science, both students and academic staff acknowledge the value of hands-on activities as well as model laboratory activities and interpersonal skills (See Figure 3 and 4). When comparing the students' and academic staff recognition of the importance of written procedures versus guided pictures, the students and academic staff seem to choose the guided pictures.

By investigating the reading and wiring category of the survey results, it is understandable that students choose to read and be assessed using scientific comprehension passages as a preferable teaching and learning method. Academic staff shares the same view regarding the use of comprehension passages as a teaching method. The results of the survey indicate

that the students have a stronger preference to use journals and lecture notes. This may be linked to using the lecturing notes as a summary of a text book. The results show the need for the students to write specific scientific terms and their definitions. Answering questions that are correlated to teaching objectives is considered as a desirable learning method. This allows the students the time to comprehend the objective and formulate proper English structured statements. Answering questions is considered by the academic staff a means by which lessons can be divided into clear objectives.

Under the instruction category, both students and academic staff realize the importance of formulating or reformulating their comprehension of a specific teaching/ learning objective, therefore, they value the time needed to do so. It is clear, that pre-translation or translation of new scientific terminology will help the students comprehend the teaching learning objective. Students distinguish the significance of time allowed to respond to a question. This allows the students to enhance their English language proficiency while formulating the answers to questions.

In vocabulary, while students show neutrality towards using the language based science game teaching approach, academic staff consider it as an effective means of instruction.

This may be explained by inadequate session preparation or limited exposure to such activities. However, students in general prefer to use pictures and pictorial flash cards to learn and memorize new terms. The results show that students would rather understand the Greek and Latin term as well as root words by learning the language origin of the terms. Students are almost equally divided towards using mathematical expressions rather than word problems. Nevertheless, the students seem indifferent about the use of word group posters.

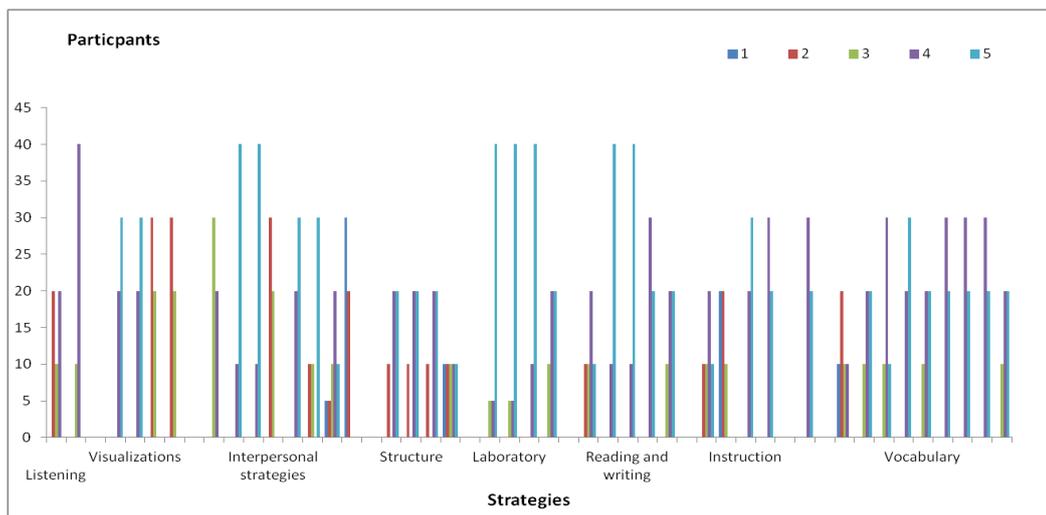


Figure 3: Shows the Surveyed Results that Academic Staff Prefers Some Strategies over the Others

According to the surveyed sample, under visualization, both academic staff and students agree that students understand better using visual aids such as educational videos and online animations. Academic staff and students prefer narrated videos. This provides the students an instant translation that ensures a better comprehension of scientific ideas. Instructors and students would rather use manual videos control, this allows a better opportunity to stop and replay unclear concepts. It is obvious that charts, diagrams, mind and concept maps are helpful learning/teaching tools when teaching science.

For interpersonal strategies, the survey results show that students understand better through group projects and cooperative learning. Cooperative learning allows for peer support and diversity for viewpoints of knowledge and skill which enhance the learning experience of the students. The results also indicate a considerable percentage of the surveyed sample

staff and students may not find collaborative learning productive. During collaborative learning, there is a good chance when 1 or 2 students end up doing all the work and other do not get involved in the learning process. As per peer tutoring skills, students prefer peers with stronger English language skills. Teachers believe that more proficient partner will help present the idea to the weak partner. Students learn better with their peers through reading and discussing passages. Students find no different between reading the passages using a loud voice or silently. On contrary, teachers consider reading loudly is a better learning means since it allows the students to read and listen. On one hand students prefer a teaching style that allows a gradual participation; on the other hand, students do support neither enforced participation nor no participation at all.

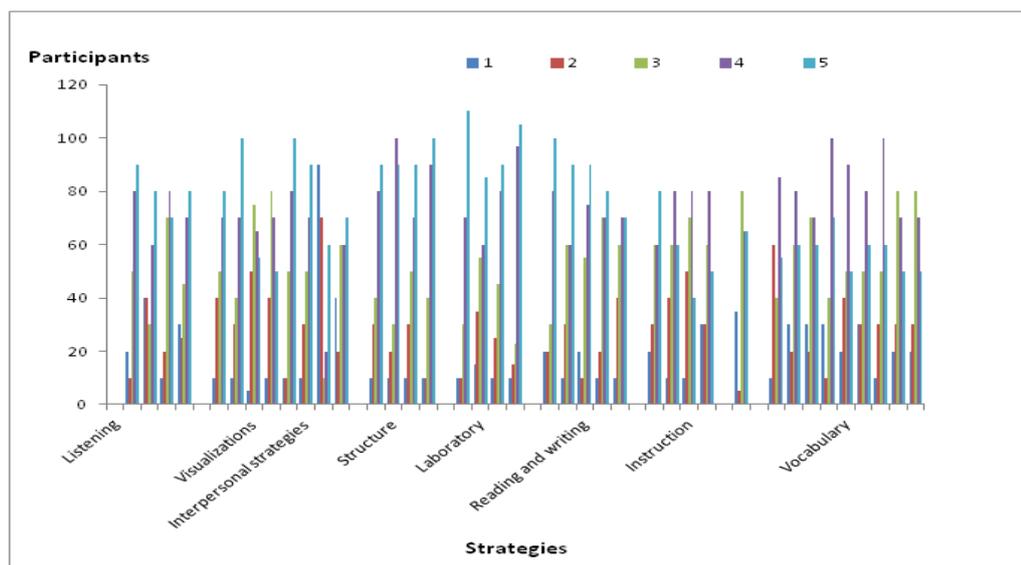


Figure 4: Shows the Surveyed Results, Students Prefer Strategies over Others

CONCLUSIONS

It is essential for students, administration and academics at Kurdish universities to recognize challenges that face teaching\learning Science using English as a language of instruction. Among many challenges, this paper identified; lack of interest, variable learning styles of students and pre-existing knowledge. Academics, students and administration can use a variety of strategies to help dissolve such challenges. It is important that administration help empower the English linguistic skills of both the academics and students by enrolling them in appropriate English language training. This should be complemented by applying suitable teaching strategies.

It is also vital that administration equip universities for a successful application of suitable audio visual tools. Such tools are independent of language, yet it can present a strong starting point for academics to help link the strong conceptual comprehension to proper English expression. Academics or teachers should value the contact classroom time. This requires effective planning to ensure comprehension. Time and effort should be focused to design and plan course road map, and individual detailed lesson plans that link the learning objectives to proper assessments, teaching tools and simplified diagrams.

Introducing complex scientific terminology is a challenge that academics should put effort to resolve. New terminology should be pre-identified and introduced before each lesson to allow students time to translate them. This allows stronger comprehension. Academics should encourage participation and allow time for students to write in their journals and allow them time to formulate their answers to questions with the help of stronger English speaking peer tutors.

Laboratory practice is a means by which an academic can monitor the progress of scientific writing skills of their students. Instructors should help the students practice the scientific inquiry: observations, research, asking questions, forming a hypothesis, planning a procedure, collecting data, drawing conclusions and communicating the results. While the need for English language competent science teachers is recognized on the governmental level, it remains unknown to the public or university students. This information can work as a strong motive to encourage students to work in parallel on both their language and scientific knowledge competency.

The results of this work indicate that both students and academic staff in Kurdish universities recognise the effectiveness of applying innovative teaching/learning approach skills. However, that both academic staff and administration and students require intense training and support to apply such innovative methodologies. It is recommended that universities hold many workshops and in class training to ensure efficient and effective teaching/learning process. Kurdish universities should prepare their science course subjects to include life and career, learning and innovation skills, and information media and technology skills. This is only achievable by revisiting the learning environment, professional development plans, curriculum contents, instructional methods, and assessments. The analysed results in Tables 1 and 2, demonstrate clearly the difference in the knowledge retention when using innovative approaches versus traditional methods.

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