THE DYNAMIC TRANSITION FROM LIMITED ENGLISH PROFICIENCY INTO ENGLISH PROFICIENCY IN ASSESSING UNIVERSITY STUDENTS' UNDERSTANDING OF CHEMISTRY CONCEPTS

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Abstract:
Jordanian students study science using their mother tongue Arabic at school; however, they shift into English in studying scientific courses at university. The study investigates if using English in assessing the level of understanding scientific concepts would underestimate the level of freshman's comprehension for those concepts. The results of the study show that the group of freshman students who had been tested with the Arabic version of SAP (Symbolic Application Particulate) chemistry test did better than the group who got the English version 41%> 38%, without a significant difference at **α** =.05; the results also show that senior students who had been tested with the English version of the test did better than those who had been tested with the Arabic version 49%> 44%, still without a significant difference at **α** =.05; the results also show that the two groups of sophomore students (who had been tested with the English version and those who had been tested with Arabic version) got the same average -39% each.

The findings of the study show that there is a dynamic transition in students' ability to comprehend scientific concepts; students became more fluent in understanding scientific concepts at later stages of study.

The findings of the study suggests that important decisions related to the academic achievement of freshman students (as acceptance into medical college) should not be based upon assessment in English language content courses at the early stage of students' academic study.

Key Words: Science-assessment, dynamic transition, English language proficiency

Introduction:

Brown, Reveles, & Kelly, 2005 show the importance of understanding the role of language in science learning; it was considered that learning science ideas exist independently of the words; the scientific language (presenting ideas in linguistic, symbolic and mathematical form), add conceptual depth for understanding concepts at higher levels of specificity. The study indicated that if science instruction used English as the only means of presenting new concepts to students who have a low proficiency in this language, the risk would be that new ideas would be presented using incomprehensible language on the part of students. Science instruction that does not take into its account the language factor runs the risk of negatively affecting students' conceptual understanding.

Brown & Ryoo 2008, Seigle, 2007, indicated that assessing students' science learning implies assessing the assessment tool to be linguistically accessible for students with limited English proficiency. Solano-Flores, & Nelson-Barber, 2001, considered that the sociocultural perspective allows assessment developers to make informed decisions involving word equivalent across languages.

Kelly &Green 1998 show the implication of testing the specialized content knowledge of students in their second language. They considered that the cultural practice of assessing students as

literate members in the community of science by the means of a second language could hide under using it political ideology.

Gumpers, 1982 indicated that individuals learn to signal their identity (indication of how an individual want to perceive as) through language, that reflects abroad set of symbols that are constructed in moment-to-moment interaction, over time and over a broader sociohistorical context.

In the same way, Gee 2001, considered that language use can be seen as a resource for signaling one's identity as well as a resource for maintaining cultural and political identity. Identity is dynamic in nature and can change from moment to moment in the interaction and can change from context to context. Agar, 1994 emphasized that one can't use a new language unless he changes the consciousness that is tied to the old one. It is the issue of appropriating changes in the consciousness associated with science language use; students may choose to avoid certain linguistic forms in an effort to maintain their personal identities and group affiliation.

Brown et al., 2005 indicated the importance of understanding the relationship between the language students use in learning, and their identity- the way students perceive language that had been used as a medium of instruction; students should have an appropriate identities associated with those language that had been used as a medium of instruction. If students perceive science language to be a form of cultural membership, then they would experience feelings of conflict when scientific concepts are presented in their second language. Reading and teaching science without respect to the language that is used as a medium of instruction that is associated with students identity, could cause feelings of identity conflict, marginalization or promote notion of inferiority and discursive identity development for students. Without an ideology that carefully examines the relationship between language, identity, and students' learning, researchers make the erroneous assumption that participation in science occurs free from the cultural implications associated with language use.

Lee, O., Deaktor, R., Enders, K., & Lambert, J., (2008) considered that the product of the intense social and linguistic interactions associated within adolescents' public discourse make science courses a point of potential conflict for students. Students' adaptation into school culture of science may pose challenges to their identity development. This issue would be complicated when school culture conflict with students primary cultural identity. The culturally complicated of language, identity and classroom learning becomes increasingly intense as students are enculturated into science education. Students become bicultural and bilingual through the merging of their first mother language culture into second language scientific culture. Lee et al., 2008, indicated that such issue stands in direct conflict with science educators' adherence to the notion of universalism, in contrast to the long-held conceptions that present images of science as a culturally neutral medium, sociolinguistic research suggests that serious linguistic issue may exist for those who used English as a second language; Lee, et al., 2008, suggested that such an area of study is often considered elite; science and its associated discourse reflects elite membership in the cultural ecology and that science educators should understand that minority students face dual challenges of mastering the main stream language while also learning the content and processes of academic scientific discipline.

Previous researches: The study of Tobin, 1996, show that despite Chinese-Australian students' efforts to learn chemistry with understanding, difficulties in speaking and writing English were factors that limited their performance; using English language to learn chemistry and assess performance placed students with limited English proficiency (LEP) with a potential failure. The results of the study indicated that learning chemistry can be facilitated when LEP students are provided with opportunities to fully employ their native language in learning and assessment.

The results of the study also indicated that if primary goal of Chinese students who their primary goal was studying science, and who did not expect the teaching to be in their own native language, have still less difficulties to adaptation from other minority students; Chinese students usually succeeded academically in later stages of learning, while they have to make an extra effort at the beginning. The result of the study also indicated that science achievement for LEP students at lower stages of learning was statistically lower than those who were proficient in English.

The study asserted the conclusion that at lower stage of study Chinese students' understanding of chemistry were under- assessed because of their inability to represent what they knew in English. Limited English proficiency can be particular handicap in tests and examinations where inability to make sense of questions can make it impossible for students to make a start and

show what they had earned. Students who did better in chemistry did so because they were able to overcome the barriers of having limited proficiency in English relatively quickly.

Accordingly; the study suggested several low cost ways to reduce such problem:

a.   Because Chinese students are learning chemistry in a second language- English-, it is necessary to give them more time to complete their scientific tasks if they were written in English;

b.   Instead of making proficiency in English prerequisite to science learning, or using the native language as a medium of instruction, the solution is to overcome deficiency in English while building corresponding skills in science learning.

The study of Lee, Maerten-Rivera, Penfield, LeRoy, & Secada, (2008) examined science achievement gains and gaps at the completion of the first year implementation of a project that had been designed to handle limited English proficiency. The project developed a science test in English to be consistent with the language of instruction. Results on Stanford Achievement Test indicated that although English proficient students still performed significantly better than limited English proficient students, however, science achievement for LEP students increased in direct relation to the number of year's minority students participated in program. On the other hand, the study show that although modification had been entered for the science test that had been developed in English to be consistent with the language of instruction, however, the study concluded that the modified written assessment in English still underestimate the science knowledge for students with limited proficiency in English.

The study of Lee, Deaktor, Enders, & Lambert 2008, indicated that although white English students did better in science at lower grades, the achievement gaps sometimes narrowed with fourth grade

Stoddart, Pinal, Latzke, & Canaday, (2002), considered that when teaching science to bilingual students, science educator should not assume that proficiency in English is a prerequisite to academic success in science; their study show that the integration of science instruction and language acquisition enhances learning in both domains.

The study of Brown & Ryoo, 2008 used the design of content- first approach to assess the performance of students with limited English proficiency (LEP) in science tests. The approach depends upon merging between teaching scientific content while providing scaffolding for LEP students; adopting systematic way of addressing the challenging relationship between language, identity and science learning.

The findings of the study indicated that teaching English as a second language for LEP students should not be considered as a prerequisite for understanding scientific concept and that the impact of content –first approach to instruction, is critical for such type of students. The study concluded that such approach as teaching science concepts in English while providing instructural scaffolds to help LEP students in constructing scientific meaning can promote an understanding of scientific concepts as well as enhance students' proficiency in English.

The project of Solano-Flores, & Nelson-Barber, (2001) aimed to ensure validity of measuring the academic achievement of students with limited English proficiency, and to reduce the impact of limited English proficiency on the skills being measured. The results of the study show that despite LEP students were having an understanding for scientific principle; still they were not being able to demonstrate that knowledge in the test. The obstacles to attain the goal of the project were that the validity of assessments depended upon the proficiency in the language being used in assessment.

The study of Brown, 2006 explore how students' identity affect science learning through identifying the issues of linguistic conflict that could initiate identity conflict for students whose mother language is not English. The study findings indicated that under achievement of students who studied science as their second language is a product of linguistic differences. These findings, they suggest, highlighted the complexity of attempting to provide equitable science learning environment.

The study of Abedi , Lord, Hofstetter, & Baker, 2000, show that assessments with linguistically modified items proved to be the most effective in narrowing the gap in performance between students with limited English proficiency –LEP- and those with English Proficiency; the modifications happened in such a away as altering several linguistic features through switching infrequent words with more common words, shortening the names, and removing relative clauses.

The study of assessments Seigel, 2007, represents the findings of research –based project aimed of developing useful assessments that are equitable for LEP students (Limited English Proficiency). The study have the assumption that using English in assessing LEP students brings up questions of validity and fairness; they considered that the performance of any student is very dependent on the wording that is used in assessment, and that LEP students take longer time to read in their second language than in their mother tongue. The study focused on the ways to improve written science assessments to make it more accessible and equitable for students.

The findings of the study show that translating items into students' native language proved to be difficult and ineffective because language and content are linked; if instruction add a new concepts not familiar to students in their first language; translation the assessment would introduced more ambiguities and confusion to students. Also, the findings show that integrating language instruction with academic content was a difficult task; most teachers were not equipped to make such integration; beside that; they were unaware of the center commonalities between science and language teaching.

On the other hand, the findings of the study project show that the principles for equitable assessment to increase fairness depend upon using design that requires the careful consideration of many factors as:

1- Assessment should match language of instruction to items of assessment.
2- Assessment should be linguistically comprehensible for LEP students by offering modification for the content of assessment to make it more comprehensible. Written assessments should be readable, comprehensible while sentences can be shortened.
3- Assessment should challenge students to think about difficult ideas without watering down content; controlling of language factor should take into account not to affect such content; the challenge is to simplify items linguistically without affecting the meaning.
4- Assessment should elicit student' understanding.
5- Assessment should scaffold the use of language to support students' comprehension, such as providing sentence starters, graphic organizer; a sequence of classroom assessment may begin with scaffolds that are later removed as students make a progress into later stages of science learning.
6- Assessment should use designs to reduce anxiety, extent time limits, adding visual support, and providing customized glossaries.
7- Assessment can be used to determine how much language affects performance on items in different languages. Items should be improved, in many ways as possible, to make them more comprehensible. The development and the refining of the items should be in both languages at the same time so that both versions are validated using the same process.

Rationale:

Looking for equitable assessment that can contribute to science learning for students whose their native language is not English, is a goal of increasing importance (Siegle, 2007)

This study tried to investigate if assessing academic achievement in second language- English- is adequate in evaluating the performance of Jordanian university students. The study examines the success of university students in their transition from high school culture of using their mother tongue Arabic in their academic study, into university culture of using a second language – English- in their science studies.

Specifically; the study tries to answer these three questions:
1-   Is there any significant difference on performance between the two groups of freshman students, those who get the Arabic version of SAP (Symbolic Application, Particulate) chemistry test, and those who get the English version of it?
2-   Is there any significant difference on performance between the two groups of sophomore students, those who get the Arabic version of SAP (Symbolic Application, Particulate) chemistry test and those who get the English version of it?
3-   Is there any significant difference on performance between the two groups of senior students, those who get the Arabic version of SAP (Symbolic Application, Particulate) chemistry test, and those who got the English version of it?

Analysis of findings: The sample was consisted of 84 students at three stages of university studies, freshman, sophomore, and senior (28 each); the assessment took place at the end of the term; both freshman and sophomore students were studying General Chemistry 101; the senior' students were studying organic chemistry

Students were assigned randomly to two identical versions of SAP (Symbolic Application Particulate) chemistry test (Designed by Dorothy Gable, 1994) , 14 students at every stage, had been tested using the Arabic version of the test, the other 14 had been tested using the English version of the test.

Table 1 shows that the group of freshman students who had been tested with the Arabic version of the test did better than the group who got the English version of it, 41%> 38%,

The standard deviation for freshman students who got the Arabic version of the test and the students who got the English version of it had been obtained, S_{x1-x2} =1.36, t= 12.14-11.43/1.36= .52

The critical value for t at $\alpha_{.05}$= 2.056, which means that there is no significant difference between the group who got the Arabic version of the test and those who got the English version of it.

Table 1 also shows that the two groups of sophomore students (who had been tested with the English version and those who had been tested with Arabic version) get the same average- 39%, each.

Table 1 also shows that senior students who had been tested with the English version of the test, did better, than those who had been tested with the Arabic version of it 49%> 44%.

The standard deviation for senior students who get Arabic version of the test and the students who get the English version of it had been obtained, S_{x5-x6} =1.36, t= 14.64-13.14/1.36= 1.1 .

The critical value for t at $\alpha_{.05}$= 2.056, which means that there is no significant difference between the group who get the Arabic version of the test and those who get the English version of it.

Conclusion:

The results of the study show that at early stages of studying science courses, using a second language- English, freshman students who had been tested with the Arabic version of the test, did better than the group who get the English version of it, 41%> 38%, without a significance difference at **α** =.05; however, this gap had been narrowed at the second year of university study; the two groups of sophomore students (who had been tested with the English version and those who had been tested with Arabic version) got the same average -39% each; the lower in performance for sophomore than freshman students in the Arabic version of the test, could be explained by the fact that the sophomore sample had been drawn from students who were studying General chemistry 1; and those students who usually postponed the General Chemistry I to second year are usually not the higher achiever.

The results of the study also show that at later stages of university studies, students became more customized to using their second language in their academic studies; senior students who had been tested with the English version of the test did better than those who had been tested with the Arabic version of it 49%> 44%, still without a significant difference at **α** =.05.

The fact that freshman students did better in the Arabic version than in the English version of the test, could be explained by the fact that freshman students come to university, usually, mastering their first language, being customized to using such language in understanding scientific content; however, such fact is usually overlooked in assessing their performance by only depending on English language on such assessment.

These findings indicate that important decisions related to the academic achievement of freshman students (such as acceptance into medical colleges) should not take place depending upon assessment written in the students' second language at the early stage of their academic study.

Freshman students are faced with the additional challenge of learning academic content and process through the medium of instruction of a new language. The policy makers must reconsider the notions of underachievement of those students in university science courses by incorporating a theoretical and pedagogical perspective that recognizes the role of students' original cultural identity – Arabic- as an influential component of their performance in science at university studies, without such recognition, there would be the risk of underestimating students' performance in their initial years of study. Lee et al., 2008 indicated that if science educators and policy makers fail to address the social, cultural identity, associated with teaching science courses, the underachievement of limited English proficiency students in science courses will continue to be invisible.

The solution of the problem could be done by introducing modification to the assessment of LEP students (limited English proficiency) as Shaw 1997, had suggested, through increasing the clarity of assessment design; allowing more time to complete assessment; and not to make a serious decision concerning the level of LEP students; assessment in English could confound subject matter knowledge with English language proficiency.

The fact that senior students who had been tested with the English version of the test did better than those who had been tested with the Arabic version of it 49%> 44%, could be explained in that there is a dynamic transition in students' ability to comprehend scientific concepts in their second English language. Brown, 2006 indicated that the customization of students for the way of presenting scientific language would highlight the dynamic cultural interaction that comes into play when one consider how the language of science has the potential to affect students' sense of self identity.

This theorization would explain how Jordanian students who seek to be seen as intelligent by being fluent in using their mother language in their primary education at school level have to face cultural conflict at the beginning of their university studies. Students face the dilemma between perceiving themselves as intelligent in mastering the basic tool of their native culture (being fluent in their mother language), and making a good performance in academic study in the second language. Students have to make changes in the consciousness that is tied to the use of the Arabic language to make good performance in their academic studies in the second language, and the results show that senior students had succeeded in doing that.

These results of the better in performance for senior students in the English version of the test agree with the study of Tobin & Campbell, 1996. Their study shows that Chinese students whose primary goal was studying science were facing less difficulties in making good performance from other minority students; Chinese students usually succeeded academically in the later stages of learning, while they had to make an extra effort at the beginning.

These findings agree also with the theorizing of Gee 2001, that identity is dynamic in nature and can change from context to context.

Further studies are needed to investigate whether using a second language in the assessment of students' academic performance would underestimate their true level of achievement.

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Table (1)

Comparison between freshman, sophomore and senior students in their performance on SAP test

Students' group	No of student	Average	Percentile	Std-deviation
Freshman Arabic ver test	14	12.14	41%	3.9
Freshman English ver test	14	11.43	38%	4.64
Sophomore Arabic ver test	14	11.64	39%	3.43
Sophomore Eng version test	14	11.71	39%	2.7
Senior Arabic version t	14	13.14	44%	4.42
Senior English version	14	14.64	49%	3.25