

Stem Learners' Biotechnology Content Knowledge and Entrepreneurial Aspirations as Basis for Module Development

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Abstract

Science learning should not be purely intellectual but also practical. Stem learners content knowledge and entrepreneurial skills had been assessed in this research to obtain the data whether learning of science concepts can be extended to technology development and eventual business paths. The needs and gaps in content knowledge were determined through the administration of the Quizlet in Biotechnology Understanding. Assessment of learners' readiness for entrepreneurship was done through the administration of the Learners' Entrepreneurial Aspirations questionnaire. The instruments were validated and underwent reliability testing. Results showed that the level of conceptual understanding of learners in biotechnology was very satisfactory. Furthermore, assessment results revealed that the level of entrepreneurship intentions and aspirations indicated that learners were ready to become entrepreneurs. Results obtained will be utilized as a basis for developing a contextualized module in biotechnology that will enhance the teaching of biotechnology, an advanced subject taught in Grade 8 Science, Technology, and Engineering program of the Philippine Curriculum specifically in the Science, Technology and Engineering program.

Keywords: biotechnology, biotechnology understanding, entrepreneurial aspirations, contextualized module .

INTRODUCTION

A new scientific and technological era is beginning—the biotechnology era. Biotechnology places a greater emphasis on technological way-of-knowing and gaining of substantive scientific knowledge [9]. Biotechnology being part of the STEM curriculum provide opportunities for today's learners to acquire technology, and use it as a tool to enrich learning [5].

STEM Education despite its noble objective faces many challenges partly due to the lack of clarity of how lessons should be carried out and applied to the real world [7]. Oftentimes than not, learners simply know science concepts; merely equivalent to acquiring knowledge or a collection of huge depot of facts and trivia [1]. Science should be much more than that especially dealing with STEM learners [2]. Science should create the impression as good and fun, exploratory experiences and endless experimentations, creations and innovations [13]. Strategies must be varied, interesting enjoyable and relevant to be able to contribute to real learning [7]. Studies further revealed that biotechnology, a field of science offered as a subject in the STEM curriculum in the Philippines [4] should not only be confined to learning concepts but rather enhanced by technology

development and product entrepreneurship [12]. Entrepreneurship when integrated in teaching can help learners acquire future-ready skills preparing them to an array of new career opportunities. A proposal actively pursued today is the introduction of entrepreneurship and enterprise as part of the STEM education [10]. Entrepreneurial mindset should be raised among STEM learners as basis of future career choices [11].

This research focused on the assessment of biotechnology content knowledge and entrepreneurial aspirations of Stem learners was used to gather initial data which will be worked on a basis of developing contextualized module ; a module with an educational model of context-based supplementary teaching material in Biotechnology projected to include science concepts, technology (application), and local product entrepreneurship.

METHODS

Research design

The study used quantitative research design with the descriptive approach. Descriptive research for discussions on the biotechnology content knowledge of STEM learners and their entrepreneurship aspirations had been made using a survey questionnaire.

Participants and Sampling

Total population sampling was done. Population included the Grade 12 STEM learners who are in the STEM track in their Senior High School, and had taken up the Biotechnology and Entrepreneurship subject in their Junior High School. The chosen Grade 12 STEM learners are from a public school in the locality. Learners' have answered the sets of questionnaires prepared by the researcher.

Instrument

There were two instruments used for this study: the Quizlet on Biotechnology Understanding (QBU) and a questionnaire on Learners' Entrepreneurial Aspirations in Biotechnology. QBU was used to identify competencies that should be included in the proposed module to be developed and Learners' Entrepreneurial Aspirations to determine whether STEM learners are inclined to entrepreneurship, an innovation that will be introduced. The first questionnaire was composed of a set of questions on the Biotechnology Lessons; this 25-item test was used to determine the level of understanding of STEM learners. Items of which were generated from and patterned after the curriculum guide (MELCS-DepEd). This questionnaire was used to gauge the level of understanding of learners of content in Biotechnology and check whether possible applications were introduced. A Table of specification of test items was prepared to ensure that all competencies were covered. The initial draft of the instruments have undergone the process of validation by three biotechnology teachers to further assess their administrability and reliability.

The Entrepreneurship Aspiration questionnaire was used to assess whether learners are entrepreneurship ready. The results were specifically aimed at finding whether introduction of entrepreneurship is highly significant to them when offered as part of their science lesson in the STEM Curriculum. The level of aspiration/ motivation have two parts; first part included four questions to determine the external influence of entrepreneurship and are answerable by a YES or a NO, and the second part have questions that gauged the three main pillars of a personality ready for entrepreneurship: sociological, psychological and specific entrepreneurial traits [10]. The specific instrument are composed of 10 questions and have utilized the four- point Likert Type Scale with the following descriptions; yes to a

great extent (4), yes to large extent(3), yes at some extent(2) and no, not at all(1). Two entrepreneurship teachers and a guidance counselor had validated the instrument.

Both questionnaires were pilot-tested, and the reliability of the researcher-made questionnaires were encoded and statistically analyzed through KR20 measure of scale for the Quizlet in Biotechnology Understanding and Cronbach’s alpha for measure of reliability of the instrument Learners’ Entrepreneurial Aspirations in Biotechnology. Biotechnology understanding reliability was determined to .7319 and Learners’ Entrepreneurial Aspirations in Biotechnology was also reliable at .911.

The questionnaires were prepared in google forms and answered online since the restricted the conduct of the research face to face.

Data collection

Prior to the distribution of the instruments, standard protocol and procedures were undertaken. Permission was secured for the distribution of the instruments. After the permission was secured; respondents were approached and requested to answer the two questionnaires; Quizlet on Biotechnology Understanding and the Learners’ Entrepreneurial Aspiration online. . The questionnaires were prepared in google forms for face-to-face administration was discouraged. When the results from the questionnaires; Quizlet on Biotechnology Understanding and th Learners’ Entrepreneurial Aspiration were obtained, the researcher statistically analyzed the responses.

Data analysis

The data obtained from the 25-item Quizlet on Biotechnology Understanding, learning competencies was tallied and subjected through the Statistical Package for Social Science (SPSS) Software. Descriptive analysis of data involved getting the means and standard deviations to determine the level of understanding of students on biology and biotechnology concepts. The initial quantitative data obtained were interpreted and used as bases of gauging gaps or deficiencies, as well as the basis for module preparation. The results obtained in the first instrument- The QUIZLET in Biotechnology Understanding were interpreted using the means scores transmuted to percentage using DepEd’ s Transmutation reflected in the e- class record and tied up to the Written Work. The scores reflected as percentages will be interpreted as follows:

Table 3 Transmuted Score and Grading Scale.

Grading Scale	DESCRIPTIVE RATING
90-100	Outstanding
85-89	Very Satisfactory
80-84	Satisfactory
75-79	Fairly Satisfactory
74- Below	Did Not Meet Expectations

Descriptor: *Mean is interpreted as follows: 3.51-4.0, very ready; 2.51-3.5 Ready; 1.51-2.50 fairly ready and 1.0-1.50 for not ready.*

The obtained result have shown concepts were best learned by the learners in Biotechnology along in the areas identified and tested. If in particular the result showed that learning were unsatisfactory, a module will be developed.

The results of the second questionnaire, Learners’ Entrepreneurial Aspiration and Motivation towards Venture Creation and Biotechnological Intentions which measured the entrepreneurship readiness of

learners were interpreted from the mean scores obtained from the respondents' answers. Part One; the external factor, answerable by yes or no would give the idea whether family, peers or anyone has an influence on the likelihood for entrepreneurship inclinations. The second part; answerable by: yes to a great extent, yes to large extent, yes at some extent and no, not at all.

For the responses to part 1, Yes/No Questions for External Influence for Readiness, tabulated results were interpreted through the percentage to determine whether external factors contributed to readiness or not.

The extent of readiness after getting the mean using the 4-point Likert scale, it was interpreted using the following range presented in Table 4.

Table 4. Range of Mean and the Descriptors used to Describe Readiness of Learners for Entrepreneurship.

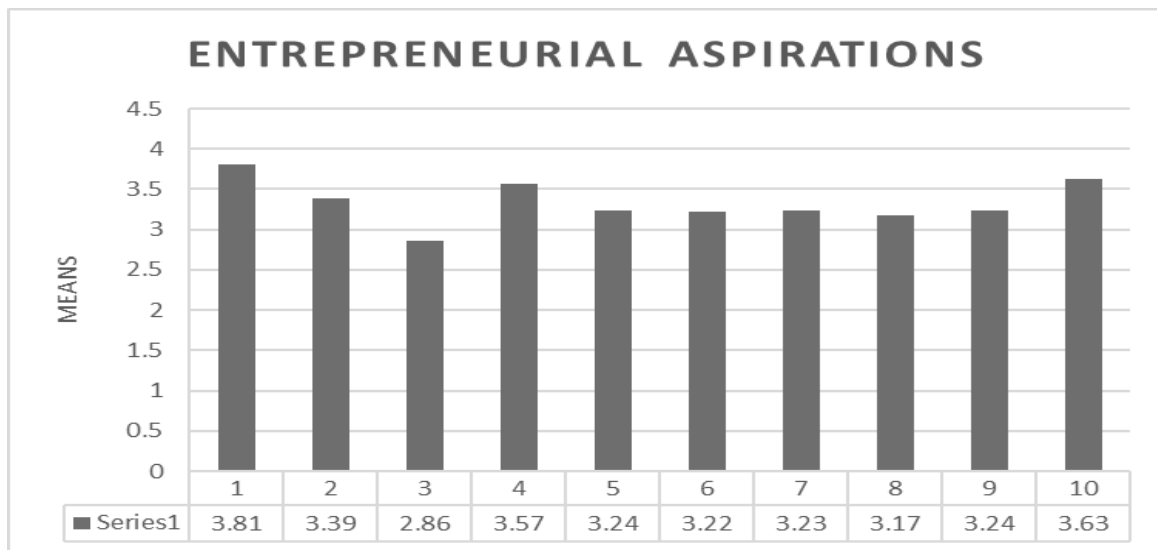
Range of Mean	DESCRIPTIVE RATING
1.75-2.00	Very Ready
1.5 - 1.74	Ready
1.25-1.49	Fairly Ready
1.00-1.24	Not ready

Descriptor: *Mean was interpreted as follows: 3.51-4.0, very ready; 2.51-3.5 Ready; 1.51-2.50 fairly ready and 1.0-1.50 for not ready.*

RESULTS

In the assessment of learner's content knowledge, data revealed that there were topics on Biotechnology that did not meet expectations and were not fully understood by the learners. These topics fall under these different learning competencies in the MELC or the Most Essential Learning Competencies of biotechnology: (1) differentiate traditional biotechnology from modern biotechnology; (2) discuss techniques and practices used in traditional biotechnology; (3) identify the common microbes in biotechnology; and (5) describe the applications of biotechnology in industry, agriculture, and health. The results were used to identify the topics included in the BIOPRENEUR Module and established the module content.

The data showed the entrepreneurial aspiration and motivation towards venture creation and biotechnological intentions based on the percentage of agreement and non-agreement on each question asked. When asked if parents were entrepreneurs, 96.59% of the respondents said "yes" and only 3.41% said "no". Also, 77.27% of the respondents admired at least one of the famous entrepreneurs while 22.73% said "no". In addition, 96.59% of the respondents indicated that they had relatives who were entrepreneurs and 3.41% said "no". And lastly, 69.23% agreed that some of their classmates were entrepreneurs and 30.68% do not agree. It is therefore connected that career interests are linked to positive learners' achievement (Lehmann, 2011). When parents' knowledge of business increases, their children would be encouraged to follow the same path.



Results showed that, in all aspects and categories, they were highly inclined to be entrepreneurs ; most notable of which were their answers to question one wherein majority believed that entrepreneurship can provide them opportunities for personal growth to a very large extent and give them the opportunity to be able to transfer their knowledge to technology and product development to a very high extent as reflected in the responses to question four. Despite their affirmative answers to question number one (1) and four (4), they were not overly confident that venturing into entrepreneurship early on could really help their family to be financially secure as noted in the spread of their responses. There was also a difference in their perspective as to whether they can start up a business initiative though they're young. One of the reasons for such a result could be the fact that they were still indecisive at the time for they are not graduates and are not financially stable. Results also implied that learners have great potential to become Bio-entrepreneur or biopreneurs.

DISCUSSION

The level of conceptual understanding of learners in biotechnology is very satisfactory. However, STEM learners did not meet expectations on the level of conceptual understanding of topics that fell under these different learning competencies in the MELC or the Most Essential Learning Competencies of biotechnology. These topics will be the basis for the creation of the module content.

Learners' Entrepreneurial Aspiration and Motivation Towards Venture Creation and Biotechnological Intentions results of the showed that learners' have the inclination and aspirations to become entrepreneurs and are are ready for the introduction of entrepreneurship in the subject Biotechnology.

CONCLUSION

Assessment of stem learners' biotechnology content knowledge and entrepreneurial aspirations revealed that there are certain areas in biotechnology that learners have not fully understood and that teachers need to address these topics in the discussion of their lessons to increase competency. Learners, as revealed by the results were ready to take on lessons in entrepreneurship as part of biotechnology instructions. The module can be developed connecting biotechnology principles, it's technology transfer through product development and making it practical with the introduction of entrepreneurship.

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Conflict of interest

Authors have no conflict of interest to declare for the research had been an original study. No one during the research wherein intellectual rights had been violated and no copyright infringement was made.

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